2021 California High Occupancy Vehicle Facilities Degradation Action Plans

Prepared by

California Department of Transportation
Division of Traffic Operations
Office of Mobility Programs

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TABLE OF CONTENTS

1. OVERVIEW

As required by Title 23 of the United States Code, section 166 (23 U.S.C. § 166), the California Department of Transportation (Caltrans) has prepared the *2021 California High Occupancy Vehicle Facilities Degradation Action Plan*. This document details the actions Caltrans will take to make significant progress toward bringing degraded high occupancy vehicle (HOV) facilities on State highways into compliance with the federal performance standard. These actions could include changes to the operation of the facility or other improvements.

2. COMMON CAUSES FOR DEGRADATION ON HOV FACILITIES

The analyses conducted by the districts identified some common causes for degradation on HOV facilities. These are listed below.

Demand Exceeding Capacity

Heavy vehicle volumes on HOV lanes produce congestion and slow traffic conditions. HOV facilities with high volumes tend to be located on commute routes which lead toward job centers in the morning peak hour period and away from job centers in the return afternoon peak hour period. In addition, heavy use of the HOV lanes can occur at some locations as a result of special events, or because of recreational travel, such as the traffic on routes leaving urban areas just before the weekends. In order to ensure that HOV lanes continue to offer a time-savings incentive to carpool, Caltrans has traditionally set 1,650 vehicles per hour as the maximum capacity of HOV lanes. Some of the most heavily used HOV lanes on the State Highway System are exceeding this threshold.

Friction Factor

The term "friction factor" refers to the slowing of vehicles in the HOV lane because of the presence of slow vehicles in the adjacent general purpose (GP) lanes. The speed differential between the HOV lane and the GP lanes can cause travelers in the HOV lane to decelerate in anticipation of slow-moving vehicles suddenly merging into the HOV lane. It can also cause vehicles in the HOV lane to slow as they prepare to change lanes into the slow-moving adjacent traffic in order to access exit ramps on the right side of the freeway. The effect of friction is reduced when there is less expectation that vehicles will change lanes into the HOV lane (such as through the use of painted buffers or physical barriers), and when easier merge opportunities exist for leaving the HOV lane.

Roadway Geometry

The geometry of the GP lanes or the HOV lanes affects traffic by introducing a disruption in the smooth flow of vehicles. Lane drops and bottlenecks in the GP lanes can cause congestion and thus associated lane friction for the HOV lane. Unless otherwise noted, the bottlenecks referred to in these action plans are located in the GP lanes. When an HOV facility ends at the edges of the HOV network or where there is a gap in the HOV network, vehicles must exit the HOV lane and merge into (potentially) slower general traffic.

For HOVs traveling on more than one facility, the lack of direct connectors between intersecting freeways also requires HOVs to merge back into general traffic temporarily, potentially causing slowing and congestion in the HOV lanes.

3. STATEWIDE PLANS FOR ADDRESSING DEGRADATION

Subsection (d) of 23 U.S.C. § 166 requires Caltrans to develop a remediation plan to address degradation. Each district is expected to review local traffic data and field conditions to identify potential causes of degradation on each HOV facility and develop appropriate solutions. These actions could include:

- Increasing the occupancy requirement for the HOV facility
- Varying the toll charged to toll-paying vehicles to reduce demand
- Discontinuing allowing exempt vehicles to use the HOV facility
- Increasing the available capacity of the HOV facility

A list of potential actions has been developed for all districts to consider as they develop their action plans. This list can be found in Table 1. It includes all four

(4) of the strategies listed above as well as other strategies identified by the districts and Headquarters. Actions are listed in order of their potential ability to address degradation, as well as whether they can be implemented in the near-term or may require some time to implement.

TABLE 1. STATEWIDE HOV DEGRADATION REMEDIATION STRATEGIES

HOV Degradation Remediation Strategy	Type of Project	Purpose	Potential to Address Degradation	Time to Implementation
Increase Occupancy Requirements	Operational	Operational Improvement	High	Near-Term
Increase Occupancy Requirements and Convert to HOT Lane	Operational Capital	Operational Improvement	High	Near to Mid-Term
Addition of HOV auxiliary (weave) lanes.	Capital	Operational Improvement	High	Mid- to Long-Term
Addition of a second HOV lane.	Capital	Add Capacity	High	Mid- to Long-Term
Install flexible delineators	Operational	Operational Improvement	Medium to High	Near-Term
Enhanced, dedicated, and targeted HOV enforcement including the establishment of enforcement zones.	Operational Capital	Enforcement	Medium to High	Near- to Mid-Term

HOV Degradation Remediation Strategy	Type of Project	Purpose	Potential to Address Degradation	Time to Implementation
Revise pricing strategy on HOT lanes to address degradation.	Operational	Operational Improvement	Medium to High	Near to Mid-Term
Toll exempted clean air vehicles on HOT lanes using tiered/reduced rates	Operational	Operational Improvement	Medium to High	Near to Mid-Term
Implement access strategies, including access restrictions, increasing the length of access openings or modification/elimination of bottlenecks such as ingress/egress locations.	Operational Capital	Operational Improvement	Medium to High	Near- to Mid-Term
Use Shoulders to Provide Additional Managed Lane Capacity	Capital	Add Capacity	Medium to High	Mid- to Long-Term

HOV Degradation Remediation Strategy	Type of Project	Purpose	Potential to Address Degradation	Time to Implementation
Implementation of Integrated Corridor Management, or other traffic management techniques such as speed harmonization and lane control signals to optimize system performance.	Capital	Operational Improvement	Medium to High	Mid- to Long-Term
Close gaps in the HOV lane network	Capital	Operational Improvement	Medium to High	Long-Term
Interchange improvements including, but not limited to, construction of direct HOV connectors, ramp widenings, or truck climbing lanes.	Capital	Add Capacity	Medium to High for direct HOV connectors, Low to Medium for other improvements	Long-Term

HOV Degradation Remediation Strategy	Type of Project	Purpose	Potential to Address Degradation	Time to Implementation
Increase public awareness. Update HOV violation fine amount on the existing signs to the current value.	Operational	Education	Low to Medium	Near-Term
Mark the number of minimum occupants in sequence after the pavement HOV diamond symbol	Operational	Education	Low to Medium	Near-Term
Improvement in Traffic Incident Management including the deployment or expansion of Freeway Service Patrol.	Operational	Operational Improvement	Low to Medium	Near- to Mid-Term
Evaluate the impacts of incidents, weather or construction	Analysis	Analysis	Medium to High	Immediate

HOV Degradation Remediation Strategy	Type of Project	Purpose	Potential to Address Degradation	Time to Implementation
Expand the use of ramp metering, through the addition of new meters, metering HOV preferential lanes, or corridor wide adaptive ramp metering	Capital	Operational Improvement	Low to Medium	Near- to Mid-Term
Standardize managed lane signing and markings statewide.	Capital	Education	Low to Medium	Near- to Mid-Term
Additional or enhanced signing and markings at the beginning and along the HOV lanes.	Capital	Education Enforcement	Low to Medium	Near- to Mid-Term
Implement or expand commuter assistance programs such as vanpools and Park-and-Ride facilities.	Operational Capital	Operational Improvement	Low to Medium	Mid to Long-Term

HOV Degradation Remediation Strategy	Type of Project	Purpose	Potential to Address Degradation	Time to Implementation
Addition of general-purpose auxiliary lanes.	Capital	Operational Improvement	Low	Mid- to Long-Term

3.1. FUNDING FOR ADDRESSING DEGRADATION

Caltrans has set aside approximately $30 million in State Highway Operations and Protection Program (SHOPP) funds for the purpose of addressing HOV degradation. The money will be allocated among the six Caltrans districts where degradation was observed with each district receiving a share proportional to the amount of degradation observed. Funds must be used specifically for projects that are intended to address degradation. The districts and headquarters staff are in the process of identifying projects and developing performance measures and targets. Projects will need to be included in the 2024 SHOPP.

In addition, districts will also now be required to conduct operational investigations for degraded HOV facilities. Caltrans HQ initiated the traffic investigations in June 2022 after the 2021 degradation report was completed. These investigations will result in either no action or identify improvements needed which can then become candidates for SHOPP funding.

3.2. RESTRICTIONS ON EXEMPT VEHICLES

Currently, California has no plans to prohibit clean air vehicles (CAVs) from HOV facilities since it is state policy to encourage the purchase and use of CAVs, and access to HOV facilities is a primary incentive. There are also no plans at this time to convert high occupancy/toll (HOT) facilities back to HOV lanes. Caltrans coordinates regularly with the regional transportation agencies who operate the HOT facilities to ensure that provisions are in place to keep the facilities in compliance with the federal performance standard. These operators generally keep track of the performance of these facilities in addition to Caltrans. Provisions that have been implemented already or are being implemented include raising tolls, operating the facilities in an "HOV Only" mode, and automated enforcement.

The expiration dates of the decals are set in state law. Starting January 1, 2019, the decals are only valid until January 1 of the fourth year after the year of issuance. Decals issued after January 1, 2022 cannot be renewed. Changes to the expiration dates would require legislative action and Caltrans is not looking to make any changes to the program. The program that allows clean air vehicle to access HOV lanes is governed by federal law and the enabling federal statute is currently set to expire on September 30, 2025.

3.3. CHANGING VEHICLE OCCUPANCY REQUIREMENTS

In November 2020 Caltrans released a policy that directed districts to consider changing vehicle occupancy requirements on HOV and HOT lanes under certain conditions and provided guidance to the districts on this process. One of the conditions is if an HOV facility is very degraded. The analysis would consider the geographic, geometric, and traffic demand characteristics of both the individual HOV facility and the region. All potential issues and actions would be explored, including violation rates, toll rates on HOT lanes, planned capital improvements to the facility or the other lanes of the freeway, and other multimodal improvements that might be expected to reduce traffic volumes. The guidance recommends that HOV lanes be converted to HOT lanes whenever vehicle occupancy requirements are increased. This can help offset the impacts on freeway performance caused by increasing vehicle occupancy requirements. Other improvements also need to be considered, such as park and ride facilities, and transportation demand management strategies such as vanpools, or other types of programs that can encourage higher vehicle occupancies and/or modal shift.

Occupancy changes on HOV facilities in California typically occur only as part of conversions to HOT operations for the reasons outlined above. In October 2020, occupancy requirements were increased on the HOV facility on Route 880 in District 4 as part of the conversion of that facility to HOT operations. Vehicles with three or more occupants can use the lanes without paying a toll, while vehicles with at least two or more occupants pay fifty percent of the posted toll. A similar operational change was implemented on the HOT facility on Route 237, which connects directly with the facility on Route 880. In February 2022, similar operational changes were made on HOT facilities on Routes 85 and 101. As noted in the action plans, changes in occupancy requirements are under consideration or planned for several other HOV facilities as part of planned conversions to HOT lanes. And the Los Angeles County Metropolitan Transportation Authority is proposing to raise vehicle occupancy requirements on the Route 10 HOT facility from 3 persons to 5 persons during peak periods.

3.4. COORDINATION WITH THE CALIFORNIA HIGHWAY PATROL

The California Highway Patrol (CHP) is responsible for enforcing vehicle occupancy requirements on all HOV facilities. Caltrans regularly coordinates with the CHP, both at the headquarters and the district level, to address violation rates on HOV lanes. The districts provide their local CHP offices with annual reports about violation rates on HOV facilities so that the CHP can be aware of where additional enforcement may be needed. HOT lane operators typically have agreements in place with the CHP to provide additional enforcement on those facilities above and beyond what the CHP normally provides; this is funded by toll revenues. Automated vehicle occupancy detection systems are being tested or used. More information and results from these efforts can be found in the district-specific degradation analyses and action plans.

3.5. WAIVERS

Per 23 U.S.C. § 166, sanctions may be imposed if Caltrans fails to bring degraded HOV facilities into compliance with the federal performance standard. Sanctions may include withholding of Federal transportation funds or approval of projects. A waiver from sanctions may be requested for degraded facilities where good faith efforts have been attempted and found still ineffective, and where it is determined that such a waiver may be in the best interest of the traveling public. If, upon review of the action plans, FHWA believes these or other facilities may qualify for a waiver, Caltrans will then begin the process of formally requesting a waiver. Caltrans will submit waiver requests for the facilities that are deemed as “Not likely to make significant progress” on the 2021 final action plans. These facilities will continue to be monitored for compliance with the federal performance standards and under the conditions of the waiver, certain actions may still be required on those facilities.

4. DISTRICT-SPECIFIC ACTION PLANS

Each district has developed an action plan for each route which has a degraded HOV facility. No summary is provided for District 10 because no HOV facilities in that district were degraded. A list of HOV facilities that were identified as degraded in 2021 is provided in Appendix A. Caltrans classifies degradation into three (3) categories based on how frequently degradation occurs in order to identify potential causes and to formulate remediation strategies. The criteria for each category of degradation status are as follows:

- Slightly Degraded—degradation occurs from 10 to 49 percent of the time.
- Very Degraded—degradation occurs from 50 to 74 percent of the time.
- Extremely Degraded—degradation occurs 75 percent or more of the time.

The action plans may include general information related to district-wide studies or plans developed to address degradation. These include plans developed by the districts as well as those developed by regional partners.

As part of analyzing each HOV facility for degradation, the peak period average speed was calculated for each detection station on the facility and a count was taken of the number of times the average speed went below 45 mph. This count was then divided by the number of days for which data was available from that detection station in order to determine the percentage of time the speed was below 45 mph. The average speed and this percentage data were then plotted. The districts review this data and the plots (hereafter referred to as "profiles") to identify the locations and causes of degradation, such as roadway geometrics, traffic and travel patterns on the route, or other freeway performance issues. If necessary, the districts may conduct additional operational analyses of the facilities if the cause is unclear. The speed and degradation profiles for each degraded facility in the district are provided at the beginning of each district's section. These plots should be read from left to right. The outcomes of these reviews and analyses are reported in the "Analysis" section of each action plan. This section also includes statistics such as violation rates or percentages of CAVs if those are causes.

If a facility experienced severe, pervasive degradation, the "Analysis" section of the action plans may also include the "spot time" plots or the plots showing the HOV and adjacent GP lane speeds along the length of the HOV facility. The purpose of providing these plots is to provide additional information related to bottlenecks and the length and duration of congestion on HOV facilities and also to provide a snapshot of GP lane performance alongside the HOV facilities. As noted in section 2, GP lane performance issues are a significant contributor to degradation.

The "Remediation Strategies" section describes the specific actions for the route based on the analyses. The actions should be tied back to the causes identified in the "Analysis" section. These actions may include strategies for individual spots on a facility, for portions of a facility, for a facility as a whole, or for the entire route. Information is provided regarding the scope and schedule of the proposed actions and expected outcomes.

The "Remediation Strategies" section will include information on these and other actions that have been taken in the past and the results of those actions, where such information is available. It is important to note that the analyses may also pre-date some of these improvements, and any impacts resulting from those improvements will be addressed in future degradation reports and action plans. In the future, districts will also be asked to provide regular updates on the status of the action plans and any observed outcomes. This evaluation will be included as part of the action plans for each route going forward.

DISTRICT 3 2021 DEGRADATION ACTION PLANS

4.1.1 SUMMARY OF DEGRADATION ON HOV FACILITIES IN DISTRICT 3

APPENDIX A provides the list of degraded facilities in District 3 that were identified in the 2021 California High Occupancy Vehicle Facilities Degradation Report. The speed and degradation profiles for each degraded facility are provided in APPENDIX B.

4.1.2 DISTRICT-WIDE ACTIONS RELATED TO DEGRADATION

District 3 is currently developing a Managed Lanes System Plan to identify and prioritize future managed lanes projects and strategies over the next 20 years. This effort is being led by District 3 Division of Planning, with support from District 3 Traffic Operations and in consultation with regional transportation agencies and other stakeholders. One of the major factors being considered is how to address existing and future HOV degradation.

While the scope of work for the study is still being developed, HOV degradation remediation will be a major part of the project and strategy scoring system. The study is anticipated to kick off in March of 2022, with the study completion scheduled for July of 2023.

4.1.3 ACTION PLAN FOR HOV FACILITIES ON INTERSTATE 80

A. ANALYSIS

Interstate 80 (I-80) in Sacramento experiences heavy directional congestion during the PM peak period in the eastbound and westbound directions. This heavy directional congestion is the result of jobs/housing imbalance where the residents of large housing developments in Placer County and the surrounding cities commute to employment centers to the west, such as the San Francisco Bay Area and Downtown Sacramento, using I-80 as the connection.

The HOV lanes on I-80 initially provided a reliable commute option for carpoolers and transit users traveling between Roseville and Downtown Sacramento. However, as travel demand has increased along this corridor, the HOV lanes have become a less reliable option in some segments for commuters during the peak periods.

Eastbound AM:

Eastbound I-80 does not experience HOV degradation during the AM peak period.

Eastbound PM:

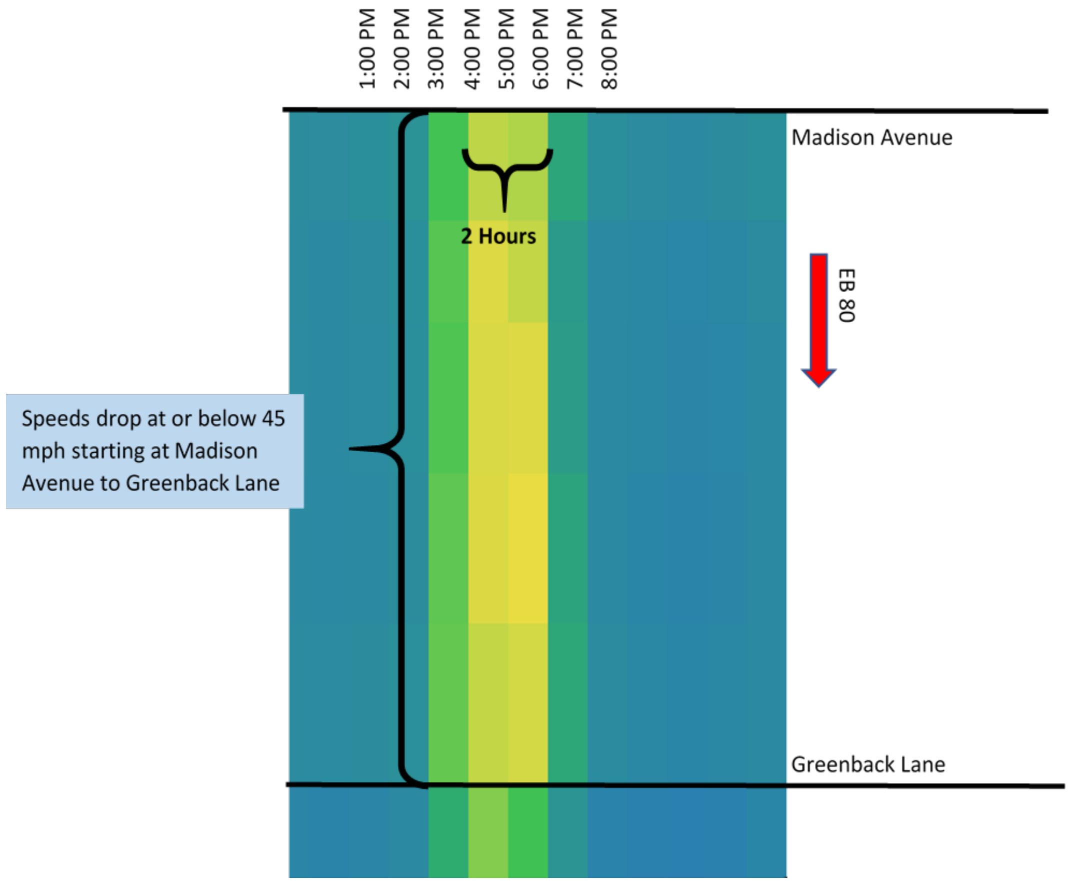
The Eastbound 80 HOV lane experiences slight degradation during the afternoon commute period in a 1.55-mile segment from Absolute PM 96.119 to 97.213 (SAC 12.6 to 13.694). The degradation occurs at the Greenback Lane interchange and extends west through the Madison Avenue interchange. The primary cause of the degradation at this location is due to friction between the HOV lane and the general purpose (GP) lanes. Other causes that lead to degradation on eastbound I-80 include HOV violation and recreational traffic.

Friction Factor

The friction between the HOV lane and general-purpose lanes is a predominant reason why there is slight degradation on eastbound I-80 during the afternoon commute. The primary cause of the friction is due to high demand for the off-ramp from eastbound I-80 to Greenback Lane, which results in a queue that spills back to the mainline and impacts multiple lanes of the freeway.

Figure 4.1-1 is a 2021 speed heat map for eastbound I-80 across all lanes during the PM peak period. The figure shows a segment where speeds decline between 4:00 PM and 6:00 PM from Madison Avenue to Greenback Lane, which coincides with the limits of HOV degradation.

FIGURE 4.1-1. EB I-80 Speed Heat Maps from Madison Avenue to Greenback Lane in 2021 Via INRIX



Analysis of PeMS lane by lane speed data confirms that the #2 lane speeds during the PM peak hour dop slightly below 45 mph increasing friction between the HOV lane, leading to slight degradation. Table 4.1-1 shows the #2 lane and average GP lane speeds for select locations on eastbound I-80 during the PM peak hour and period. In general, speeds should be lower in all GP lanes compared to the #2 GP Lane, however detector health issues contributed to some data discrepancies. Overall, the table displays GP lane speeds impact HOV Lane speeds as well.

TABLE 4.1-1. EB I-80 Lane Speeds and Volume Data in 2021 Via PeMS

Locations		Peak Period		Peak Hour	
		Speed (mph)	Volume (vph)	Speed (mph)	Volume (vph)
East of Madison	HOV Lane	49	1,428	41	1,411
	#2 GP Lane	49	1,560	41	1,500
	All GP Lanes	55	7,330	48	7,250

Source: Caltrans Performance Measurement System (PeMS) Fall 2021. Speed and volume data collected and post-processed from individual detector stations listed above.

Ramp Metering

Unmetered HOV preferential lanes at on-ramps within congested segments

limit our ability to control freeway volume. This leads to the freeway reaching capacity, resulting in an increasing friction factor.

HOV Violations

HOV violators also cause degradation by using up available capacity and increasing the density of vehicles in the lane. The HOV lane violation rates during the peak traffic period on EB I-80 is at 39 percent, adding more vehicles to the lane and impairing performance.

Recreational Traffic

Eastbound I-80 experiences heavy recreational traffic because the corridor connects the Bay Area/Sacramento Area with Reno, NV and Lake Tahoe, CA. Travel speeds on Fridays going towards Reno/Lake Tahoe (in the eastbound direction) are 15 mph lower than typical weekday travel speeds, likely due to the increase in demand associated with recreational travel. Friday HOV degradation makes up a significant portion of overall degradation between Madison Avenue and Greenback Lane (32-63 percent).

Westbound AM:

Westbound Route 80 does not experience HOV degradation during the AM peak period.

Westbound PM:

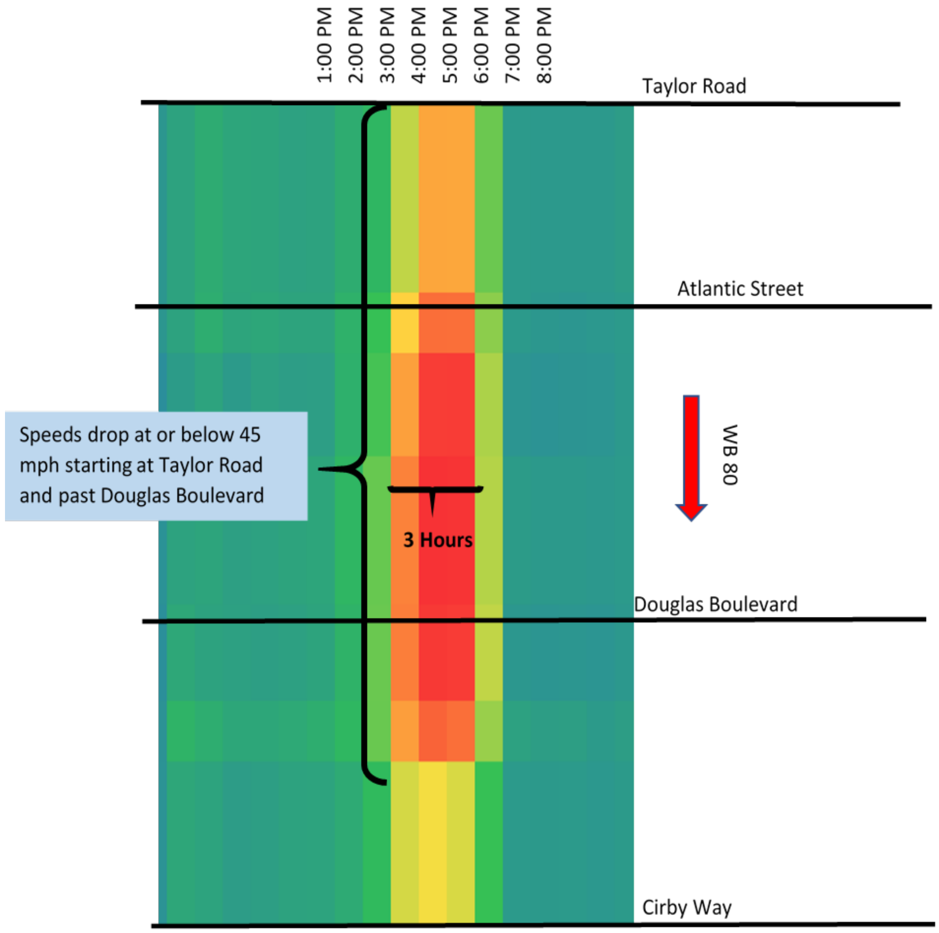
During the PM peak period, the HOV lanes on westbound I-80 experiences degradation ranging from slight to extreme. The degradation occurs for roughly 2.28 miles from Taylor Road to Cirby Way Absolute PM 103.376 to 105.137 (PLA 1.861 to 3.612). Approximately 2 miles of extreme degradation occurs from Atlantic Street to west of Douglas Boulevard. There are three causes of degradation for this direction and time period: friction between the GP lanes and HOV lane, unmetered on-ramps, and a high percentage of HOV lane violators.

Friction Factor

The friction between the HOV lane and general-purpose lanes is a major reason why there is slight to extreme degradation on westbound I-80 during the afternoon commute. The primary cause of the friction is the lane drop at the Douglas Boulevard off-ramp, which causes congestion and queueing. This lowers the capacity on westbound I-80 by reducing the number of available lanes from 5 to 4, bringing the V/C ration closer to 1 and ultimately leads to the formation of a bottleneck and an increased friction factor between the GP lanes and the HOV lane.

Figure 4.1-2 is a 2021 speed heat map for westbound I-80 across all lanes in the afternoon commute. The figure shows significant congestion between 3:00 PM and 6:00 PM from Atlantic Street to west of Douglas Boulevard, which coincides with the limits of HOV degradation.

FIGURE 4.1-2. WB I-80 Speed Heat Maps from Taylor Road to Cirby Way in 2021 Via INRIX



Analysis of PeMS lane by lane speed data confirms that lane #2 speeds during the AM peak hour and peak period drop significantly below 45 mph causing HOV lane speeds to drop below 45 mph. Table 4.1-2 shows the #2 lane and average GP lane speeds for select locations on westbound I-80 during the PM peak hour and period.

TABLE 4.1-2. WB I-80 Lane Speeds and Volume Data in 2021 Via PeMS

Location		Peak Period		Peak Hour	
		Speed (mph)	Volume (vph)	Speed (mph)	Volume (vph)
Douglas Blvd	HOV Lane	37	1,346	36	1,365
	#2 GP Lane	33	1,600	29	1,550
	All GP Lanes	29	3,880	26	3,790

Source: Caltrans Performance Measurement System (PeMS) Fall 2021. Speed and volume data collected and post-processed from individual detector stations listed above.

Ramp Metering

On-ramps with limited storage limits Caltrans' ability to control the flow of vehicles entering the freeway since more vehicles need to be released at a higher rate in order to avoid queue spillback onto the local system.

HOV Violators

HOV violators also cause degradation by using up available capacity and increasing the density of vehicles in the lane. The HOV lane violation rates during the peak traffic period on WB 80 is at 34 percent, adding more vehicles to the lane and impairing performance.

B. REMEDIATION STRATEGIES

Both Directions

Long Term Solution

District 3 is in the planning stage for a project (03-2J180) to address degradation by evaluating other managed lanes strategies by converting the existing HOV lanes along the I-80 corridor between West El Camino Avenue in West Sacramento and SR 65 in Roseville. Changes in managed lane type, minimum occupancy requirements, and operational improvements, such as reducing weaving and friction from slower operating general-purpose lanes through limited access striping, will be studied and part of the project alternatives. The Project Initiation Document is scheduled to be completed by December 2022.

HOV Violators

In coordination with CHP, District 3 initiated a Pilot Special Enforcement Study on SR 99 that started on September 19, 2022 and lasted for four weeks. This study added Special enforcement, in the form of 2 CHP units, to NB SR 99 from 6-10AM. The CHP units and Caltrans staff were in the field three days a week (Monday, Wednesday and Thursday every week) for the full four-week period. Following the special enforcement, Freeway Operations is in the process of conducting a study that will analyze the impact that this enforcement had on reducing the number of violators in the HOV lane. In addition to the enhanced CHP presence, Caltrans completed a Before, During and After occupancy count to determine the impact special enforcement had made on violations in the HOV lane on NB and SB 99. Results of these counts will be included in the study.

This study will help determine if similar special enforcements could be conducted on other HOV lanes in the district to help reduce high violation locations that lead to degradation. It is anticipated that the study will be completed in early 2023.

Occupancy Detection

In 2022, District 3 conducted a Special Enforcement Study on SR 99 in partnership with FHWA California Division, which included CHP enforcement of the HOV lane and Caltrans Staff conducting visual occupancy counts downstream of the enforcement area. This was to demonstrate the potential benefit of CHP enforcement to reduce the number of HOV violators in the HOV lane on our most degraded corridor. District 3 met with FHWA California Division on December 6, 2022, to discuss a similar focus on I-80, and committed to install Automated Vehicle Occupancy Detection (AVOD) systems to further enhance the accuracy of future studies and set baseline occupancy for the HOV lanes on SR 99 and I-80 (degraded routes in our 2021 HOV Action Plans). District 3 has reached out to Headquarters Division of Research, Innovation and System Information (DRISI) to help conduct a pilot study which would supply the district with a secondary source of automated occupancy count data, that could potentially be more reliable or help validate visual counts conducted by staff. While this is only part two of our efforts, District 3 will continue to lead the way in

California with innovative projects and studies, with the goal of significantly reducing long term degradation on both SR 99 and I-80.

Eastbound

Friction factor

D3 conducted an investigation, that looked further into the EB I-80 degradation. The investigation was completed in November 2022 and concluded that signal timing changes needs to be made by Sacramento County, who are responsible for operating the signals at the interchange. Freeway Operations contacted Sacramento County and they are in the process of investigating the signal timing at this interchange, new timing should be complete by the end of December 2022.

Caltrans will continue to work with Sacramento County and monitor the changes that are made, in an attempt to reduce queuing at the off-ramp. Routinely conducted analysis will be needed to determine if any changes made are beneficial to the SHS and to HOV degradation.

Ramp Metering

D3 has identified several ramp metering issues along the eastbound I-80 corridor associated with unmetered HOVPL's, which greatly impact the effectiveness of the ramp meters along this corridor. This degraded segment has 4 unmetered HOVPLs (2 at Madison Avenue and 2 at Greenback Lane) that contribute to congestion and increased friction factor along the corridor in specifically in the degraded segment. District 3 is currently working towards funding the 2 locations at Madison Avenue in a future project; therefore, construction completion dates are currently unknown. Project 03-3J210 will meter the 2 unmetered HOVPLs at Greenback Lane within the degraded segment of eastbound I-80. The project is scheduled to complete construction in 2023.

Westbound

Friction factor

District 3 received Cycle 2 Trade Corridor Enhancement Program funding for a project that eliminates the lane drop at Douglas Boulevard, which is the cause of extreme degradation in the afternoon. The project is scheduled to complete construction in 2024. This project will construct an auxiliary lane which will extend the 4th GP Lane (5th mainline lane) from Douglas Boulevard to Riverside Avenue and upgrade existing on-ramps to help limit congestion and increase throughput at Douglas Boulevard.

Ramp Metering

The Atlantic Street on-ramp has limited storage which limits D3's ability to meter this location effectively. Vehicles must be released at a faster rate to limit queue spillback onto local streets. Project 03-0H460 was completed in July 2022 and widened the previous single lane on-ramp to a 3-lane on-ramp, which allowed for greater storage and gives D3 the ability to better manage traffic entering the freeway on this degraded section of WB I-80. Field observations have shown qualitative benefits, but more time is needed to demonstrate the quantitative benefits of adding additional storage. Further investigations will be conducted over the course of the next year.

4.1.4 ACTION PLAN FOR HOV FACILITIES ON STATE ROUTE 99

A. ANALYSIS

State Route 99 (SR 99) in Sacramento experiences heavy directional congestion during the AM in the Northbound and PM peak period in the Southbound directions. This heavy directional congestion is the result of the jobs/housing imbalance where the residents of large housing developments in Sacramento County and the surrounding cities commute to employment centers to the north, such as Downtown Sacramento and the City of Roseville, using SR 99 as a connection.

The HOV lanes on SR 99 initially provided a reliable commute option for carpoolers and transit users traveling between Elk Grove and Downtown Sacramento. However, as travel demand has increased along this corridor, the HOV lanes have become a less reliable option in some segments for commuters during the peak periods.

Northbound SR 99:

Northbound SR 99 experiences degradation during both AM and PM commute period from Abs. PM 288.86 to 299.11 (SAC 14.309 to R24.332). The degradation occurs at the Laguna Rd interchange and extends north through T Street (Downtown Sac-51) with non-degraded segments at various locations in between. The degradation segment length is about 4.6 miles for AM and 7.1

miles for PM. The primary causes of the degradation on NB 99 are due friction, Demand over capacity, HOV Violators and unmetered on-ramps.

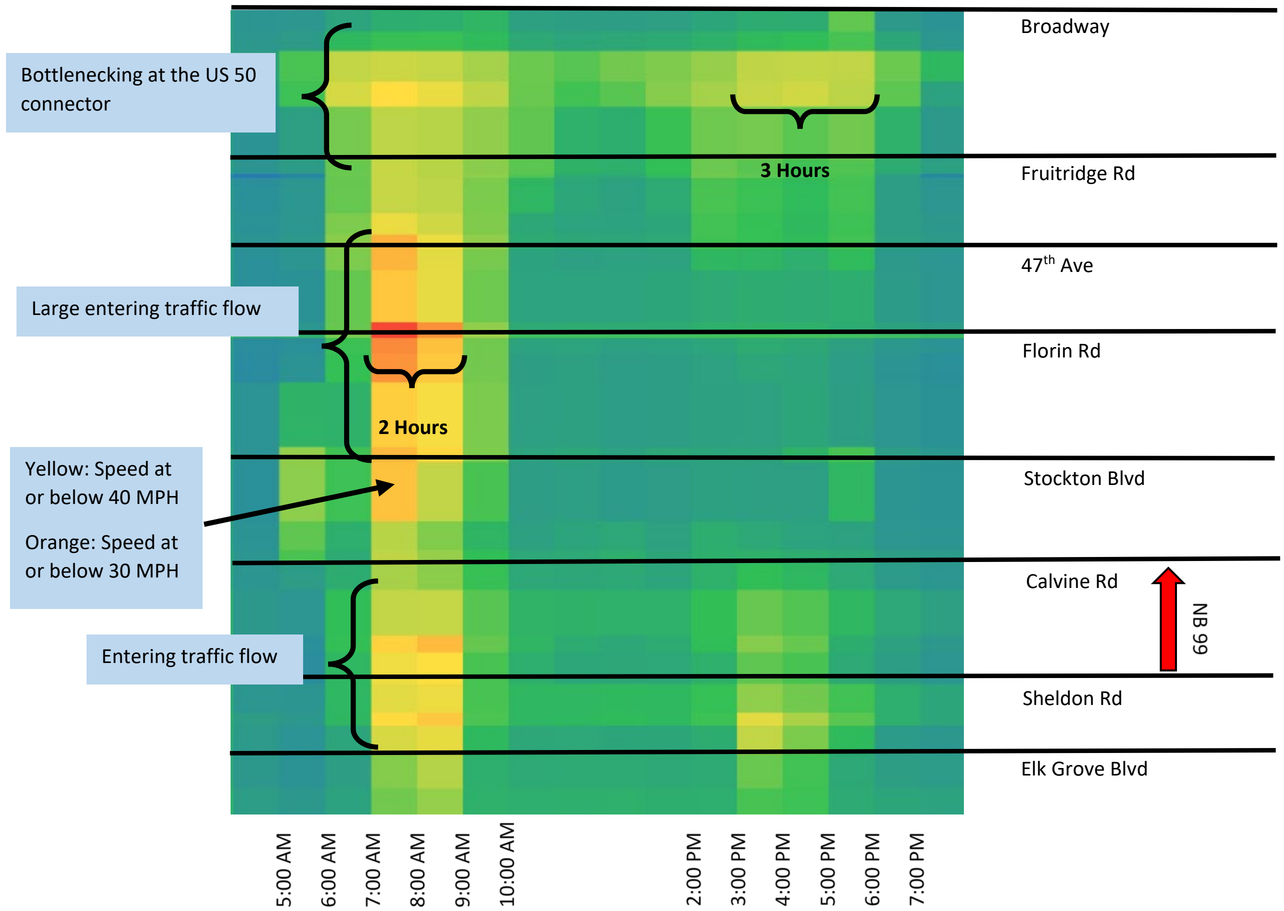
Friction Factor

Friction between HOV lane and GP lanes is a major factor in degradation. The primary cause is the heavy demand for the HOV Lane from Elk Grove to the US-50 connector which requires vehicles to cross all GP lanes, causing a weaving movement. Additionally, the heavy directional demand leads to mainline SR 99 being over capacity across all lanes. This leads to the formation of bottlenecks and an increased friction factor between the GP lanes and the HOV lane.

The friction factor is also present due to the lack of standard inside shoulders. Most of the 7 miles of the degraded segment features non-standard inside shoulder widths that increase friction. This means that drivers experience friction on both sides of their vehicles, lowering speeds and increasing the extent of degradation.

Figure 4.1-3 displays 2021 speeds for Northbound SR 99 across all lanes during the AM and PM peak period via INRIX Analytics. The figure shows a segment where speeds decline between 7:00 to 9:00 AM, and 3:00 to 6:00 PM from Elk Grove Blvd to Broadway, which coincides with the limits of HOV degradation.

FIGURE 4.1-3. NB SR 99 Speed Heat Maps from Elk Grove Blvd to Broadway in 2021 via INRIX



Demand over Capacity

Another factor that leads to degradation is the volume over capacity ratio. According to PeMS, at the 47th Ave interchange, the V/C ratio (based on a theoretical capacity of 1600 vph due to friction factor between GP lanes and limited shoulder widths) for the #2 GP lane is 1.04 and HOV is 0.85, this high demand for the lane leads to slower speeds and reduced capacity in the HOV lane. Table 4.1-3 provides volume and speed information for the HOV lane, #2 GP lane and all GP lanes combined. Capacity is lowered in the HOV lane due to the increased friction factor causing lower speeds and reduced throughout in the HOV lane. Due to detector health, there are some data discrepancies in Table 4.1-3. Additionally, data was collected during the pandemic, which led to different traffic patterns and higher speeds in some locations. The table displays numbers that indicate the segment is not degraded however these segments typically do experience degradation, which may not be reflected in the average speeds.

TABLE 4.1-3. NB SR 99 Lane Speeds and Volume Data in 2021 Via PeMS

Location		Peak Period		Peak Hour		
		Speed (mph)	Volume (vph)	Speed (mph)	Volume (vph)	Volume/Capacity
Florin Rd	HOV Lane	63	1,048	62	1,123	0.7019
	#2 GP Lane	61	1,378	58	1,448	0.9050
	All GP Lanes	58	4,162	55	4,410	0.9188
47th Avenue	HOV Lane	52	1,223	48	1,354	0.8463
	#2 GP Lane	51	1,659	46	1,668	1.0425
	All GP Lanes	49	4,422	45	4,569	0.9519

Source: Caltrans Performance Measurement System (PeMS) Fall 2021. Speed and volume data collected and post-processed from individual detector stations listed above.

Ramp metering

Unmetered HOV preferential lanes at the on-ramps within congested segments

limits Caltrans ability to control freeway volume and leads to the freeway reaching capacity, resulting in an increasing friction factor and an increase V/C ratio. Project 1H630 is currently in PS&E phase and will add metering on the HOVPL at the Sheldon Rd Interchange and the Calvine Rd Interchange.

HOV Violations

HOV violators also cause degradation by using up available capacity and increasing the density of vehicles in the lane. The HOV lane violation rates during the peak traffic period on NB 99 is at 47 percent, adding more vehicles to the lane and impairing performance.

Southbound SR 99:

The Southbound SR 99 HOV lane also experiences degradation during the afternoon commute period from Abs PM 290.6 to 299.6 (SAC 16.04 to R24.332). The degradation occurs at N Street (Downtown SAC-51) and extends south through the Calvine Road interchange, with non-degraded segments at various locations in between. The degradation segment length is about 7.4 miles during the afternoon peak period. The primary cause of the degradation on SB 99 is due to friction, Demand over capacity, HOV Violators and unmetered on-ramps.

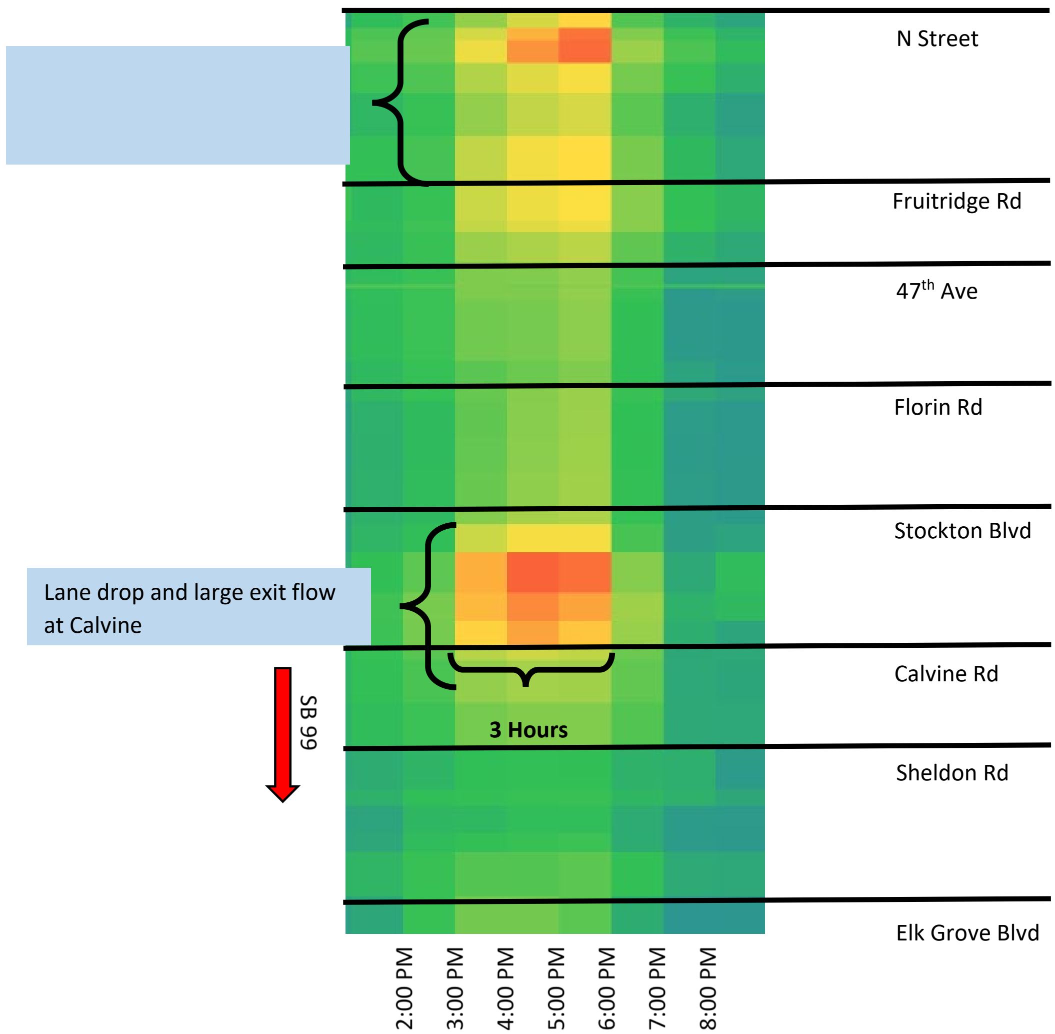
Friction Factor

Friction between HOV lane and GP lanes is a major factor in degradation. At the northern portion, the merging operation of exiting US-50 traffic onto southbound SR 99 traffic has reduced the capacity of the freeway and increases the V/C ratio across all lanes. At the southern portion of the degradation segment, the GP lane drop at Calvine Rd off-ramp lowers capacity and increases the V/C ratio in the GP lanes, which lowers the overall capacity in this segment. This leads to the formation of an extremely intense bottleneck and an increased friction factor between the GP lanes and the HOV lane.

The friction factor is also present due to the lack of standard inside shoulders. Most of the almost 7.5-mile degraded segment includes non-standard inside shoulder widths that increase friction. This means that drivers experience friction on both sides of their vehicles, lowering speeds and increasing the extent of degradation.

Figure 4.1-4 displays 2021 speeds for Southbound SR 99 across all lanes during the PM peak period via INRIX Analytics. The figure shows a segment where speeds decline between 3:00 and 6:00 PM from N Street to Elk Grove Blvd, which coincides with the limits of HOV degradation.

FIGURE 4.1-4. SB SR 99 Speed Heat Maps from N Street to Elk Grove Blvd in 2021 via INRIX



Demand over capacity

Another factor that leads to degradation is the volume to capacity ratio. According to PeMS, near the Calvine Rd lane drop, the V/C ratio (based on a theoretical capacity of 1600 vph due to friction factor between GP lanes and limited shoulder widths) for the #2 GP lane is 1.01 and HOV is 0.82, this high demand for the lane leads to slower speeds and reduced capacity in the HOV lane. Table 4.1-4 shows the HOV lane, the number 2 lane and overall GP lane speeds and volumes at one of the major bottleneck locations on southbound Route 99 during the afternoon peak hour and period. Capacity is lowered in the

HOV lane due to the increased friction factor causing lower speeds and reduced throughout in the HOV lane. Due to detector health at Stockton Blvd, there are data discrepancies shown in Table 4.1-4.

TABLE 4.1-4. SB SR 99 Lane Speeds and Volume Data in 2021 Via PeMS

Location		Peak Period		Peak Hour		
		Speed (mph)	Volume (vph)	Speed (mph)	Volume (vph)	Volume/Capacity
Stockton Blvd	HOV Lane	58	1,344	56	1,368	0.8550
	#2 GP Lane	48	1,231	48	1,228	0.7675
	All GP Lanes	48	3,154	49	3,136	0.6533
Calvine Rd	HOV Lane	42	1,276	43	1,306	0.8163
	#2 GP Lane	37	1,546	39	1,608	1.0050
	All GP Lanes	35	2,764	36	2,826	0.5888

Source: Caltrans Performance Measurement System (PeMS) Fall 2021. Speed and volume data collected and post-processed from individual detector stations listed above.

Ramp metering

Unmetered on-ramps at Sheldon Rd, and Laguna Blvd limits Caltrans' ability to control freeway volume and leads to the freeway reaching its capacity, resulting in an increasing friction factor.

HOV Violations

HOV violators also cause degradation by using up available capacity and increasing the density of vehicles in the lane. The HOV lane violation rates during the peak traffic period on SB 99 is at 35 percent, adding more vehicles to the lane and decreasing performance.

B. REMEDIATION STRATEGIES

Both Directions:

Long Term Degradation Solution

In July of 2021, Caltrans completed a preliminary Managed Lanes Study on SR 99. This study contained seven (7) alternatives that analyzed conversion of the current HOV 2+ lane (see Table 4.1-5 below for reference). The analysis was conducted to address the short and long term HOV degradation in both directions of SR 99.

TABLE 4.1-5. Managed Lanes Study Alternatives

Alt	Managed Lane Alternative Description	Recommendation
1	No Build	Carry forward only for the purpose of comparison under CEQA
2	Convert HOV 2+ to HOT 2+ (HOV 2+ Free, SOV Pay Full)	Drop from consideration
3	Convert HOV 2+ to HOT 3+ (HOV 3+ Free, HOV 2 Pay Half, SOV Pay Full)	Carry forward to next stage of analysis
4	Convert HOV 2+ to HOT 3+ (HOV 3+ Free, HOV 2/ SOV Pay Full)	Carry forward to next stage of analysis
5	Change Minimum Occupancy from HOV 2+ to HOV 3+	Drop from consideration
6	Convert Inside GP lane to HOV 2+ (two HOV 2+ lanes)	Carry forward to next stage of analysis
7	Convert HOV 2+ and inside GP lane to HOT 2+ (two HOT 2+ lanes, HOV 2+ Free, SOV Pay Full)	Carry forward to next stage of analysis only if it appears that the federal government would consider allowing a GP-to-HOT conversion

Color Code

- (Green) Alternative recommended for further study as a live option
- (Yellow) Alternative recommended for further study, but not considered a live option
- (Red) Alternative not recommended for further study

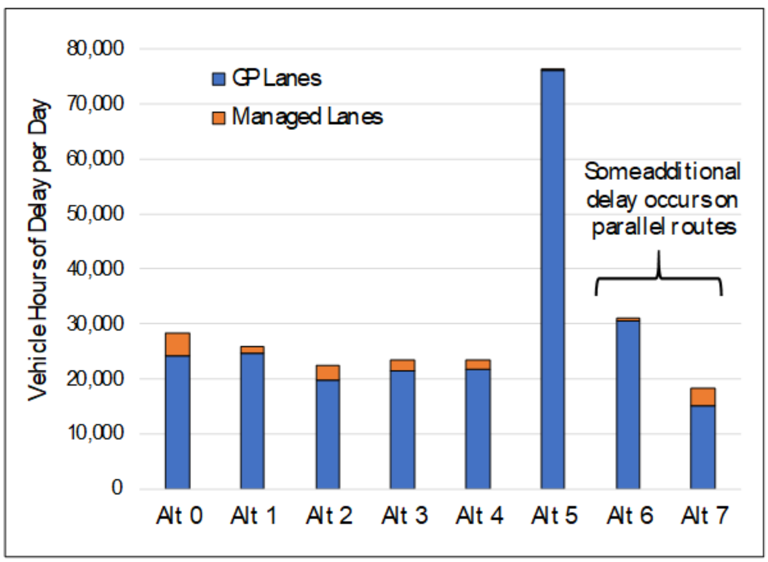
Of the 7 alternatives, 3 of them were recommended to be analyzed going forward. Those included: Alternatives 3 and 4, where the lane would be converted to a HOT 3+ lane in each (in Alt 3 HOV 2+ pays half) and Alternative

6, where the inside GP lane would be converted to an HOV 2+ lane giving the corridor two HOV 2+ lanes in each direction.

As a result of the July 2021 Managed Lanes study, limited access striping was also evaluated on NB and SB 99. Limited access on NB 99 proved to be an equity concern and consideration for limited access on NB 99 was dropped, however on SB 99 limited access is being considered on two segments: from the SR 99/US 50 Interchange to Fruitridge Road, and upstream of Mack Road to Calvine Road. This limited access striping project has been added to the 2026 SHOPP.

The performance of each alternative in term of Delay is presented in Figure 4.1-5 below.

Figure 4.1-5: Forecast of Vehicle Hours of Delay in the Corridor in 2050



D3 wanted to look at an incremental approach to fixing the problem, which was considered in the form of converting to an HOV 3+ lane. As identified by Figure 4.1-5, the conversion from HOV2+ to a HOV3+ lane in Alternative 5 performs very well in the managed lane due to the low number of users. Conversely, the GP lanes perform very poorly due to the addition of HOV2 that would be prohibited from using the managed lane.

District 3 is in the planning stage for project 03-2J210 (Sacramento 99-51 Managed Lanes) to address degradation by evaluating other managed lanes strategies for the existing HOV lanes along the SR 99 corridor between City of Elk

Grove and downtown Sacramento. Changes in managed lane type, minimum occupancy requirements, access control, and operational improvements, such as reducing weaving and friction from slower operating general-purpose lanes through limited access striping, will be studied and part of the project alternatives. Capacity will not be able to be added on SR 99 due to geometric constraints, however this project will help to redistribute demand across the GP lanes to better control demand in the managed lane. The Project initiation Document is scheduled to be completed by February 2023.

HOV Violations

In coordination with CHP, District 3 initiated a Pilot Special Enforcement Study on SR 99 that started on September 19, 2022 and lasted for four weeks. This study added Special enforcement, in the form of 2 CHP units, to NB SR 99 from 6-10AM. The CHP units and Caltrans staff were in the field three days a week (Monday, Wednesday and Thursday every week) for the full four-week period. Following the special enforcement, Freeway Operations is in the process of conducting a study that will analyze the impact that this enforcement had on reducing the number of violators in the HOV lane. In addition to the enhanced CHP presence, Caltrans completed a Before, During and After occupancy count to determine the impact special enforcement had made on violations in the HOV lane on NB and SB 99. Results of these counts will be included in the study.

This study will help determine if similar special enforcements could be conducted on other HOV lanes in the district to help reduce high violation locations that lead to degradation. It is anticipated that the study will be completed in early 2023.

Occupancy Detection

In 2022, District 3 conducted a Special Enforcement Study on SR 99 in partnership with FHWA California Division, which included CHP enforcement of the HOV lane and Caltrans Staff conducting visual occupancy counts downstream of the enforcement area. This was to demonstrate the potential benefit of CHP enforcement to reduce the number of HOV violators in the HOV lane on our most degraded corridor. District 3 met with FHWA California Division on December 6, 2022, to discuss a similar focus on I-80, and committed to install Automated Vehicle Occupancy Detection (AVOD) systems to further enhance the accuracy of future studies and set baseline occupancy for the HOV lanes on SR 99 and I-80 (degraded routes in our 2021 HOV Action Plans). District 3 has reached out to Headquarters Division of Research, Innovation and System Information (DRISI) to help conduct a pilot study which would supply the district with a secondary source of automated occupancy count data, that could potentially be more reliable or help validate visual counts conducted by staff. While this is only part two of our efforts, District 3 will continue to lead the way in California with innovative projects and studies, with the goal of significantly reducing long term degradation on both SR 99 and I-80.

Northbound SR 99 Direction:

Friction Factor

D3 will conduct an investigation, looking further into the NB SR 99 degradation. The results from this investigation will be used to determine what the next steps are that need to be taken for this location.

Ramp Metering

District 3 has identified several ramp metering deficiencies along the northbound Route 99 corridor associated with unmetered HOV preferential lanes. Recent ramp count data shows HOV preferential lanes violation rates of over 60 percent, which greatly impacts the effectiveness of the ramp meters along this corridor. Recently, District 3 implemented its first HOV preferential lane metering in this segment of Route 99 (Mack Road Slip to northbound 99) and observed improvements in travel times across all lanes in the project area (roughly 2 percent to 4 percent).

District 3 has initiated projects to meter 9 unmetered HOV preferential lanes along the degraded portion of this corridor. Project 03-1J460 will meter 2 HOV preferential lanes at both on-ramps from 47th Avenue to northbound Route 99. The project will complete construction in 2022. Project 03-3J220 will meter 2 HOV preferential lanes at the Florin Road slip on-ramp and the Mack Road loop on-ramp. The project is programmed to be construction in 2023. Project 03-1H630 is currently in the environmental phase and will meter the 5 total HOV preferential lanes at Calvine Road (Slip and Loop), Sheldon Road (Slip and Loop) and Elk Grove Blvd (Slip). The project is currently scheduled to complete construction in 2025.

Once these projects are completed, D3 will have no unmetered on-ramps in the NB direction of SR 99 within the HOV lane limits.

Southbound SR 99 Direction:

Friction Factor

D3 will conduct an investigation, looking further into the SB SR 99 degradation. The results from this investigation will be used to determine what the next steps are that need to be taken for this location.

Ramp Metering

Caltrans is adding ramp meters at Sheldon Rd and Laguna Rd with a Change Order, which is attached to the on-going SAC-99 CAPM project. These meters are planned to be completed by the end of 2022.

Once this project is completed, there will only be one unmetered on-ramp on SB 99 within the HOV lane limits.

4.2. DISTRICT 4 2021 DEGRADATION ACTION PLANS

4.2.1 SUMMARY OF DEGRADATION ON HOV FACILITIES IN DISTRICT 4

APPENDIX A provides the list of degraded facilities in District 4 that were identified in the *2021 California High Occupancy Vehicle Facilities Degradation Report*. The speed and degradation profiles for each degraded facility are provided in APPENDIX B.

4.2.2 DISTRICT-WIDE ACTIONS RELATED TO DEGRADATION

In 2021 overall traffic volumes were down due to the change in travel patterns with the continuation of employees teleworking due to the pandemic. Two routes that were degraded in 2019, SR 237 and SR 92 are no longer degraded. This is the result of the increase in Express lane occupancy to HOT 3+ on SR 237 and the "All Electronic Tolling" at the San Mateo-Hayward Bridge toll plaza on westbound SR 92. In addition to the reduced traffic demand due to the pandemic. The other routes that were degraded in 2019 we are seeing less lane-miles and severity of degradation in 2021.

4.2.3 ACTION PLAN FOR HOV FACILITIES ON ROUTE 4

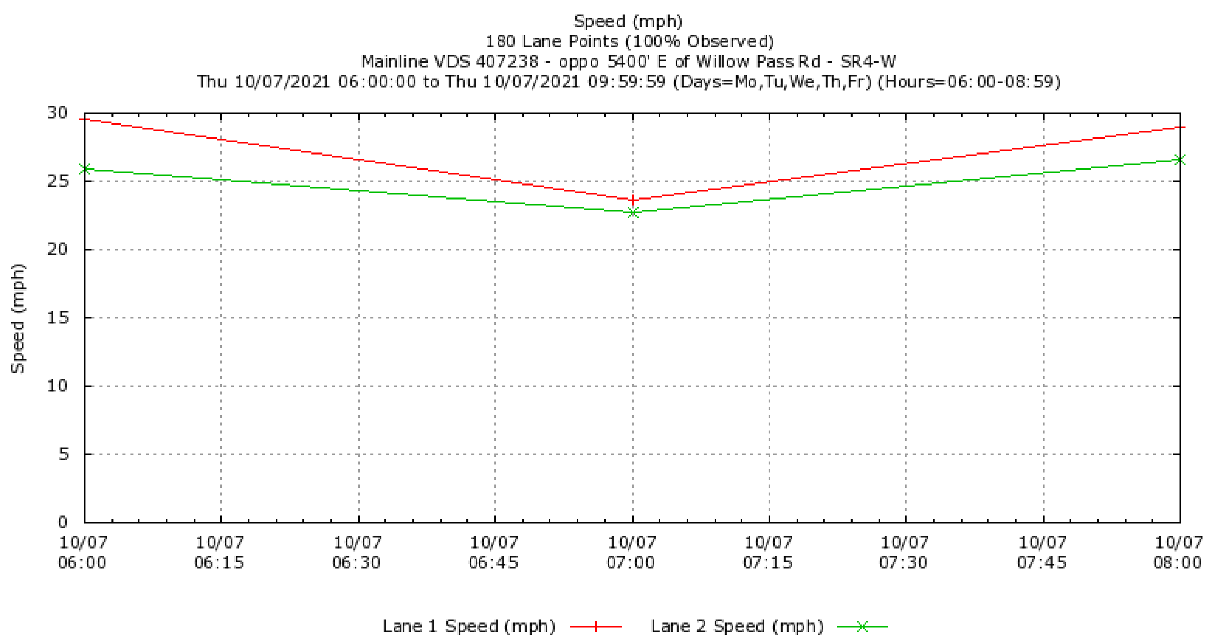
In 2019 SR 4 had 1.2 lane-miles of degraded HOV lanes in the eastbound direction during the PM peak period. There was 0.8 lane-miles with 14% of days degraded (slightly degraded) and 0.4 lane-lines with 96% of days degraded (extremely degraded). With freeway improvements completed since 2019 there were no eastbound SR 4 degraded freeway segments in 2021.

In 2019 SR 4 had 6.9 lane-miles of degraded HOV lanes in the westbound direction during the AM peak period. There was 1.5 lane-miles with 20.8% of days degraded (slightly degraded), 1.8 lane-miles with 62.9% of days degraded (very degraded) and 3.6 lane-miles with 85.1% of days degraded (extremely degraded). In 2021 westbound SR 4 had 4.8 lane-miles of degraded HOV lanes in the AM peak period, a reduction of 2.1 lane-miles with the biggest reduction in extremely degraded lane miles, -2.3 lane-miles. There was 1.4 lane-miles with 33.1% of days degraded (slightly degraded), 2.1 lane-miles 60.6% of days degraded (very degraded) and 1.3 lane-miles of 83.8% of days degraded (extremely degraded). Reduction in degraded lane-miles was mainly the result of change in commute travel pattern with more people working from home due to the pandemic.

A. ANALYSIS:

SR-4 Westbound Hillcrest Avenue to Willow Pass Road (Concord)

WB SR-4 experiences recurrent AM peak period congestion in all lanes, including the HOV lane, approaching a bottleneck between the Willow Pass Road (Concord) on-ramp and the Port Chicago Highway off-ramp. Queues typically extend upstream for over 8 miles to east of the Loveridge Road interchange. The primary factors resulting in reduced HOV lane speed are friction between HOV lane and general purpose lanes within the area of congestion and weaving at the end of the HOV lane within the bottleneck section. A "spot time" plot of the HOV and GP lane speeds on westbound Route 4 for a typical morning peak period are shown in the figure below. Lane 1 represents the HOV lane and lane 2 represents the adjacent GP lane. This illustrates how the congested speeds of the GP lanes have an effect on the speeds in the HOV lane.



B. REMEDIATION STRATEGIES:

SR-4 Westbound Hillcrest Avenue to Willow Pass Road (Concord)

An Operation Improvements Project (OIP) includes several phases to add sections of GP lane or auxiliary lanes in the westbound direction and widen off-ramps on SR 4 between SR 242 and Bailey Road. It includes future phases for westbound improvements of new auxiliary lanes, conversion of auxiliary lanes to general-purpose (GP) lanes, or new GP lanes. First Phase of project is currently in PA&ED, with construction completion schedule in 2025. PSR-PDS completed in 2016 estimated entire OIP project cost estimate is $220M.

4.2.4 ACTION PLAN FOR HOV Facilities ON ROUTE 80

There are HOV facilities on two segments of Route 80 in District 4. The first segment is located in Alameda, Contra Costa, and Solano Counties between the San Francisco-Oakland Bay Bridge and the Carquinez Bridge. The second segment is located in Solano County between Red Top Road and Airbase Parkway.

In 2019 I-80 between the San Francisco-Oakland Bay Bridge and the Carquinez Bridge had 13.2 lane-miles of degraded HOV lanes in the eastbound direction during the PM peak period. There was 1.8 lane-miles with 23.2% of days degraded (slightly degraded), 2.0 lane-lines with 69.0% of days degraded (very degraded) and 9.4 lane-miles with 87.5% of days degraded (extremely degraded). In 2021 this same section of eastbound I-80 had 10.8 lane-miles of degraded HOV lanes in the AM peak period, a reduction of 2.4 lane-miles with the biggest reduction in extremely degraded lane miles -1.9 lane-miles. There was 1.3 lane-miles with 23.1% of days degraded (slightly degraded), 2.0 lane-miles 68.1% of days degraded (very degraded) and 7.5 lane-miles of 85.8% of days degraded (extremely degraded).

In 2019 I-80 between the San Francisco-Oakland Bay Bridge and the Carquinez Bridge had 14.2 lane-miles of degraded HOV lanes in the westbound direction during the AM peak period. There was 5.5 lane-miles with 25.7% of days degraded (slightly degraded), 6.8 lane-miles with 61.5% of days degraded (very degraded) and 1.9 lane-miles with 80.4% of days degraded (extremely degraded). In 2021 westbound I-80 had 8.0 lane-miles of degraded HOV lanes in the AM peak period, a reduction of 6.2 lane-miles with the biggest reduction in very degraded lane miles -3.2 lane-miles. There was 3.8 lane-miles with 39.9% of days degraded (slightly degraded), 3.6 lane-miles 57.9% of days degraded (very degraded) and 0.6 lane-miles of 77.7% of days degraded (extremely degraded).

In 2019 I-80 in the westbound PM peak period between the San Francisco-Oakland Bay Bridge and the Carquinez Bridge there was 2.3 lane-miles of degraded HOV lanes. There was 0.9 lane-miles with 24.2% of days degraded (slightly degraded) and 1.3 lane-miles with 63.4% of days degraded (very degraded). In 2021 westbound I-80 in the PM peak period within this segment had 0.4 lane-miles with 94.6% of days degraded (extremely degraded) a reduction in total lane-miles of 1.9 lane-miles.

In 2019 I-80 in the eastbound AM perk period between Red Top Rd. to Air Base Pkwy had 0.3 lane-miles with 12% days degraded (slightly degraded) and in the PM peak period had 2.5 lane-miles of degraded HOV lanes. There was 1.9 lane-miles with 26% of days degraded (slightly degraded) and 0.6 lane-miles with 69% of days degraded (very degraded). In 2021 eastbound I-80 in the AM peak period had no degraded HOV lane segment a reduction of 0.3 lane-miles compared to 2019. In 2021 I-80 in the eastbound PM peak period there was 2.1 lane-miles of degraded HOV lane, a reduction of 0.4 lane-miles. There was 1.5 lane-miles with 32.0% of degraded days (slightly degraded) and 0.6 lane-miles with 68% degraded days (very degraded).

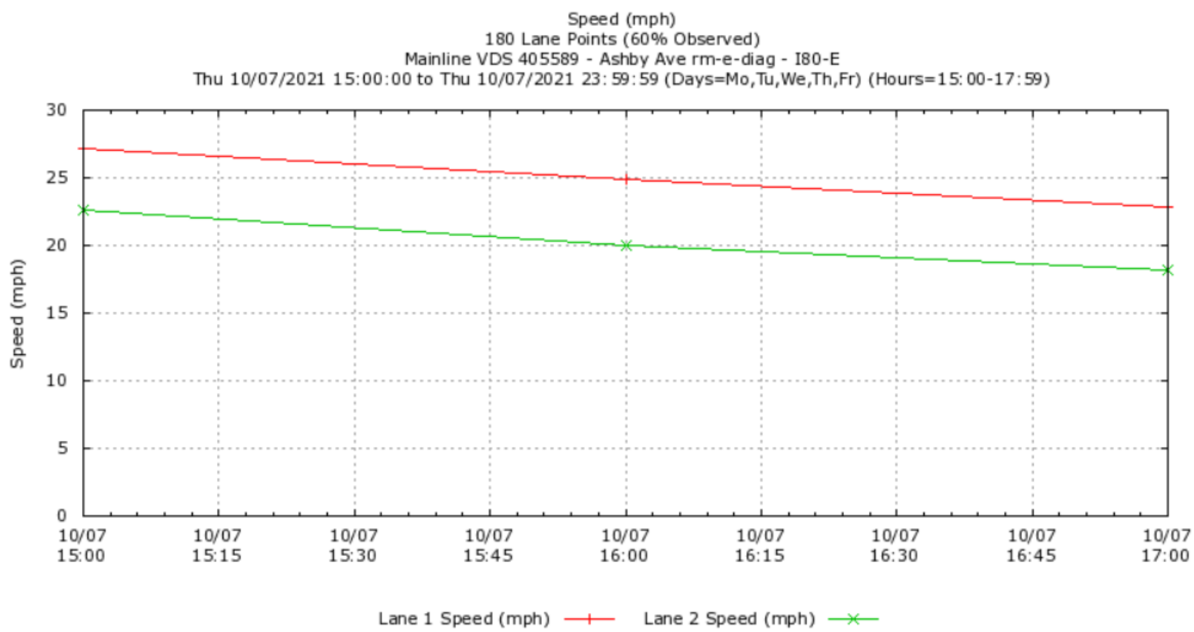
In 2019 I-80 in the westbound AM peak period between Red Top Rd. to Air Base Pkwy. Had 2.3 lane-miles of slightly degraded HOV lanes and 0.4 lane-miles of slightly degraded HOV lanes in the PM peak period. There was no degraded HOV lanes on westbound I-80 within this segment in 2021.

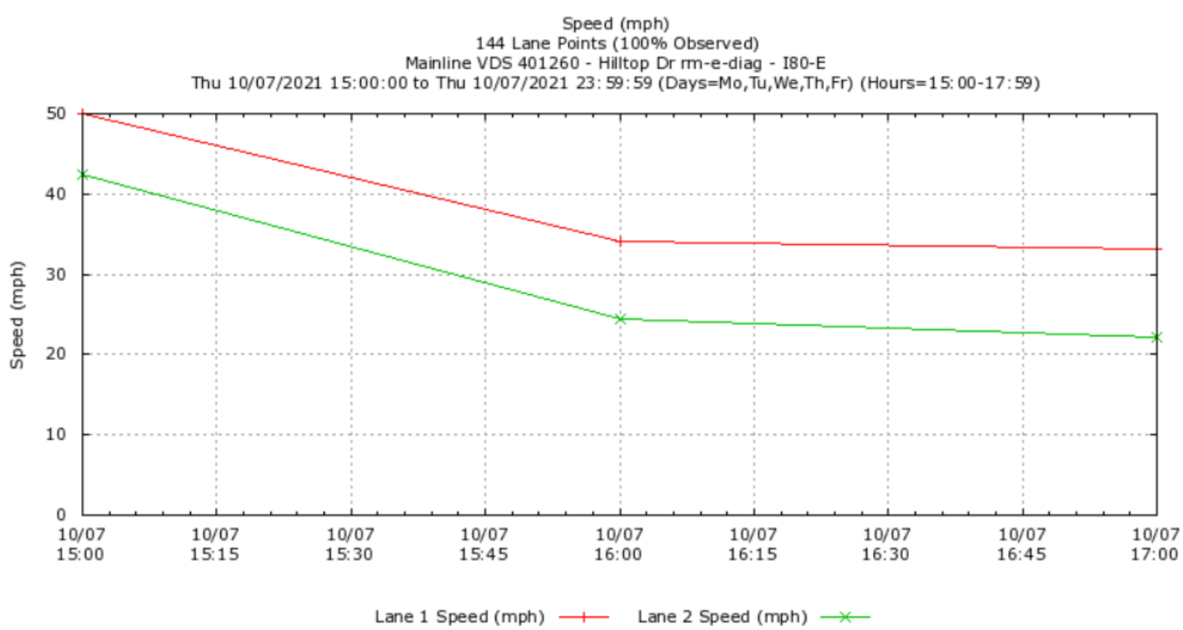
Reduction in degraded HOV lane-miles within these corridors was mainly the result of change in commute travel pattern with more people working from home due to the pandemic.

A. ANALYSIS:

I-80 Eastbound I-880 to Cummings Skyway

There are two controlling bottlenecks on eastbound Route 80 in the afternoon peak period. One bottleneck is between the University Avenue on-ramp and the Gilman Avenue off-ramp. The queue from this bottleneck extends back beyond the start of the HOV lane on eastbound Route 80 approximately 3.5 miles. The other bottleneck is downstream between Pinole Valley Road on-ramp and the Route 4 off-ramp. The queue from this bottleneck extends back to Central Avenue, approximately 8.5 miles. Peak period recurrent congestion in the GP lanes due to these conditions reduces HOV lane performance and speed due to the friction factor. Even though the HOV lanes are degraded, HOVs in the eastbound direction experiences a travel time savings over the general-purpose traffic during the afternoon peak hour. A “spot time” plot of the HOV and GP lane speeds on eastbound Route 80 for a typical afternoon peak hour is shown in the figures below. Lane 1 represents the HOV lane and lane 2 represents the adjacent GP lane. This illustrates how the congested speeds of the GP lanes have an effect on the speeds in the HOV lane.





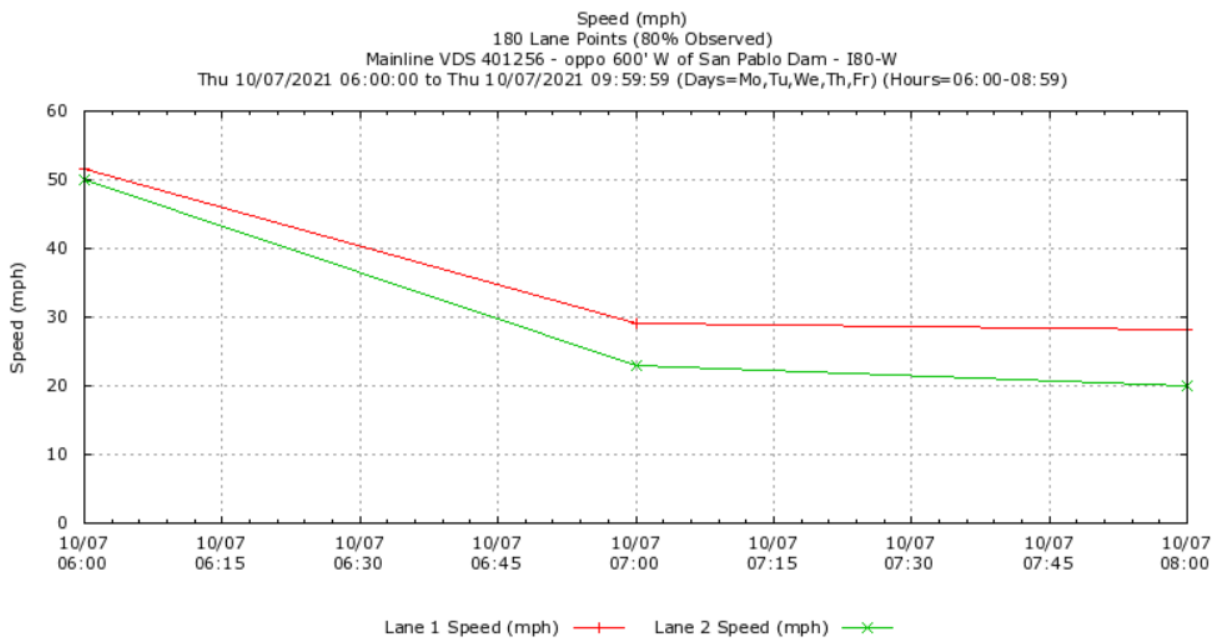
The HOV 3+ demand on this route is relatively high which can also have an effect on the speed in the HOV lane when the adjacent GP lanes are congested due to this friction factor. The HOV lane is near or at the effective capacity of the lane in order to maintain a speed at 45 mph or greater.

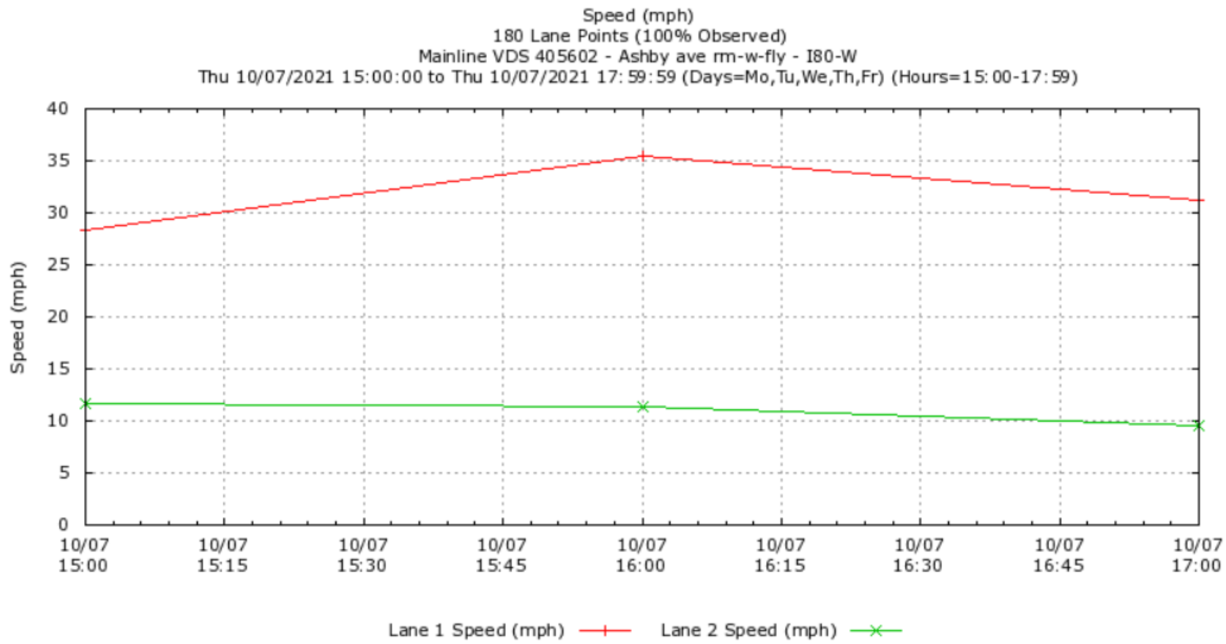
EB I-80 Pinole Valley Rd.

Hour	HOVL Flow (Veh/Hour)	HOVL Speed (mph)	GP Flow (Veh/Hour)	GP Speed (mph)
10/1/2021 15:00	1700	32	1547	20
10/1/2021 16:00	1661	34	1447	18
10/1/2021 17:00	1629	36	1486	19
10/4/2021 15:00	1531	54	1740	34
10/4/2021 16:00	1674	43	1483	18
10/4/2021 17:00	1634	42	1476	18
10/5/2021 15:00	1595	58	1781	38
10/5/2021 16:00	1657	43	1500	20
10/5/2021 17:00	1651	43	1535	19
10/6/2021 15:00	1299	20	1050	12
10/6/2021 16:00	1574	31	1373	14
10/6/2021 17:00	1673	41	1517	19
10/7/2021 15:00	1700	51	1669	29
10/7/2021 16:00	1630	44	1551	21
10/7/2021 17:00	1681	43	1559	20
10/8/2021 15:00	1682	32	1546	19
10/8/2021 16:00	1652	35	1497	19
10/8/2021 17:00	1652	33	1527	20

I-80 Westbound San Francisco Oakland Bay Bridge to Carquinez Bridge

In the westbound direction in the AM peak period, there is a bottleneck at the San Francisco-Oakland Bay Bridge mainline metering lights. This congestion extends back towards the I-80/I-580/I-880 junction. There is also a bottleneck between the Powell Street loop on-ramp to the I-80/I-580/I-880 junction. The queue from this bottleneck extends back beyond the Richmond Parkway interchange, approximately 13.0 miles. In the afternoon peak period, there is a bottleneck that develops between the Powell Street loop on-ramp and the I-80/I-580/I-880 junction. A queue from this bottleneck extends back beyond the University Avenue interchange, approximately 2.5 miles. Peak period recurrent congestion in GP lanes reduces HOV lane performance and speed due to the friction factor. Even though the HOV lanes are degraded, HOVs in the westbound direction experiences a travel time savings over the general-purpose traffic during the morning and evening peak periods. Figures below shows a “spot time” plot of the HOV and GP lane speeds on westbound Route 80 during a typical morning and evening peak period. Lane 1 represents the HOV lane and lane 2 represents the adjacent GP lane.





The HOV 3+ demand on this route is relatively high which can also have an effect on the speed in the HOV lane when the adjacent GP lanes are congested due to this friction factor. . The HOV lane is near the effective capacity of the lane in order to maintain a speed at 45 mph or greater.

WB I-80 El Portal Dr.

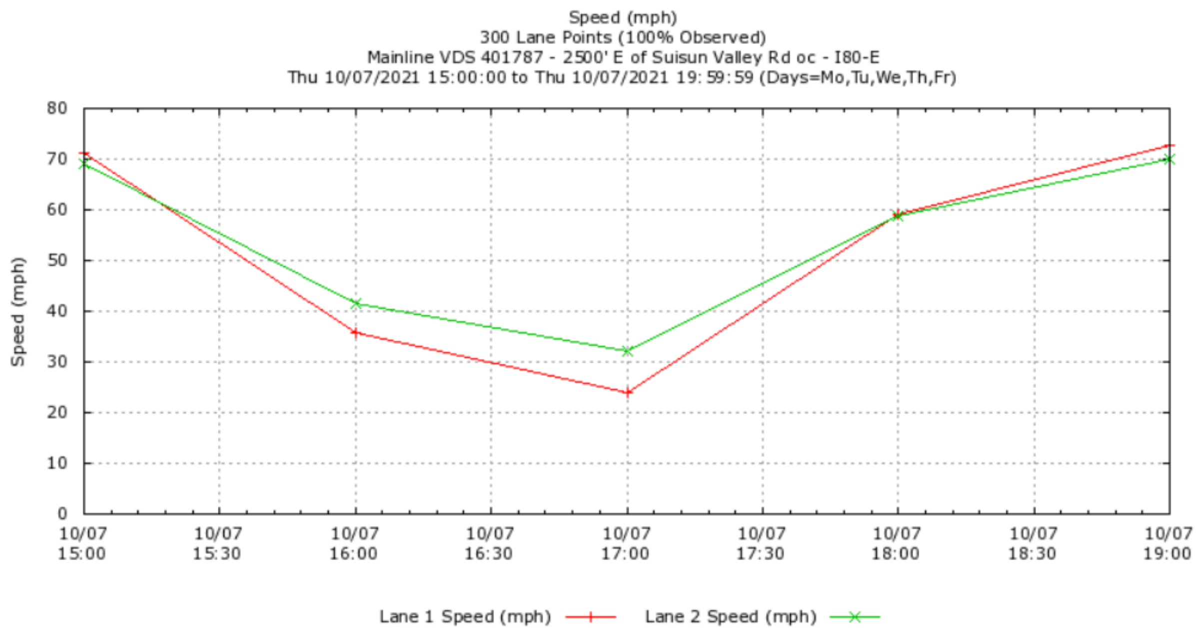
Hour	HOVL Flow (Veh/Hour)	HOVL Speed (mph)	GP Flow (Veh/Hour)	GP Speed (mph)
10/4/2021 6:00	1665	56.30	1898	48.80
10/4/2021 7:00	1492	26.30	1395	19.10
10/4/2021 8:00	1241	33.90	1573	28.70
10/5/2021 6:00	1493	49.80	1776	48.70
10/5/2021 7:00	1597	27.80	1464	22.90
10/5/2021 8:00	1417	29.40	1323	17.70
10/6/2021 6:00	1659	52.10	1853	46.60
10/6/2021 7:00	1442	22.10	1329	17.40
10/6/2021 8:00	1341	29.80	1482	23.60

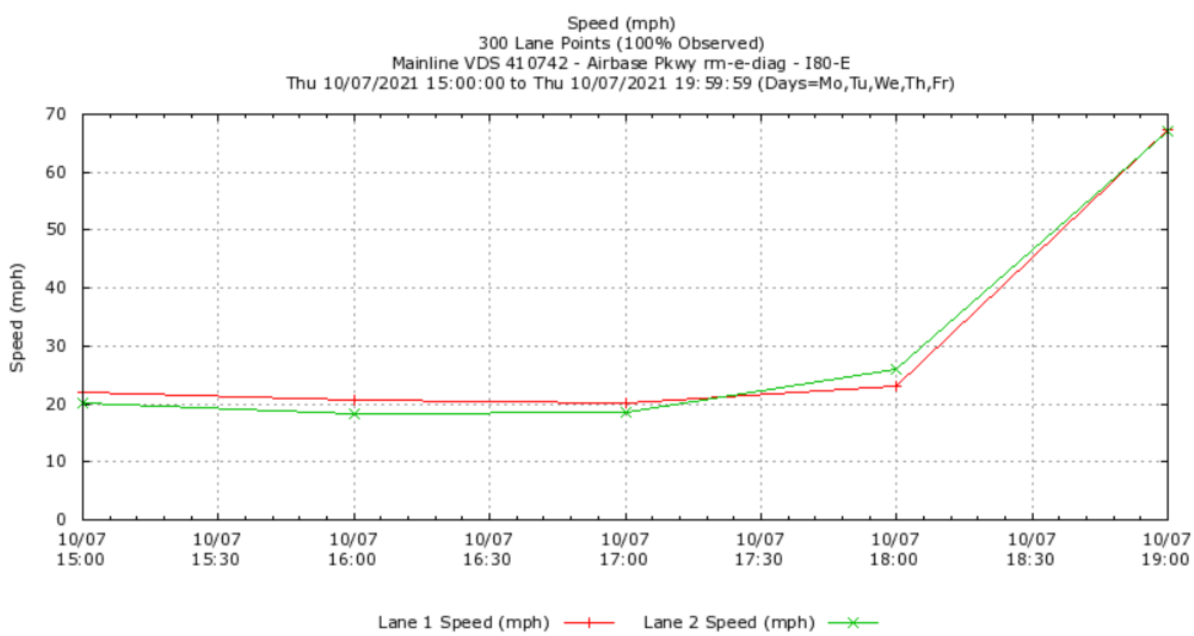
10/7/2021 6:00	1699	55.30	1894	53.50
10/7/2021 7:00	1400	21.40	1307	18.40
10/7/2021 8:00	1235	25.40	1178	16.00
10/8/2021 6:00	1347	47.90	1640	49.20
10/8/2021 7:00	1462	29.00	1415	20.40
10/8/2021 8:00	1125	57.30	1823	43.80

I-80 Eastbound, Red Top Road to Airbase Parkway

As this route is a getaway route for drivers heading to the Tahoe/Reno area, congestion on the mainline occurs around the major holidays (Independence Day, Labor Day, Thanksgiving, and week before Christmas). During the normal afternoon peak period the HOV lane is slightly degraded, occasional congestion in the GP lanes reduces HOV lane performance and speed due to the friction factor. This is due to several geometric factors on the GP lanes. In the eastbound direction there are two consecutive general-purpose lane drops – first is a mandatory off to eastbound Route 12 (7 lanes to 6 lanes), second is a lane drop after the connector to Route 12 (from 6 to 5 lanes). There is also a lane drop downstream of the end of HOV lane causing congestion to queue back into the end of the HOV lane.

Speed profiles showing friction between HOV lane #1 and General Purpose (GP) lane #2 is shown on the graphs below, along with the congestion in the HOV lane due to the lane drop downstream of the end of the HOV lane.





B. REMEDIATION STRATEGIES:

San Francisco-Oakland Bay Bridge to Carquinez Bridge

• Starting in July 2018, the Metropolitan Transportation Commission (MTC) provided CHP with funding of $1.2 million in funding to the CHP for one year (with an option to extend it to three years) for four CHP officers to specifically conduct enhanced HOV enforcement. The limits on Route 80 for this CHP enforcement pilot project are from the Carquinez Bridge to the San Francisco-Oakland Bay Bridge. MTC and Caltrans collected data to evaluate effectiveness of the enhanced enforcement effort. This enforcement pilot was stopped in 2020 due to shelter in place (SIP) order. Results only showed slight reduction in violation and did not significantly reduce degradation

• Caltrans has updated the HOV violation fine amount on existing signs along this corridor to the current dollar amount to support the enhanced HOV enforcement effort, completed end of 2018. However, this did not have a significant impact on addressing the degradation on this corridor.

• Caltrans is utilizing the westbound Route 80 electronic overhead lane use control sign to display HOV diamond symbol on the lane #1 control signal. Results did not show a significant impact on the degradation on this corridor.

• A future project will convert the HOV lanes to HOT lanes. Preliminary engineering and environmental studies are pending. Scheduled to open early 2026. Preliminary project cost is estimated at $190 million and would be funded by the MTC. With HOT lane projects there is dedicated funding provided by the HOT lane operators for CHP enforcement of the HOT lanes. This will insure a more consistent approach to enforcing and deterring violations of the HOT lanes.

• In addition, MTC is embarking on a design alternative assessment (DAA) on I-80. The DAA will identify and evaluate a range of near-term and mid-term operational improvements and demand management strategies to address congestion in the corridor focusing on improving high occupancy modes of travel such as express buses and carpools, Managed lanes, and associated operational policies. The outcome of the DAA will be a set of near-and mid-term project concepts, starting in November 2020 and to be completed by end of 2022.

I-80 Eastbound Red Top Road to Airbase Parkway

A project will convert the HOV lanes to HOT lanes and will extend them from Airbase Parkway eastward to Route 505 in Vacaville in both directions of I-80. The project cost is $143.4 M, completion scheduled for end 2023. With HOT lane projects there is dedicated funding provided by the HOT lane operators for CHP enforcement of the HOT lanes. This will insure a more consistent approach to enforcing and deterring violations of the HOT lanes.

4.2.5 ACTION PLAN FOR HOV FACILITIES ON ROUTE 85

In 2019 SR 85 had 13.6 lane-miles of degraded HOV lanes in the northbound direction during the AM peak period. There was 5.4 lane-miles with 32% of days degraded (slightly degraded), 5.6 lane-lines with 64% of days degraded (very degraded) and 2.6 lane-miles with 79% of days degraded (extremely degraded). In 2021, northbound I-85 in the AM peak period had 4.6 lane-miles of degraded HOV lanes, with 28.1 % of days degraded (slightly degraded). This was a reduction of 9 lane-miles.

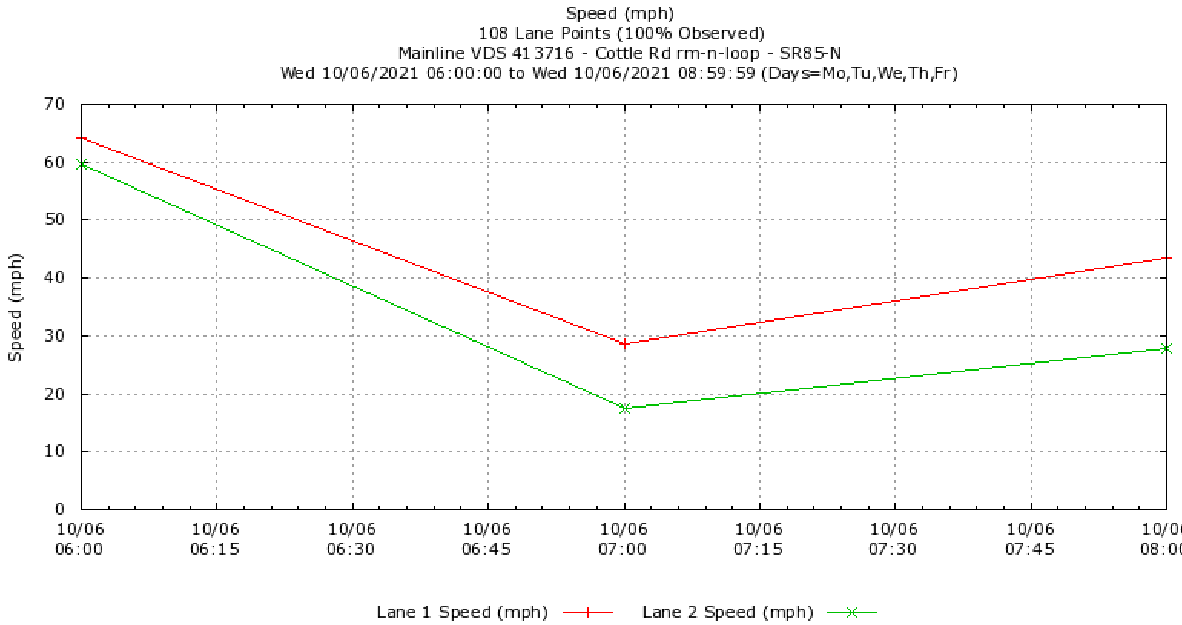
In 2019 SR 85 had 16.2 lane-miles of degraded HOV lanes in the southbound direction during the PM peak period. There was 1.7 lane-miles with 21.6% of days degraded (slightly degraded), 5.9 lane-miles with 69.5% of days degraded (very degraded) and 8.6 lane-miles with 87.8% of days degraded (extremely degraded). In 2021, southbound I-85 in the PM peak period had 8.3 lane-miles of degraded HOV lanes, a reduction of 7.9 lane-miles. There was 6.0 lane-miles with 33.9% of days degraded (slightly degraded), 1.0 lane-mile with 65.8% of days degraded (very degraded) and 1.4 lane-miles with 85% of days degraded (extremely degraded). The greatest reduction was of extremely degraded segments with -7.2 lane-miles.

Reduction in degraded lane-miles was mainly the result of change in commute travel pattern with more people working from home due to the pandemic.

A. ANALYSIS:

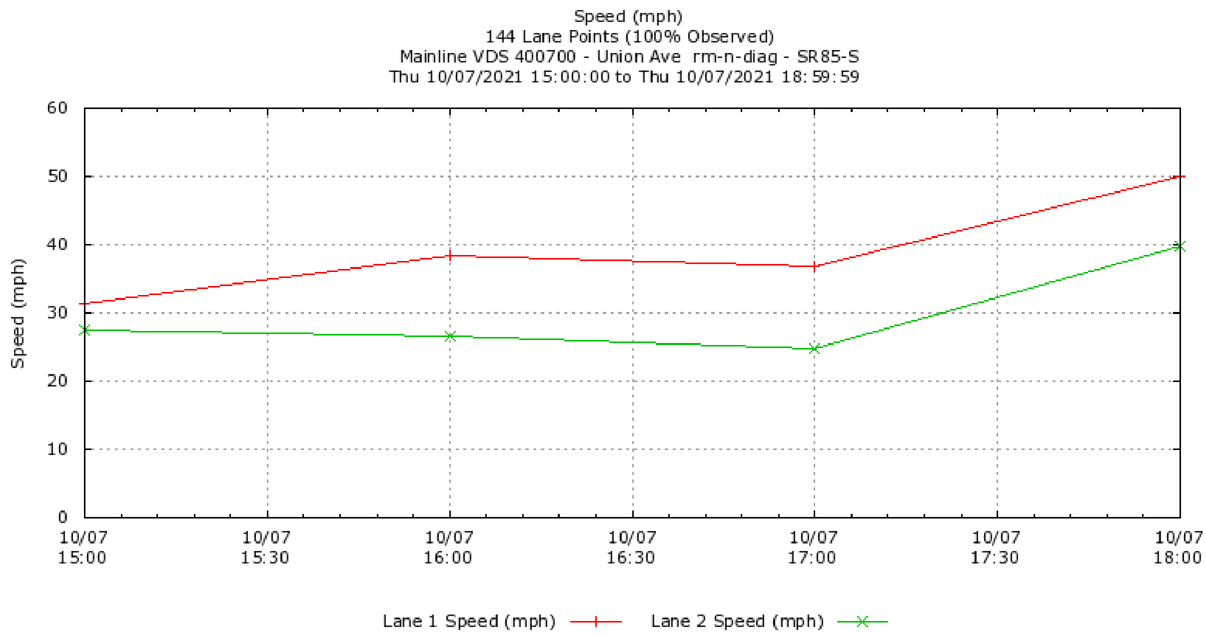
SR 85 Northbound US 101 (S. San Jose) to US 101 (Mountain View)

In the northbound direction during the AM peak period traffic conditions have improved compared to pre-pandemic conditions. However there is still a bottleneck between the Winchester Boulevard on-ramp and the Saratoga Avenue off-ramp. The queue from this bottleneck currently only reaches the SR 17 interchange and therefore has revealed a hidden bottleneck between the Almaden Expwy. on-ramp and the Camden Ave. off-ramp. The queue from this bottleneck extends upstream to the SR 87 interchange and periodically causes slowdown further upstream. There is a bottleneck that develops downstream at the I-280 and Homestead Rd. interchanges. Peak period recurrent congestion in the general-purpose lanes reduces HOV lane performance and speed due to the friction factor between these lanes.



SR 85 Southbound US 101 US 101 (Mountain View to (S. San Jose)

In the southbound direction during the PM peak period traffic conditions have improved compared to pre-pandemic conditions. However, as the severity of the congestion has been reduced this has uncovered multiply bottlenecks along this route. The major bottleneck is still between the Union Avenue on-ramp and the Camden Avenue off-ramp. Queues from this bottleneck extend to the SR 17 interchange. Other bottlenecks are at the Saratoga Ave. on-ramp to the Winchester Blvd. off-ramp, at the lane drop upstream of De Anza Blvd, between the Fremont Ave. on-ramp and the Homestead Rd. off-ramp and between the SR 237 and the El Camino Real interchanges. Peak period recurrent congestion in the general-purpose lanes reduces HOV lane performance and speed due to the friction factor between these lanes.



B. REMEDIATION STRATEGIES:

There is a project to convert existing HOV lanes to HOT lanes and add a second HOT lane to provide a dual lane facility. The project limits are from the Route 101 interchange in south San Jose to the Route 101 interchange in Mountain View. Preliminary project cost is estimated at $185 million and would be funded by the Santa Clara Valley Transportation Authority (VTA) through the design stage of the project. There is also a proposal to raise occupancy to HOV 3+ with HOT lane conversion. The HOT lane would operate in “HOV Only” mode if the lane becomes degraded. In addition, HOV 2 and Clean Air Vehicles would be tolled at a discounted rate. With HOT lane projects there is dedicated funding provided by the HOT lane operators for additional CHP enforcement of the HOT lanes. This will insure a more consistent approach to enforcing and deterring violations of the HOT lanes. VTA plans to build this project and the Route 101 HOT lane project in phases. The first segment on Route 85 opened in February 2022 between Central Expwy. and US 101 (Mountain View). The segment from Route 101 (south San Jose) to Route 87 is currently in the design phase with construction to start in 2023 and completed in 2025 with a project cost of $55M. The middle section of the Route 85 HOT lane conversion and lane addition will follow this project.

4.2.6 ACTION PLAN FOR HOV FACILITIES ON ROUTE 87

In 2019 SR 87 had 4.6 lane-miles of degraded HOV lanes in the northbound direction during the AM peak period. There was 2.8 lane-miles with 38% of days degraded (slightly degraded), 1.0 lane-mile with 63% of days degraded (very degraded) and 0.8 lane-miles with 81% of days degraded (extremely degraded). In 2021, northbound SR 87 in the AM peak period had 1.3 lane-miles of degraded HOV lanes, with 36.7% of days degraded (slightly degraded). This was an overall reduction of 3.3 lane-miles. In 2021 northbound SR 87 had 0.5 lane-miles of degraded HOV lanes with 12% of days degraded (slightly degraded) in the PM peak period while 2019 didn't have any segments degraded.

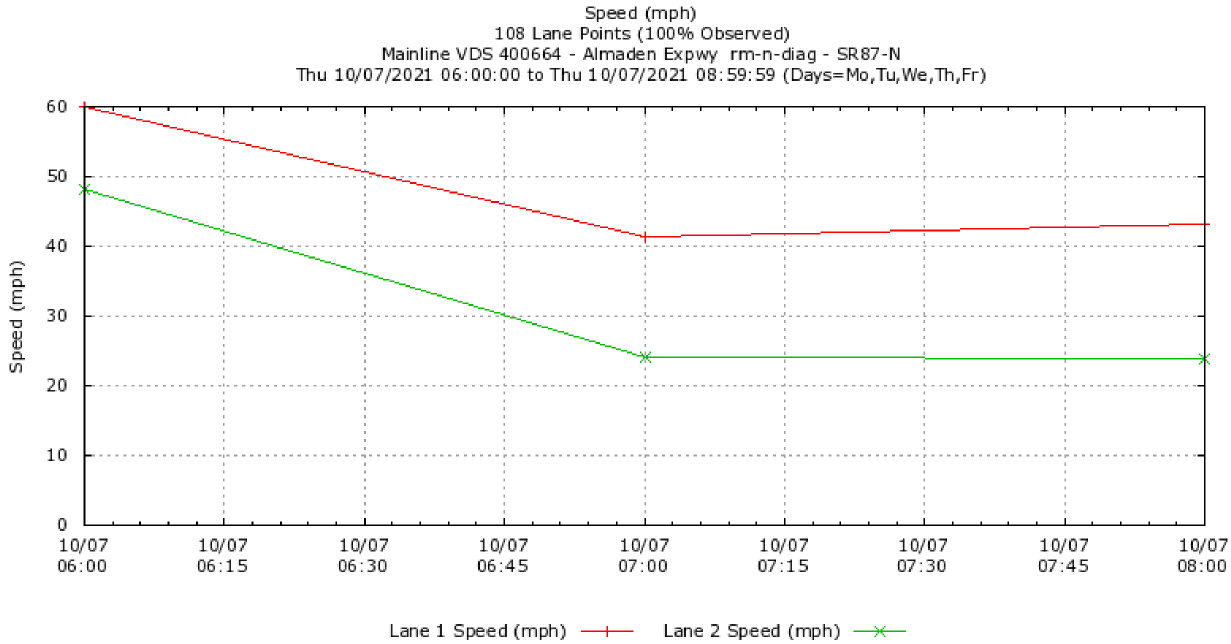
In 2019 SR 87 had 4.9 lane-miles of degraded HOV lanes in the southbound direction during the PM peak period. There was 4.3 lane-miles with 31.1% of days degraded (slightly degraded) and 0.6 lane-miles with 65% of days degraded (very degraded). In 2021, southbound SR 87 in the PM peak period had 0.5 lane-miles of degraded HOV lanes with 16% of days degraded (slightly degraded), an overall reduction of 4.4 lane-miles.

Reduction in degraded lane-miles was mainly the result of change in commute travel pattern with more people working from home due to the pandemic.

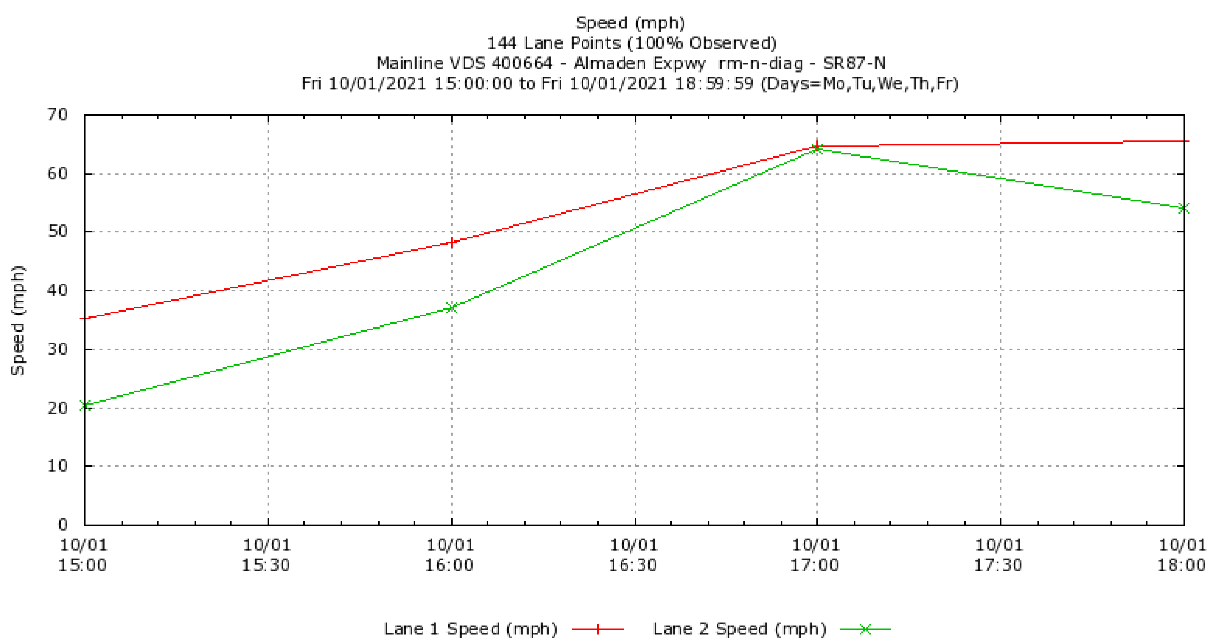
A. ANALYSIS:

SR 87 Northbound SR 85 to US 101

On northbound Route 87 during the AM peak period there is currently a bottleneck at the Almaden Expwy on-ramp with queues extending upstream to the East Capitol Expwy. Peak period recurrent congestion in the general-purpose lanes reduces HOV lane performance and speed due to the friction factor between these lanes.

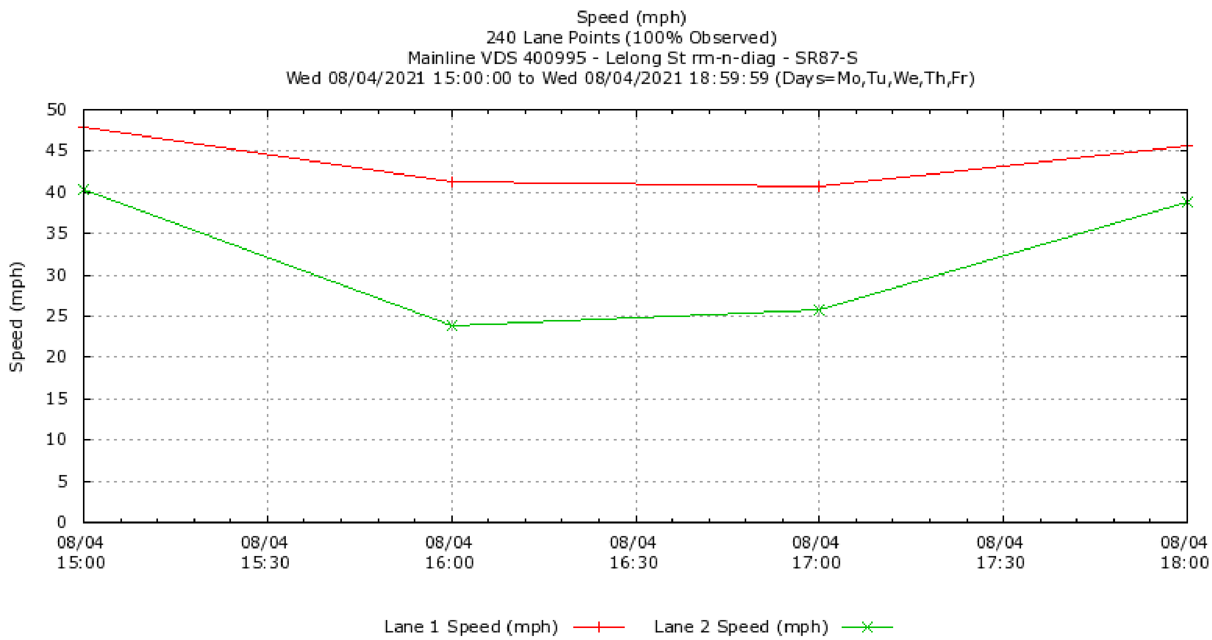


On northbound SR 87 during the PM peak period one detector location shows speeds in the HOV lane drop below 45 mph 12 % of the time. This is most likely due to a queue from the NB SR 87 to SB I-280 connector queuing back onto northbound SR 87. This congestion is in the general-purpose lanes which reduced the HOV lane performance and speed due to the friction factor between these lanes.



SR 87 Southbound SR 85 to US 101

On southbound Route 87 there is one controlling bottleneck in the afternoon peak period between the I-280 on-ramp and the Almaden Expwy off-ramp. The queue from this bottleneck extends back to the I-280 interchange. Peak period recurrent congestion in the general-purpose lanes reduces HOV lane performance and speed due to the friction factor between these lanes.



REMEDIATION STRATEGIES:

VTA conducted a corridor study and is planning a future project to convert the HOV lane to a HOT lane. At the time of conversion, occupancy may be increased to HOV 3+ with the HOT lane conversion. The HOT lane would operate in "HOV Only" mode if the lane becomes degraded. In addition, HOV 2 and Clean Air Vehicles could be tolled at a discounted rate. The corridor study was completed in August 2018 however the HOT lane conversion does not currently have a schedule completion date.

A Technology-Based Corridor improvement project ($3 Million), part-time lane (Bus), which would convert the right shoulder to a part-time lane for transit, was scheduled to start construction in the of Summer 2023 with completion in fall 2024. VTA however has put this project on hold for the time being.

There are no other projects proposed in the near term and therefore a waiver is being requested for this route.

4.2.7 HOV FACILITIES ON ROUTE 92

In 2021 the westbound SR 92 HOV lane was no longer degraded in the AM peak period as it was in 2019. In 2020 the toll plaza went to all electronic toll collection therefore the toll plaza is no longer the bottleneck on this route. In 2019, three detector stations on westbound SR 92 between Hesperian Blvd. and Clawiter Rd. in the AM peak period indicated speeds below 45 mph and these segments were determined to be very or extremely degraded in Caltrans' degradation analysis. The three detector stations indicated these segments not to be degraded in the AM peak period in 2021 degradation analysis, as speeds remained above 45 mph in the HOV lane. The strategy of electronic toll collecting at the toll plaza on westbound SR 92 made significant progress in increasing HOV lane speed, along with reduced demand on this route as a result of the pandemic.

4.2.8 ACTION PLAN FOR HOV FACILITIES ON ROUTE 101

There are multiple HOV facilities on Route 101 in District 4. There are facilities located in Santa Clara and San Mateo Counties between Cochrane Road and Whipple Avenue A second set of HOV facilities are located in Marin County between Richardson Bay Bridge and Atherton Avenue. There are also HOV facilities in Sonoma County between the Marin County line and Windsor River Road.

In 2019 US 101 between Cochrane Rd. and Whipple Ave. had 10.8 lane-miles of degraded HOV lanes in the northbound direction during the AM peak period. There was 2.0 lane-miles with 23% of days degraded (slightly degraded), 5.3 lane-lines with 66% of days degraded (very degraded) and 3.5 lane-miles with 82% of days degraded (extremely degraded). In 2021, northbound US 101 in the AM peak period had 1.8 lane-miles of degraded HOV lanes, a reduction of 9 lane-miles. The biggest reduction was in very degraded, -4.6 lane-miles. There was 1.0 lane-mile with 44.6% of days degraded (slightly degraded) and 0.8 lane-miles with 54.3% of days degraded (very degraded). In 2019, northbound US 101 PM peak period, in this segment, had a total of 2 lane-miles of degraded HOV lane. There was 1.6 lane-miles with 24% of days degraded (slightly degraded) and 0.4 lane-miles with 61% of days degraded (very degraded). There was no degrade HOV lane-miles in 2021 within this segment on NB 101 in the PM peak period. Reduction in degraded lane-miles was combination of installing ramp metering on northbound US 101 (closing the gaps) in 2021 along with the change in commute travel pattern with more people working from home due to the pandemic.

In 2019 US 101 between Cochrane Rd. and Whipple Ave. had 3.6 lane-miles of degraded HOV lanes in the southbound direction during the AM peak period. There was 3 lane-miles with 21.5% of days degraded (slightly degraded) and 0.6 lane-miles with 58.9% of days degraded (very degraded). In 2021, southbound US 101 in the AM peak period had 0.3 lane-miles of degraded HOV lanes with 10.2% of days degraded (slightly degraded), a reduction of 3.3 lane-miles (see statement under Analysis segment below as this segment detection may be corrupt). In 2019 during the PM peak period southbound US 101 had 18.2 lane-miles of degraded HOV lanes. There was 7.1 lane-miles with 24.1% of days degraded (slightly degraded), 2.3 lane-miles with 57.6% of days degraded (very degraded) and 8.8 lane-miles with 86.6% of days degraded (extremely degraded). In 2021there was 5.8 lane-miles of degraded HOV lanes, a reduction of 12.4 lane-miles with the biggest reduction of extremely degraded, -6 lane-miles. There was 1.7 lane-miles with 22.6% of days degraded (slightly degraded), 1.3 lane-miles with 61.8% of days degraded (very degraded) and 2.8 lane-miles with 92.2% of days degraded (extremely degraded). Reduction in degraded lane-miles was mainly the result of change in commute travel pattern with more people working from home due to the pandemic.

In 2019 US 101 between Richardson Bay Bridge to Atherton Ave, had 0.3 lane-miles of degraded HOV lanes in the northbound PM peak hour. In 2021, there was 1.7 lane-miles of degraded HOV lanes. The main difference between 2021 and 2019 speed data was that the degraded locations in 2021 did not have 100% detector Health data to report in 2019. However, these locations would have been degraded in 2019 if data was collected as bottlenecks and queuing occurred in 2019 as well as 2021.

In 2019 US 101 between De Long Ave. and Richardson Bay Bridge had 3.8 lane-miles of degraded HOV lanes in the southbound AM peak hour. There was 1.1 lane-miles with 39.8% of days degraded (slightly degraded), 2.3 lane-miles with 62.6% of days degraded (very degraded) and 0.4 lane-miles with 81.7% of days degraded (extremely degraded). In 2021 this segment of southbound US 101 had 2.7 lane-miles of degraded HOV lanes with 32% days degraded (slightly degraded), a reduction of 1.1 lane-miles.

In 2019 northbound US 101 between south of Marin/Sonoma County line and Windsor River Rd. had 3.6 lane-miles of degraded HOV lanes with 21% of days degraded (slightly degraded) in the PM peak period. In 2021 northbound US 101 within this segment had 1.8 lane-miles of degraded HOV lanes with 21.9% of days degraded (slightly degraded) in the PM peak period, a reduction of 1.8 lane-miles.

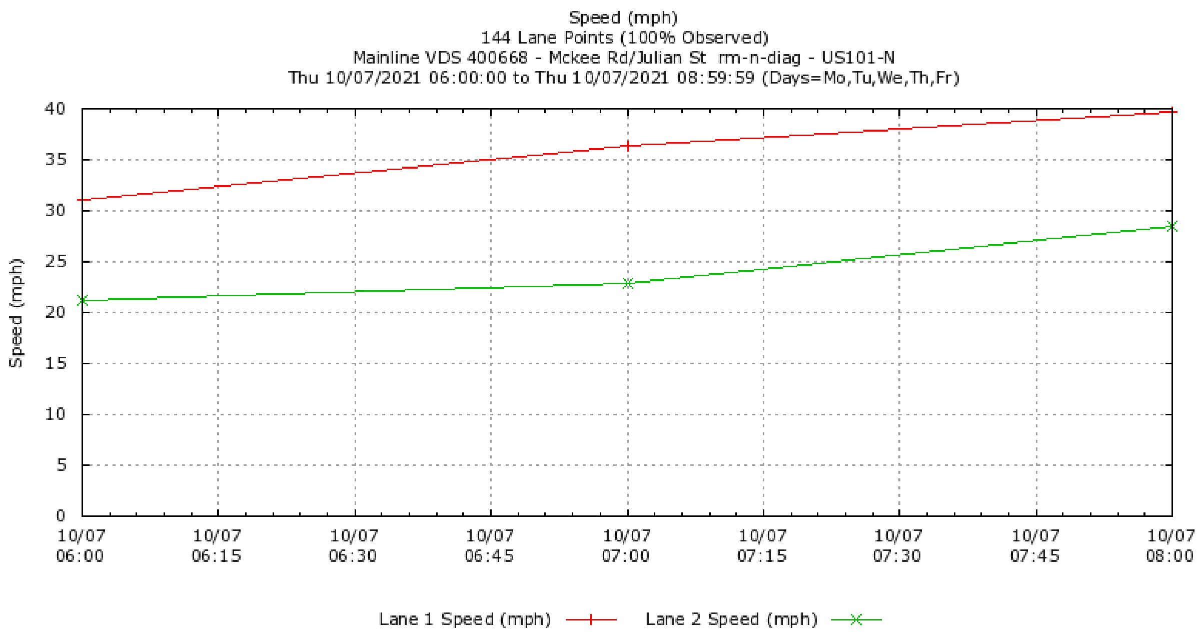
In 2019 US 101 between Windsor River Rd. and north of the Marin/Sonoma County line had 5.6 lane-miles of degraded HOV lanes in the southbound PM peak period. There was 3.2 lane-miles with 26.9% of days degraded (slightly degraded), 0.8 lane-miles with 65.2% of days degraded (very degraded) and 1.6 lane-miles with 85.5% of days degraded (extremely degraded). In 2021 this segment of southbound US 101 had 4 lane-miles of degraded HOV lanes in the PM peak period. A reduction of 1.6 lane-miles. There was 3 lane-miles with 27.6% of days degraded (slightly degraded) and 1 lane-mile with 55.6% of days degraded (very degraded).

Reduction in degraded lane-miles was mainly the result of change in commute travel pattern with more people working from home due to the pandemic.

A. ANALYSIS:

US 101 Northbound Cochrane Road to Whipple Avenue

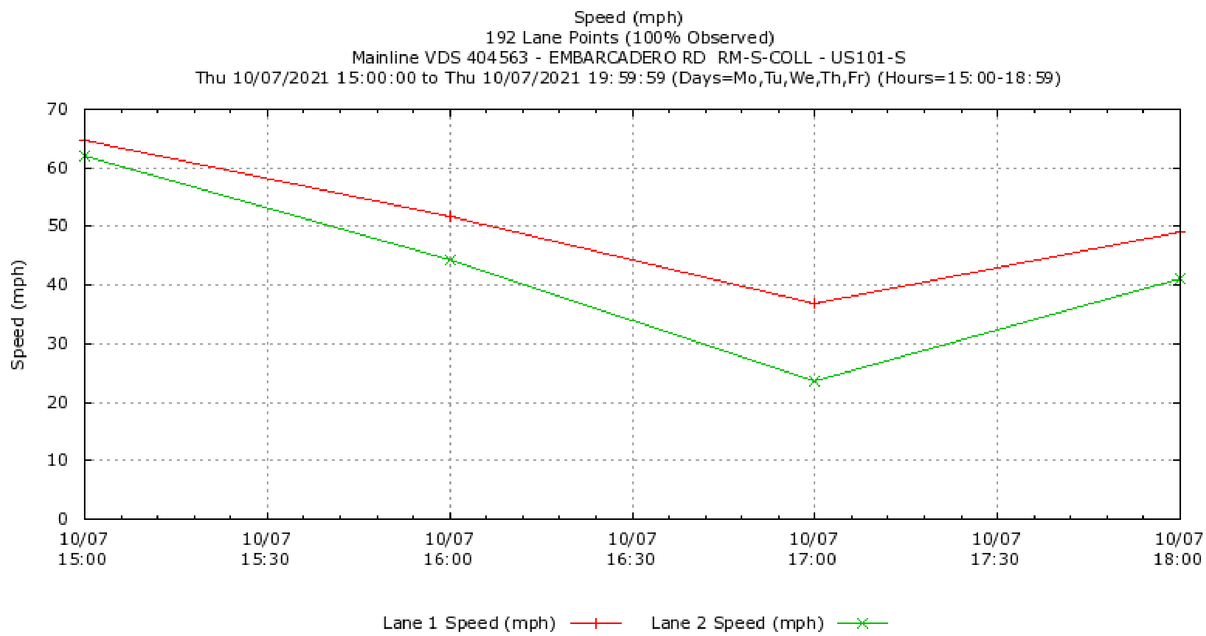
In the morning peak period, there are multiply bottlenecks along northbound Route 101. The bottlenecks between the McKee Rd, on-ramp and the Old Oakland Rd. off-ramp and Tully Rd. on-ramp and I280/I680 off-ramp causes recurrent congestion in the general-purpose lanes that reduces HOV lane performance and speed due to the friction factor between these lanes. Queues from these bottlenecks extend to beyond the Hellyer interchange.

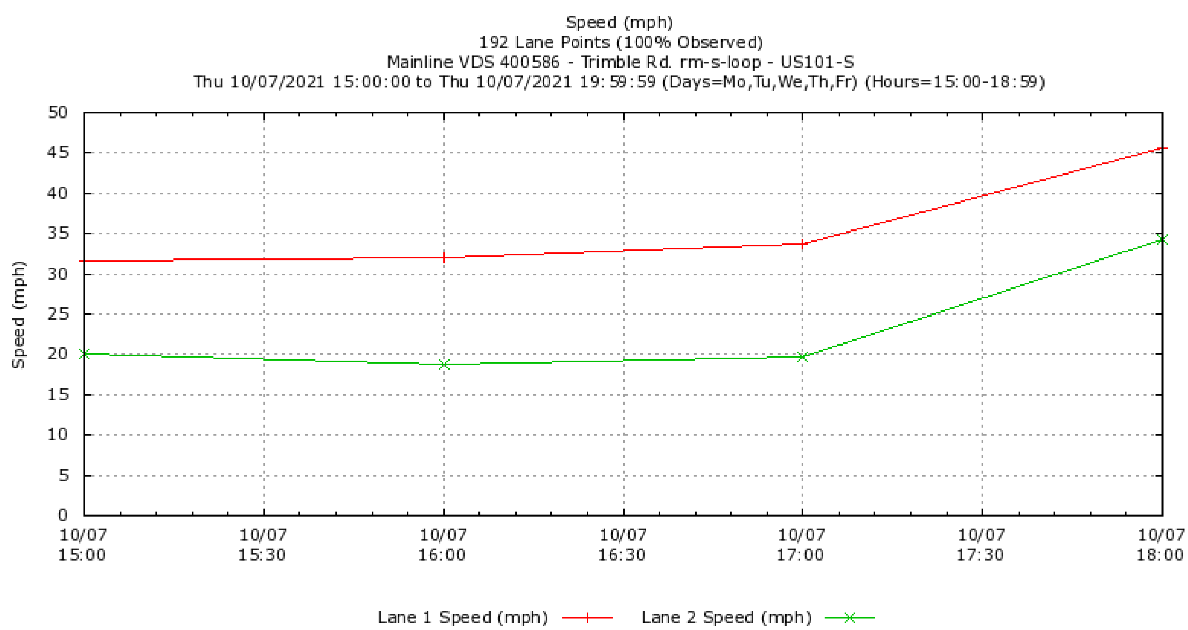


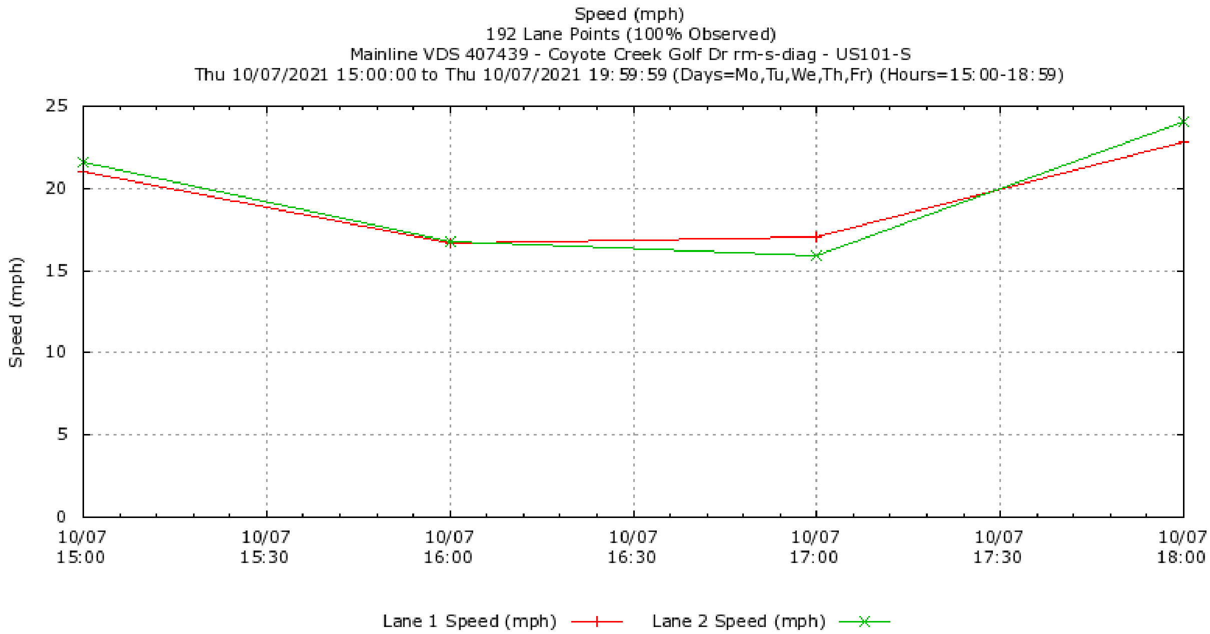
<u>*US 101 Southbound Whipple Avenue to Cochrane Road*</u>

The PeMS data indicates that there is a spot location at the Willow Rd. interchange where speeds in the HOV lane are below 45 mph just over 10 % of the time in the morning peak period. However, when reviewing the raw PeMS data, the speeds are all above 45 mph in the HOV lane. It appears that the PeMS data used for this location is not accurate and that this location is not degraded in the AM peak period.

There are multiple bottlenecks on southbound Route 101 in the afternoon peak period. A bottleneck between the Rengstorff Avenue on-ramp and southbound Route 85 off-ramp causes a queue to extend back to the Embarcadero Rd/Oregon Expwy. interchange. Further downstream there is a bottleneck between the De La Cruz Boulevard diagonal on-ramp and the southbound Route 87 off-ramp. Queue from this bottleneck extends upstream just beyond the Lawrence Expwy. interchange. Downstream of this bottleneck there is a bottleneck between the Old Oakland Road on-ramp and the Julian Street off-ramp. Queue from this bottleneck extends upstream to the Airport Parkway interchange. The resultant recurrent congestion in general-purpose lanes from these conditions reduces HOV lane performance and speed due to the friction factor between these lanes. In addition, there is a bottleneck south of the end of the HOV lane between the Cochrane Road on-ramp and the Dunne Avenue off-ramp. This causes a queue to extend back into the end of the HOV lane to the Bailey Road interchange. This results in reduced speeds in all lanes with the HOV lane operating at similar speeds as the general-purpose lanes.

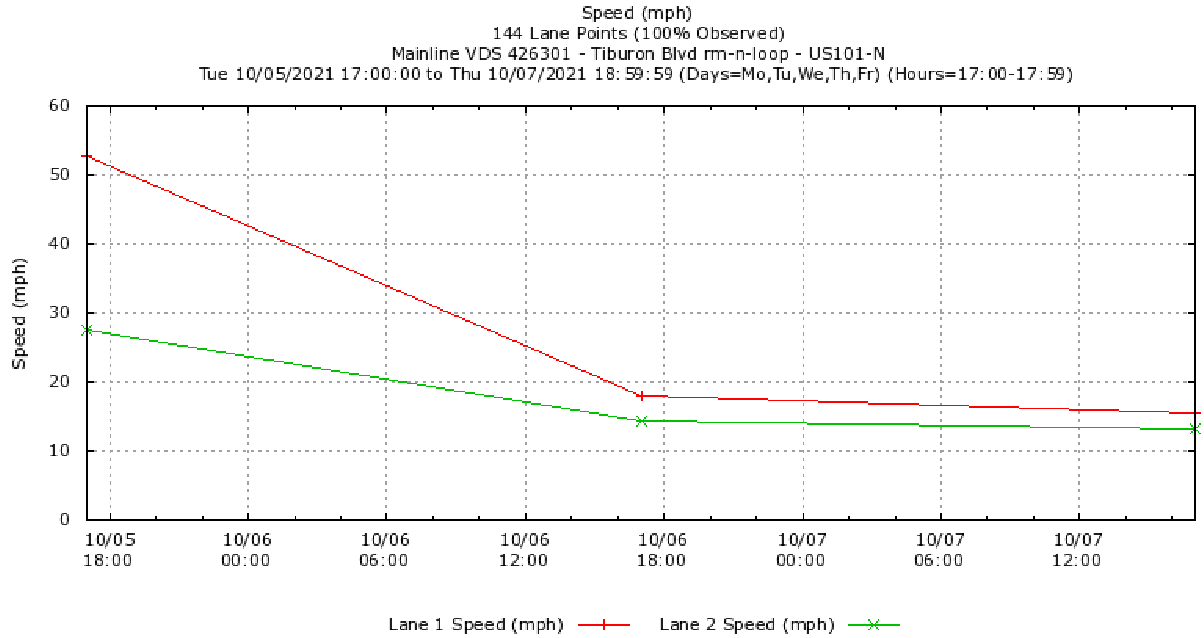






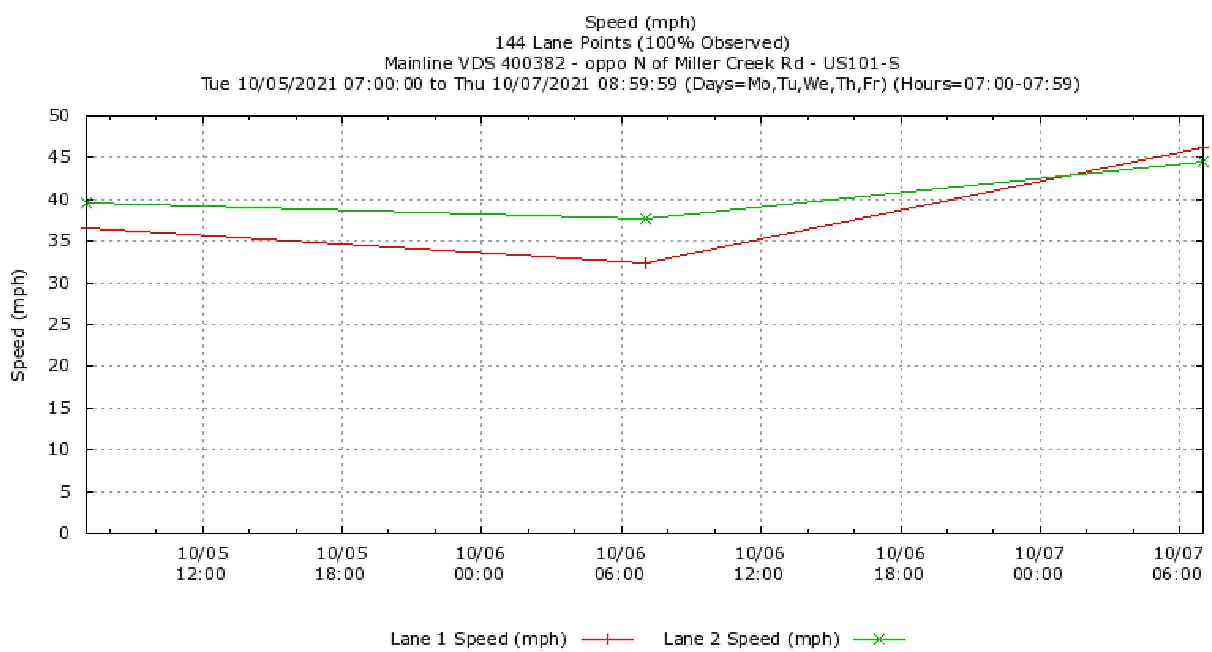
US 101 Northbound Richardson Bay Bridge to Atherton Avenue

There are two controlling bottlenecks on northbound Route 101 in Marin County. The first bottleneck is between the Tamalpais Drive diagonal on-ramp and the Lucky Drive off-ramp. The queue from this bottleneck extends upstream of the N. Bridge Blvd. off-ramp. The second bottleneck is typically downstream at the end of the HOV lane caused by a general-purpose lane drop north of the Atherton Avenue on-ramp. Queue from this bottleneck extends back to De Long Avenue interchange. The bottleneck between the Tamalpais Drive diagonal on-ramp and the Lucky Drive off-ramp causes recurrent congestion in the general-purpose lanes that reduces HOV lane performance and speed due to the friction factor between these lanes.



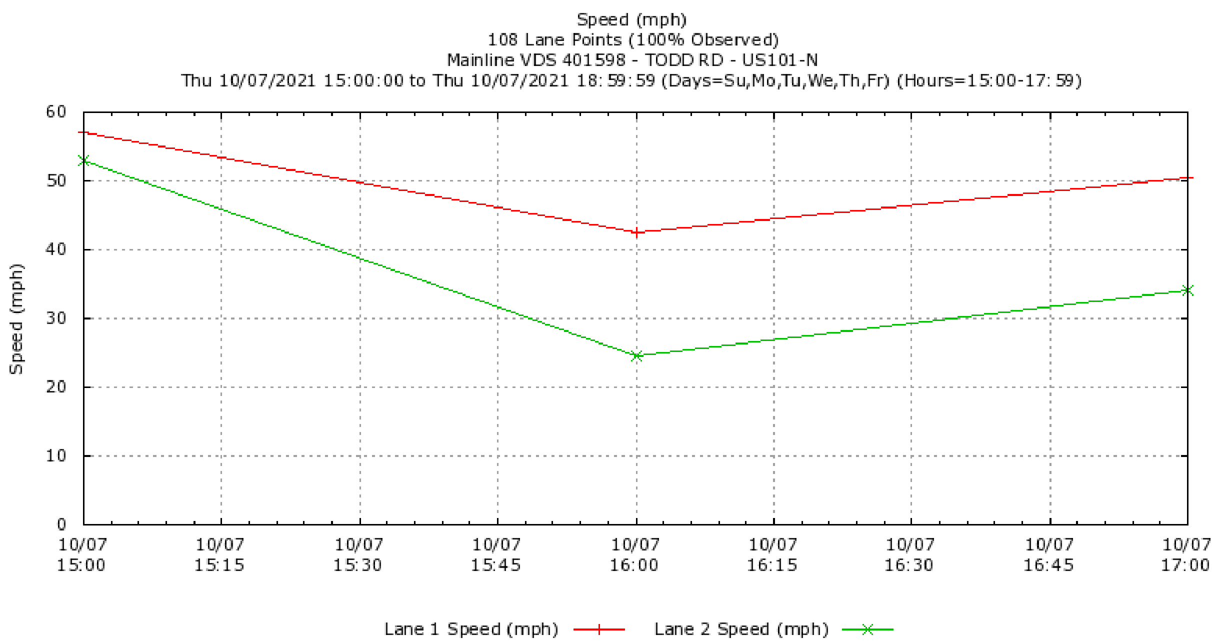
US 101 Southbound De Long Avenue to Richardson Bay Bridge

In the AM peak period there is bottleneck at the North San Pedro Road on-ramp to the Lincoln Avenue off-ramp. The queue from this bottleneck extends upstream to the Rowlands Boulevard interchange. The recurrent congestion in the general-purpose lanes caused by this bottleneck reduces HOV lane performance and speed due to the friction factor between these lanes.



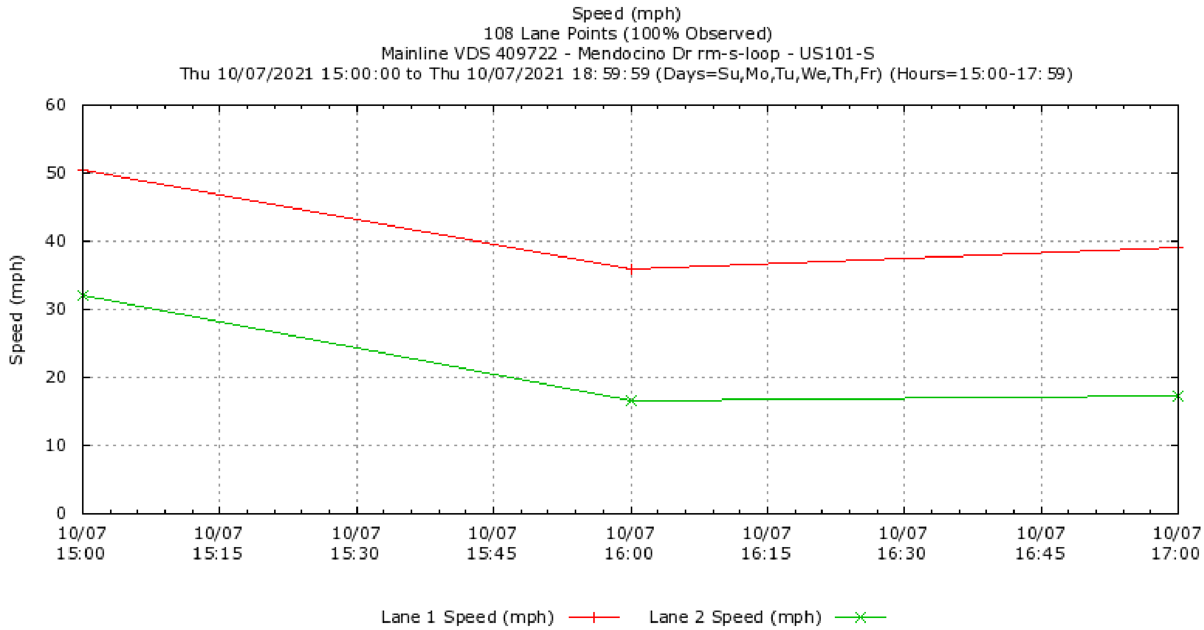
US 101 Northbound, South of Marin/Sonoma County line to Windsor River Road

In the PM peak period there is minor bottleneck between the Baker Avenue on-ramp and the Route 12 off-ramp due to weaving between these ramps. Slow speeds extend upstream to Golf Course Drive interchange. The recurrent congestion in the general-purpose lanes caused by this bottleneck reduces HOV lane performance and speed due to the friction factor between these lanes.



US 101 Southbound, Windsor River Road to North of Marin/Sonoma County line

On southbound Route 101 there is a bottleneck between the Route 12 on-ramp and the Baker Avenue off-ramp in the PM peak period. The queue from this bottleneck extends upstream to the River Road interchange. The recurrent congestion in the general-purpose lanes caused by this bottleneck reduces HOV lane performance and speed due to the friction factor between these lanes.



B. REMEDIATION STRATEGIES:

Northbound and Southbound US 101 Cochrane Road (SCL County) to Whipple Avenue (SM County)

There are plans to convert the existing HOV lanes to HOT lanes and add a second HOT lane to create a dual lane facility. The project limits are from East Dunne Avenue to the SCL/SM County line in Santa Clara County. Preliminary project cost is estimated at $416 million and would be funded by VTA. VTA plans to build this project and the Route 85 HOT lane project in segments. The first segment on Route 101 is between Route 237 and the San Mateo County line. Construction began March 8, 2019, and was completed in February 2022. Occupancy requirement for toll free travel on this segment was increased to HOV 3+ with this HOT lane conversion. The HOT lane can operate in "HOV Only" mode if the lane becomes degraded. HOV 2 and Clean Air Vehicles are tolled at a discounted rate. With HOT lane projects there is dedicated funding provided by the HOT lane operators for increased CHP enforcement of the HOT lanes. This will insure a more consistent approach to enforcing and deterring violations of the HOT lanes. The second phase, between Route 237 and Old Oakland Road, is now in the PS&E phase, with a start construction date of January 2024, opening to traffic in May 2026 as a dual HOT lane.

The connector from southbound US 101 to southbound Route 87 will be widened to two lanes. Currently, the demand for this off-ramp exceeds the capacity of a one lane ramp, causing congestion to queue back onto southbound Route 101. Construction started in February 2022 and is scheduled to be completed in November 2022, with a cost of $4.2 M.

A project to fill in the ramp metering gaps and extend ramp metering on northbound Route 101 from Fair Oaks Avenue to Embarcadero Road was completed in June 2021, project cost $8.3 M.

San Mateo County Transportation Agency, City/County Association of Governments, and Caltrans are developing a project for HOT lanes between the SCL/SM County line and Route 380. This lane is being proposed as a HOT 3+ lane and began construction in February 2020. Estimated cost of the project is $514 million with an estimated completion February 2023. This project will convert the existing HOV lane between the Santa Clara County line and Whipple Avenue into a HOT lane; this conversion was completed in February 2022. Between Whipple Avenue and Route 380, the project will add a HOT lane in both directions, scheduled to be opened to toll traffic in February 2023. The lane was opened in "HOV 3+ Only" in the fall 2022 so that the toll system could be tested under live traffic conditions. Occupancy requirements will be increased to HOV 3+ with HOT lane conversion. The HOT lane can operate in "HOV Only" mode if it becomes degraded. In addition, HOV 2 and Clean Air Vehicles are tolled at a discounted rate. With HOT lane projects there is dedicated funding provided by the HOT lane operators for increased CHP enforcement of the HOT lanes. This will insure a more consistent approach to enforcing and deterring violations of the HOT lanes.

Northbound and Southbound US 101 Richardson Bay Bridge to Atherton Avenue

Part Time Transit Bus Only Lane (Bus on Shoulder) pilot project from Novato Boulevard to Mission Boulevard is currently being studied by the Transportation Authority of Marin (TAM). Currently TAM is seeking funding to begin a Project Initiation Document (PID) for this project.

The Marin/Sonoma County narrows HOV lane gap closure project between De Long Avenue and north of the Marin/Sonoma County line started construction in July 2022. This project is scheduled to be completed July 2026 with a cost of $131 million. This project will close the gap in the HOV lane between the two counties. Current HOV hours of operation in Marin County are 6:30 AM – 8:30 AM in the southbound direction and 4:30 PM – 7:00 PM in the northbound direction. The HOV lane hours of operation in Sonoma County are 7:00 AM – 9:00 AM and 3:00 PM – 6:30 PM in both directions. Once the gap closure project is completed the hours of operation in both counties will need to match.

Northbound and Southbound US 101 South of the Marin/Sonoma County line to Windsor River Road

The HOV lane projects were completed in 2021/2022 to close gaps in the HOV lane for a continuous HOV lane between the Marin/Sonoma County line and Windsor River Road.

There are no current projects to address the bottlenecks near Route 12 which is causing degradation in the northbound and southbound Route 101 HOV lanes in Sonoma County. Heavy traffic to and from Route 12 is causing bottlenecks on northbound and southbound US 101.

4.2.9 HOV FACILITIES ON ROUTE 237

In 2021 the eastbound and westbound SR 237 HOT lane was not degraded. A combination of raising occupancy to HOT 3+ and reduced traffic due to the pandemic increased speeds in the HOT lane above 45 mph. In the 2019 degradation analysis, detector stations on eastbound SR 237 between Lawrence Expwy. and Zanker Rd. in the PM peak period indicated a slightly or extremely degraded Managed lane. The detector stations on westbound SR 237 between McCarthy Blvd. and Lawrence Expwy. in the AM peak period indicated a slightly degraded or very degraded Managed lane. These detector stations indicated no degradation in the 2021 degradation analysis with HOT lane speeds above 45 mph. The strategies that were proposed on SR 237 made significant progress to increase the HOT lane speed.

4.2.10 ACTION PLAN FOR HOV FACILITIES ON ROUTE 280

In 2019 northbound I-280 between south of Leland Ave. to Magdalena Ave. had 5 lane-miles of degraded HOV lanes during the AM peak period. There was 1.3 lane-miles with 38% of days degraded (slightly degraded), 2.6 lane-lines with 61% of days degraded (very degraded) and 1.1 lane-miles with 86% of days degraded (extremely degraded). In 2021, northbound I-280 within this segment in the AM peak period had 1.9 lane-miles of degraded HOV lanes with 30% of days degraded (slightly degrade), a reduction of 3.1 lane-miles.

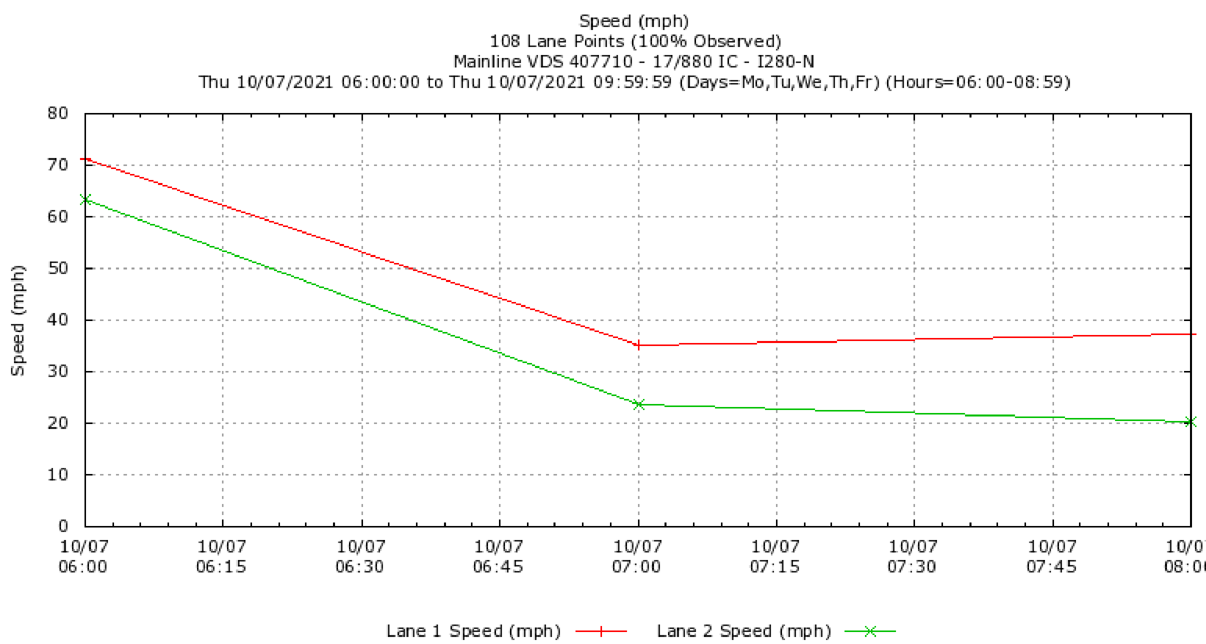
In 2019, southbound I-280 between north of Magdalena Ave. to Leland Ave. had 8.7 lane-miles of degraded HOV lanes during the PM peak period. There was 3 lane-miles with 33.5% of days degraded (slightly degraded), 0.8 lane-miles with 71.4% of days degraded (very degraded) and 4.9 lane-mile with 89.2% of days degraded (extremely degraded). In 2021, northbound I-280 within this segment in the PM peak period had 2.6 lane-miles of degraded HOV lanes with 41.2% of days degraded (slightly degraded). This is a reduction of 6.1 lane-miles.

Reduction in degraded lane-miles was mainly the result of change in commute travel pattern with more people working from home due to the pandemic.

A. ANALYSIS:

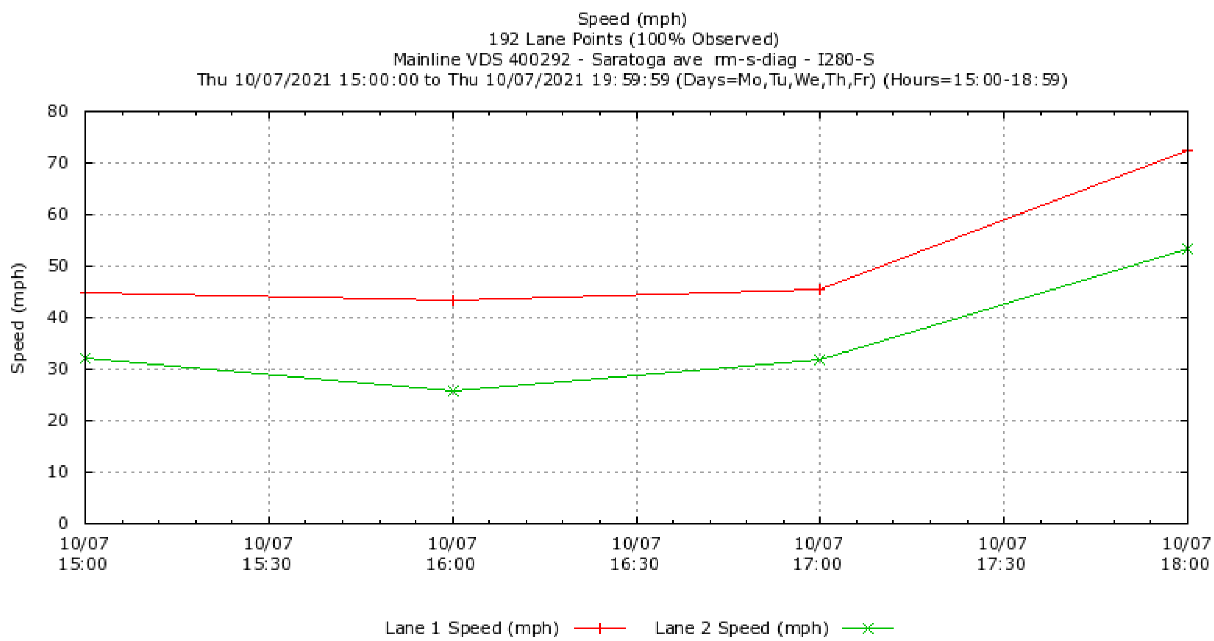
<u>*I-280 northbound, South of Leland Avenue to Magdalena Avenue*</u>

In the AM peak period there is a bottleneck between the SR 17/I-880 I/C and the Saratoga Avenue off-ramp. A queue from this bottleneck extends upstream to the Meridian Avenue on-ramp. The peak period recurrent congestion in the general-purpose lanes reduces HOV lane performance and speed due to the friction factor between these lanes.



<u>*I-280 Southbound, north of Magdalena Avenue to Leland Avenue*</u>

In the PM peak period a bottleneck develops between the Saratoga Avenue on-ramp and the Winchester off-ramp with a queue extending to De Anza Boulevard. A second bottleneck develops downstream of the end of the HOV facility between the 7th Street on-ramp and the Mclaughlin Avenue off-ramp with a queue extending to the SR 17/I-880 interchange. The peak period recurrent congestion in the general-purpose lanes reduces HOV lane performance and speed due to the friction factor between these lanes.



B. REMEDIATION STRATEGIES:

Projects programmed and listed in Envision Silicon Valley Project List dated October 1, 2015, include: A phased strategy for northbound and southbound I-280 for a HOV lane extension between Route 101 and Leland Avenue and Magdalena Avenue and the San Mateo County line. Total cost: $112 million. Then a Magdalena Avenue to San Mateo County Line HOT lane conversion project at a cost of $95 million, Leland Avenue to Magdalena Avenue HOT lane conversion project at a cost of $63 million and Route 101 to Leland Avenue HOT lane conversion project at a cost of $27 million. With conversion to a HOT lane, raising occupancy to HOV 3+ can be considered.

Southbound I-280 HOV lane was extended to 0.3 miles north of the Magdalena Ave. interchange August 2021, to address a bottleneck at Magdalena Ave.

There are no other projects proposed in the near term and therefore a waiver is being requested for this route.

4.2.11 ACTION PLAN FOR HOV FACILITIES ON ROUTE 580

In 2019 I-580 between Hacienda Dr. and Greenville Rd. had 2.8 lane-miles of degraded HOT lanes in the eastbound direction during the PM peak period. There was 1.6 lane-miles with 25% of days degraded (slightly degraded), 0.4 lane-lines with 67% of days degraded (very degraded) and 0.8 lane-miles with 88% of days degraded (extremely degraded). In 2021, eastbound I-580 within this segment in the PM peak period had 1.2 lane-miles of degraded HOT lanes with 18.4% of days degraded (slightly degrade), a reduction of 1.6 lane-miles.

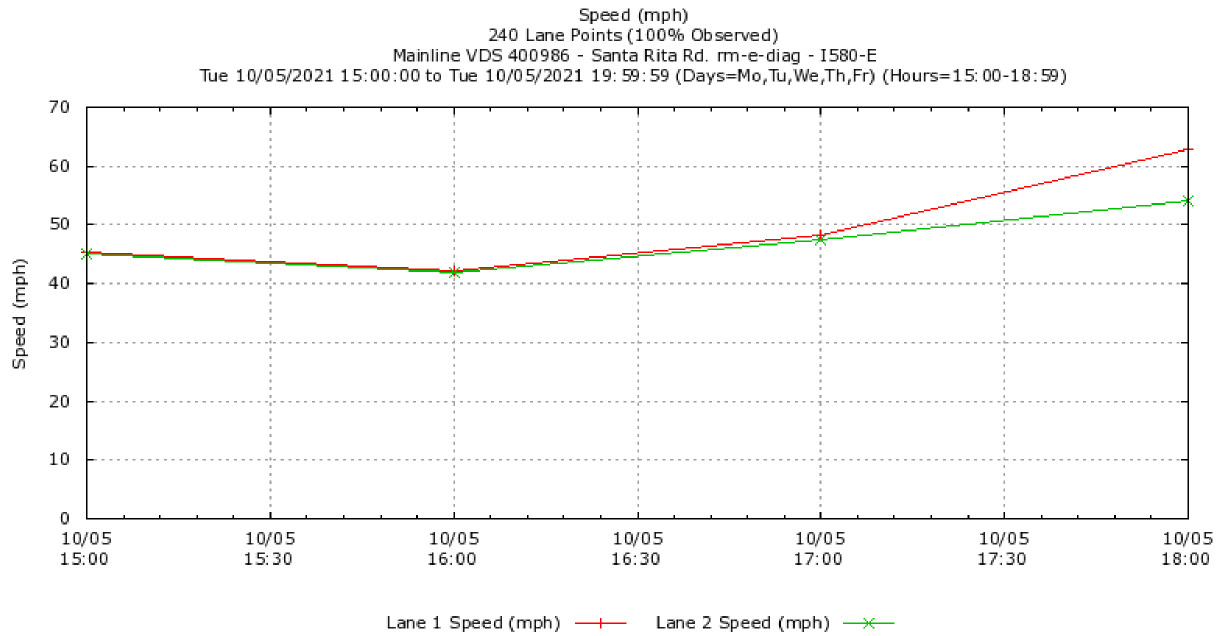
In 2019, I-580 between Greenville Rd. and I-680 had 1.3 lane-miles of degraded HOT lanes with 20% of days degraded (slightly degraded) in the westbound AM peak period. In 2021 no segments of westbound I-580 were degraded.

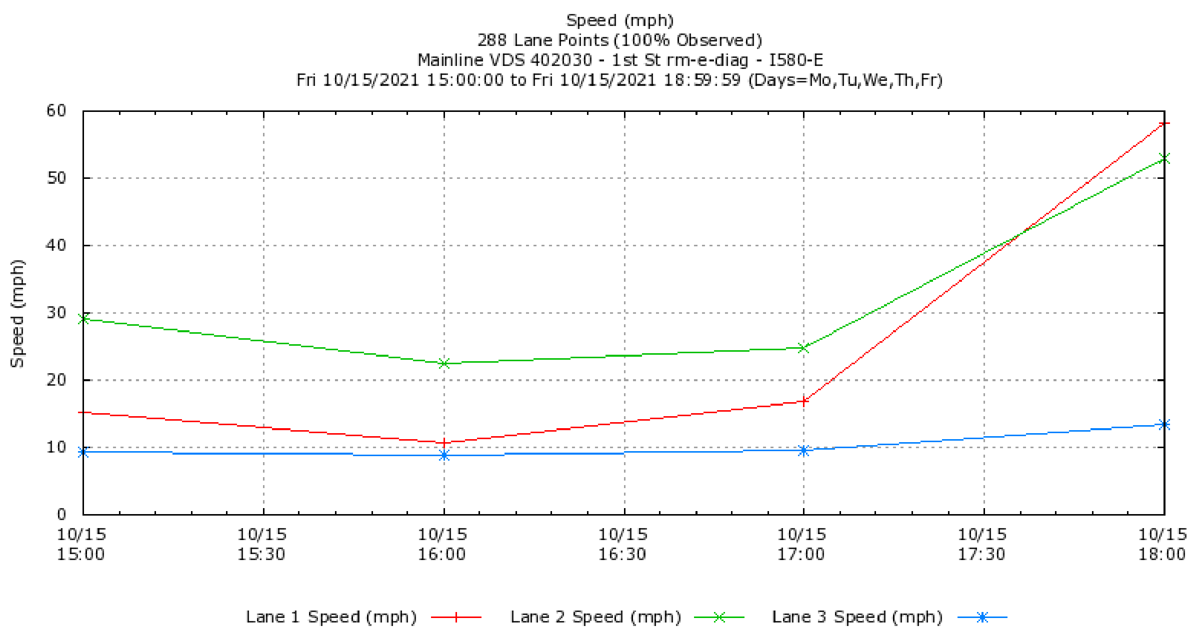
Reduction in degraded lane-miles was mainly the result of change in commute travel pattern with more people working from home due to the pandemic.

A. ANALYSIS:

I-580 eastbound, Hacienda Drive to Greenville Road

There are two primary bottlenecks controlling PM peak period traffic operations on eastbound I-580 within the express lane limits. A bottleneck downstream of the Santa Rita Road on-ramp, which results in queues typically extending west for about 9 miles to the Eden Canyon Road interchange, and a bottleneck downstream of the lane drop near the top of the Altamont Pass grade. Queues from this bottleneck typically extend as far west as the First Street interchange, a distance of about 6 miles. Congestion associated with these bottlenecks results in friction between the express lane and general purpose lanes and reduces express lane speeds.





*Dual HOV lane segment

A second factor contributing to the low express lane speeds approaching the Santa Rita Road bottleneck is express lane demands that are at or near the effective capacity of the single lane portion of the express lane facility, in order to maintain a speed at 45 mph or greater. See express lane and average general purpose lane volumes and speeds in the table below.

Date	Hour	EL Flow	EL Speed	Avg GP Flow	Avg GP Speed
10/4/2021	15:00	1704	38.3	1475	33.8
10/4/2021	16:00	1543	55.4	1602	54.1
10/5/2021	15:00	1779	45.3	1535	36.7
10/5/2021	16:00	1862	42.1	1569	36.9
10/5/2021	17:00	1767	48.2	1530	37.2
10/6/2021	15:00	1661	54.8	1579	47.7
10/6/2021	16:00	1731	52.4	1609	47.9
10/6/2021	17:00	1544	55.1	1355	47.4
10/7/2021	15:00	1725	58.5	1389	53.7
10/7/2021	16:00	1728	55.4	1388	50.9
10/7/2021	17:00	1595	52.0	1425	52.8
10/8/2021	15:00	1802	45.4	1316	40.75
10/8/2021	16:00	1759	46.8	1334	42.6
10/8/2021	17:00	1420	58.8	1449	53.9

B. REMEDIATION STRATEGIES:

There is no short-term solution for the downstream eastbound bottleneck on the Altamont Pass grade. However, Caltrans District 4, Caltrans District 10 and other regional partners have initiated a 580/205 Altamont Pass Corridor Executive Working Group. The purpose of the group and subsequent working teams is to focus on multimodal transportation challenges, improvements along the corridor on commuter and goods movement trips over the Altamont Pass.

Alameda County Transportation Commission (Alameda CTC) plans to upgrade toll system equipment and modify the toll zone limits in 2023. The project is still in progress as Alameda CTC and Caltrans have executed a cooperative agreement for a PEER/Encroachment Permit approval process.

The district will work with Alameda CTC to increase pricing of the lane to better manage the demand.

4.2.12 ACTION PLAN FOR HOV FACILITIES ON ROUTE 680

There are multiple HOV facilities on Route 680 in District 4. HOT lanes operate in Santa Clara and Alameda Counties between State Route 237/Calaveras Boulevard and State Route 84. HOT and HOV lanes also operate in Contra Costa County between Alcosta Boulevard and Marina Vista Avenue.

In 2021 northbound I-680 between South Grimmer Blvd. and SR 84 had 0.2 lane-miles of degraded HOT lanes with 16% of days degraded (slightly degraded) in the PM peak period. This lane did not exist in 2019.

In 2019 southbound I-680 between SR 84 and SR 237 hand 0.9 lane-miles of degraded HOT lanes with 10.3% of days degraded (slightly degraded) in AM peak period. In 2021 in the southbound AM peak period there was no degradation. This was in part due to the removal of the buffer between the HOT lane and the general-purpose lanes and due to the change in commute travel pattern with more people working from home due to the pandemic.

In 2019 northbound I-680 between Alcosta Blvd. and Livorna Rd. had 0.3 lane-miles of degraded HOT lanes with 14% of days degraded (slightly degraded) in the AM peak period. There was no degradation in 2021 on northbound I-680 within this segment in the AM peak period. In 2019 northbound I-680 within this segment in the PM peak period had 4.2 lane-miles of degraded HOT lanes. There was 3.5 lane-miles with 27% of days degraded (slightly degraded) and 0.7 lane-miles with 59% days degraded (very degraded). In 2021 northbound I-680 within this segment had 3.3 lane-miles of degraded HOT lanes with 25% of the days degraded (slightly degraded) in the PM peak period. This was a reduction of 0.9 lane-miles. Reduction in degraded lane-miles was mainly the result of change in commute travel pattern with more people working from home due to the pandemic.

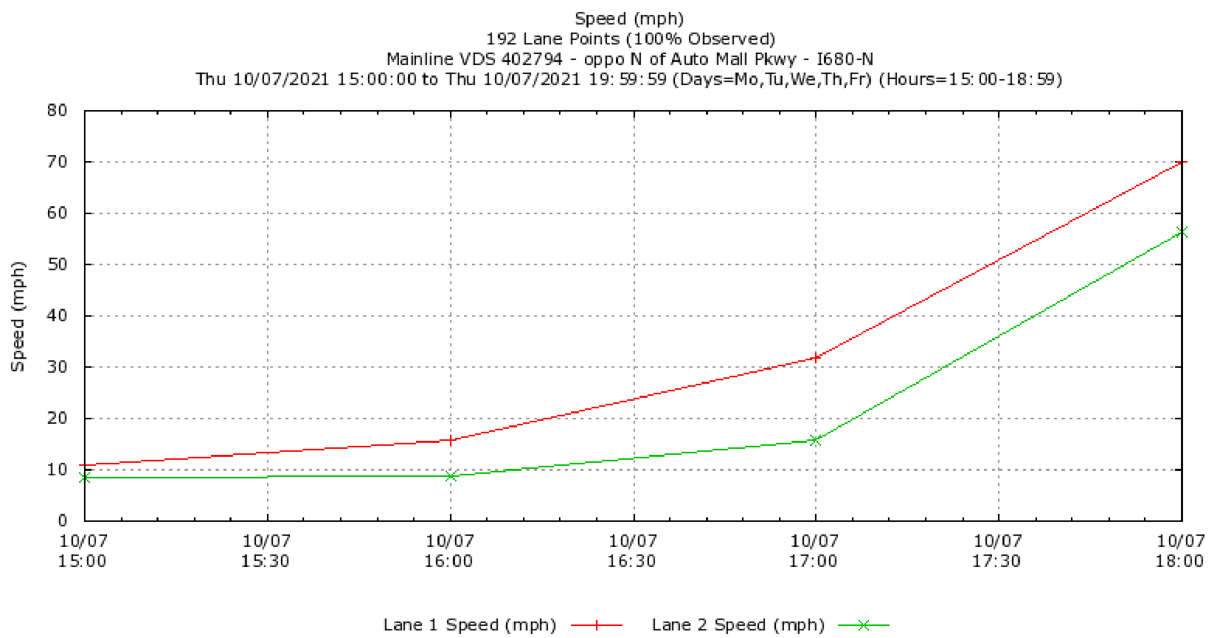
In 2019 southbound I-680 between Marina Vista Avenue and Treat Blvd. and between Rudgear Rd. and Alcosta Blvd. had 2.1 lane-miles of degraded Managed lanes in the AM peak period. There was 0.7 miles with 43.8% of days degraded (slightly degraded), 1.0 lane-mile with 64.3% of days degraded (very degraded) and 0.4 lane-miles with 82.2% of days degraded (extremely degraded). In 2021 southbound I-680 within this segment had 0.6 lane-miles of degraded HOT lanes in the AM peak period, a reduction of 1.5 lane-miles. There was 0.3 lane-miles with 32% of days degraded (slightly degraded) and 0.3 lane-miles with 63% of days degraded (very degraded). The reduction in degraded lane-miles was due to the conversion of the northern HOV lane into a HOT lane and closing the gap between Treat Blvd. and Rudgear Rd. along with the change in commute travel pattern with more people working from home due to the pandemic.

A. ANALYSIS:

The HOV facilities on Route 680 underwent significant operational changes in 2020 as mentioned in the 2020 California High Occupancy Vehicle Facilities Degradation Report. A new northbound HOT (Express lane) facility was opened to traffic between South Grimmer Boulevard and State Route 84. This lane is currently signed as an Express lane in "HOV Only" mode from 5:00 AM to 8:00 PM. In addition, the southbound Express lane between State Route 84 and State Route 237 was converted from a limited access facility to a continuous access facility and has since operated in "HOV only" mode also. Tolling of these facilities is currently scheduled to begin in Winter 2023. In 2020, a gap in the southbound direction between Treat Boulevard and Rudgear Road was closed by adding a HOT lane, and the HOV lane between Marina Vista Avenue and Treat Boulevard was converted to HOT operations to provide one continuous HOT lane facility in the southbound direction between Marina Vista Avenue and Alcosta Boulevard. The HOT lane on southbound I-680 between Marina Vista Avenue and Rudgear Road originally was opened in "HOV Only" mode and started collecting tolls in August 20, 2021.

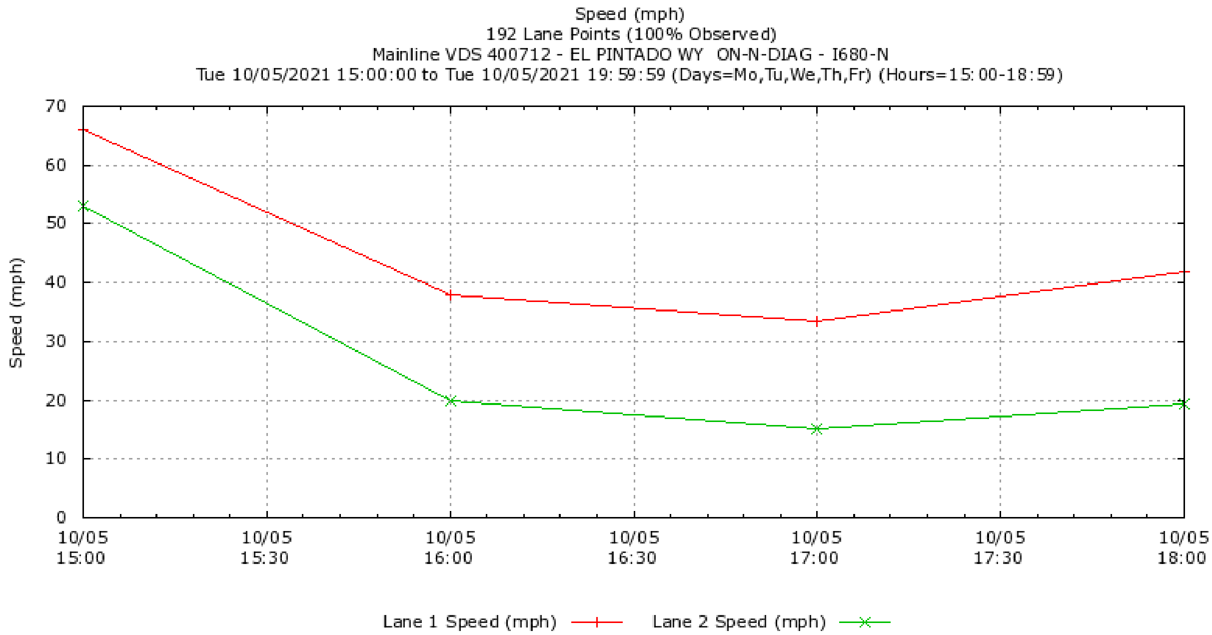
I-680 Northbound, South Grimmer Boulevard to SR 84

A recurrent northbound PM peak period bottleneck typically develops north of the Auto Mall Parkway on-ramp and results in minor congestion limited to the interchange area. Managed lane degradation is due to friction between managed lane traffic and slower moving general purpose lane traffic.



<u>*I-680 Northbound, Alcosta Boulevard to Marina Vista Avenue*</u>

There are two managed lane facilities on northbound Route 680 in Contra Costa County, a HOT lane facility between Alcosta Boulevard and Livorna Road and an HOV lane facility between State Route 242 and Marina Vista Avenue, leaving a gap in the managed lanes between Livorna Road and SR 242. A significant northbound PM peak period bottleneck develops within the manage lane gap between the Lawrence Way on-ramp and the Treat Boulevard off-ramp. Queues and slow speeds approaching this bottleneck regularly extend south nearly 10 miles to south of the Sycamore Valley Road interchange. Friction between traffic in the continuous access HOT lane and traffic in the slower moving general-purpose lanes results in reduced HOT lane speeds and performance. A second contributing factor to degradation is the in-queue weaving that takes place between HOT lane traffic and general-purpose lane traffic near the northern end of the HOT lane at Livorna Road.



I-680 Southbound, Marina Vista Avenue to Alcosta Boulevard

In the southbound direction, a recurrent AM peak period bottleneck develops downstream of the Treat Boulevard on-ramp. Queues approaching this bottleneck extend north about 5 miles to the area of the Concord Avenue interchange. HOT lane degradation occurs near the end of the buffer separation just south of the Treat Boulevard on-ramp where vehicles destined for westbound Route 24 can exit the HOT lane and vehicles entering southbound Route 680 between State Route 242 and Treat Boulevard can enter the lane. This weaving results in slower HOT lane speeds for a short distance.

B. REMEDIATION STRATEGIES:

I-680 Northbound, South Grimmer Boulevard to SR 84

This HOT lane is currently operating in "HOV 2+ Only" mode with tolling expected to begin in Winter 2023. Once tolling is implemented Clean Air Vehicles will be tolled at a discounted rate. In addition, toll revenue will be available to fund increase enforcement along this corridor. It is recommended that the need for remedial action be deferred until after tolling begins.

I-680 Northbound and Southbound, Alcosta Boulevard to Marina Vista Avenue

Innovate 680, sponsored by the Contra Costa Transportation Authority, is a comprehensive initiative plan that includes completion of the northbound HOT lane network as well as other northbound improvements including part time transit lanes, shared mobility hubs and a corridor adaptive ramp metering project between the Bollinger Canyon Road and Ygnacio Valley Road interchanges. The HOT lanes completion and adaptive ramp metering projects are currently in PA&ED phases with estimated costs of $358M and $25M, respectively. Both projects are expected to be implemented in 2027.The part time transit lane on northbound Route 680 is currently in the planning phase with an estimated cost of about $20M with an implementation date of 2025. Smart mobility hubs project is in the earlier stages of planning. A concept plan is expected to be completed in 2022 and implementation and phasing plans are still to be developed.

Although Innovate 680 initiative does include some longer-range improvements for southbound Route 680, such as corridor adaptive ramp metering and smart mobility hubs, there are no short-term improvements identified to address the degradation at the end of the HOT lane buffered section. Potential short-term measures could include shortening the buffered section by relocating it further north, which would result in similar conditions further upstream, or extending the buffer south. The latter, however, would prevent access from the HOT lane to westbound State Route 24 and prohibit HOT lane access for vehicles entering southbound Route 680 between State Route 242 and Treat Boulevard until after the State Route 24 interchange.

4.2.13 ACTION PLAN FOR HOV FACILITIES ON ROUTE 880

There are multiple managed lane facilities on Route 880 in District 4. HOT lanes operate in Santa Clara and Alameda Counties between Hegenberger Road and SR 237. HOV lanes also operate in Alameda and Santa Clara Counites at the north end of the route and between south of SR 262 and US 101.

In 2019 I-880 between Old Bayshore Hwy. and south of SR 238 had 0.2 lane-miles of degraded HOV lanes with 20% of days degraded (slightly degraded) in the northbound AM peak period. There was no degradation in 2021 on northbound I-880 within this segment in the AM peak period. In 2019 northbound I-880 within this segment in the PM peak period had 7.2 lane-miles of degraded HOV lanes. There was 1.5 lane-miles with 32% of days degraded (slightly degraded), 0.8 lane-miles with 52% days degraded (very degraded) and 4.9 lane-miles with 90% of days degraded (extremely degraded). In 2021 northbound I-880 within this segment had 3.0 lane-miles of degraded HOT lanes in the PM peak period, a reduction of 4.2 lane-miles. There was 2.4 lane-miles with 25.7% of the days degraded (slightly degraded) and 0.6 lane-miles with 82% of days degraded (extremely degraded).

In 2019 I-880 between Hegenberger Rd. and US 101 had 10 lane-miles of degraded HOV lanes in the southbound AM peak period. There was 5.3 lane-miles with 31.5% of days degraded (slightly degraded), 3.0 lane-miles with 63.1% of days degraded (very degraded) and 1.7 lane-miles with 81.7% of days degraded (extremely degraded). In 2021 southbound I-880 within this segment had 2.4 lane-miles of degraded HOT lanes with 29.7% of days degraded (slightly degraded) in the AM peak period. This was a reduction of 7.6 degraded lane-miles. In 2019 southbound I-880 within this segment in the PM peak period had 5.6 lane-miles of HOV lanes degraded. There was 3.4 lane-miles with 25.9% of days degraded (slightly degraded), 0.5 lane-miles with 61.2% of days degraded (very degraded) and 1.7 lane-miles with 85.4% of days degraded (extremely degraded). In 2021 southbound I-880 within this segment had 1.5 lane-miles of degrade HOV lanes in the PM peak period. This was a reduction of 4.1 degraded lane-miles. There was 0.9 lane-miles with 23.7% of days degraded (slightly degraded) and 0.6 lane-miles with 50% of days degraded (very degraded).

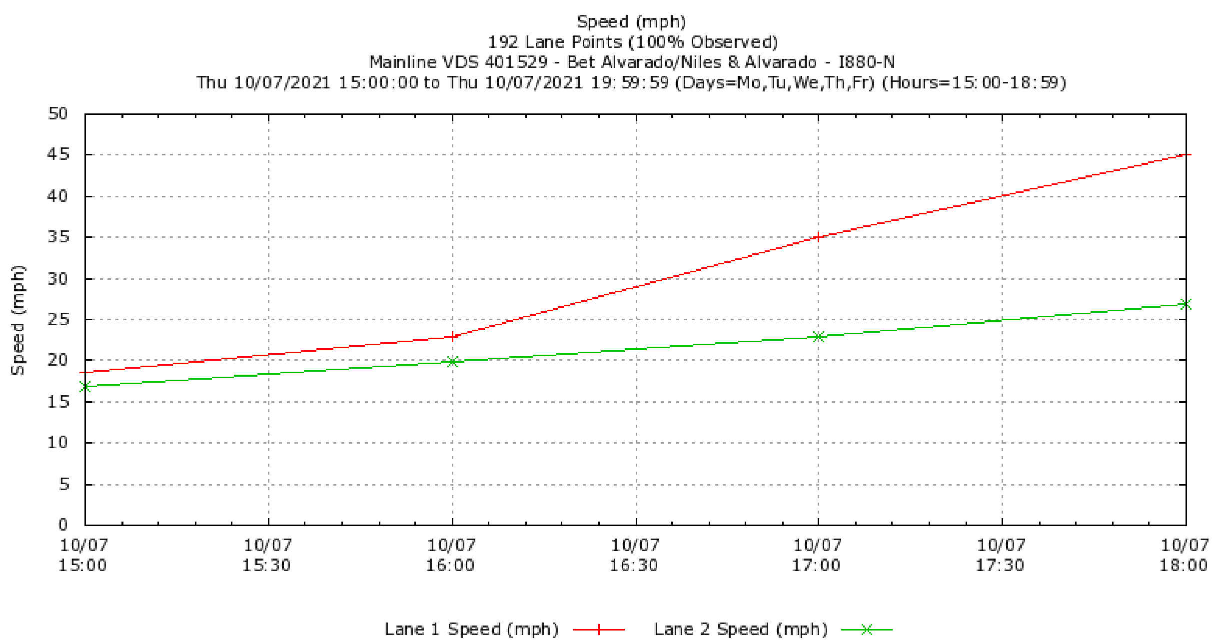
The reduction in degraded lane-miles was due to the conversion of the northern and southbound HOV lane between Hegenberger Rd. and SR 237 into a HOT lane, raising occupancy to HOV 3+ and buffer separating the HOT lane from the general-purpose lanes on segments of the corridor, along with the change in commute travel pattern with more people working from home due to the pandemic.

A. ANALYSIS:

The HOV facilities on Route 880 underwent significant operational changes in 2020 as mentioned in the *2020 California High Occupancy Vehicle Facilities Degradation Report*. These facilities were converted from HOV to HOT operation, occupancy requirements were increased, and stripped buffers were added between the HOT lane and the general purpose lanes along portions of both northbound and southbound Route 880. The HOV lane was converted to a HOT 3+ lane with HOV 2 and Clean Air Vehicles charged a discounted toll. The limits of this HOT lane are between south of SR 262 to south of SR 238 on northbound I-880 with the segment between Old Bayshore Highway and south of SR 262 remaining an HOV 2+ lane. In addition there are two separate HOV lanes approaching I-80, West Grand to eastbound I-80, and the San Francisco Oakland Bay Bridge (SFOBB), 16th Street to the SFOBB metering lights, at the north end of the corridor. In the southbound direction, the HOT lane limits are from Hegenberger Road to the SR 237 interchange. From the SR 237 interchange to the US 101 interchange the lane continues as an HOV 2+ lane.

I-880 northbound, Old Bayshore Hwy. and South of SR 238

Although several bottlenecks develop along northbound I-880 during the PM peak period, the primary bottleneck controlling traffic operations along the corridor develops between the Winton Avenue on-ramp and the A Street off-ramp near the northern end of the express lane corridor. Queues approaching this bottleneck typically extend about 10 miles upstream to south of the Thornton Avenue interchange. Friction between express lane and general purpose lane vehicles results in degraded express lane operations in the open access portions of the facility between the Stevenson Boulevard and the Whipple Road interchanges. Additional express lane degradation develops near the end of the express lane south of State Route 238, where general-purpose lane vehicles merge into the left freeway lane.

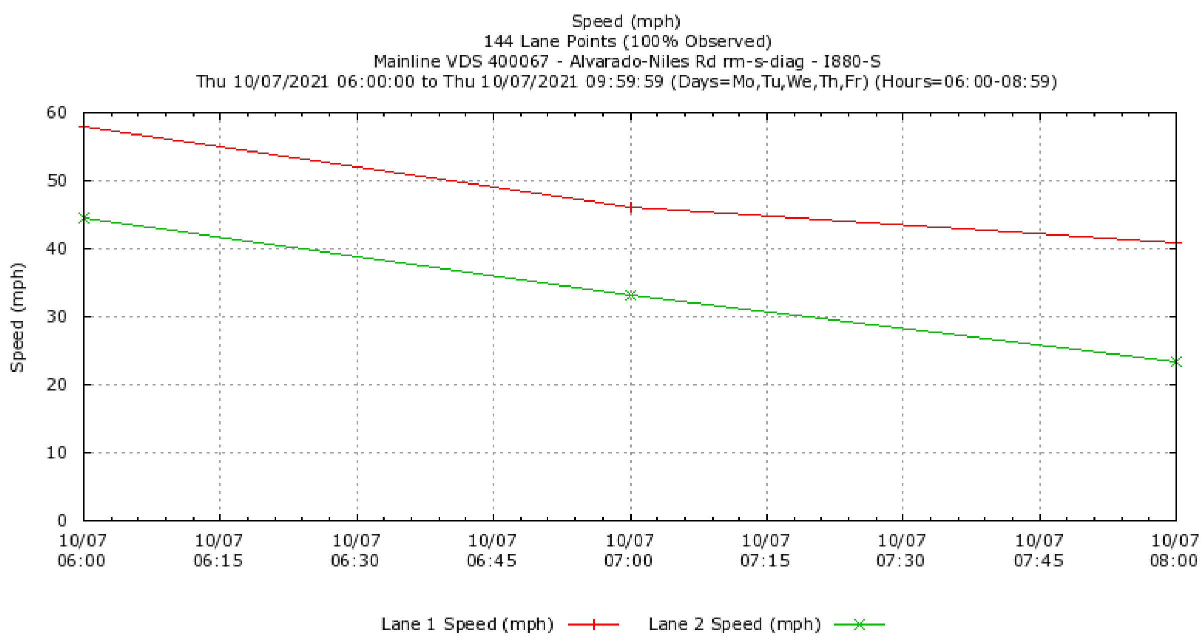


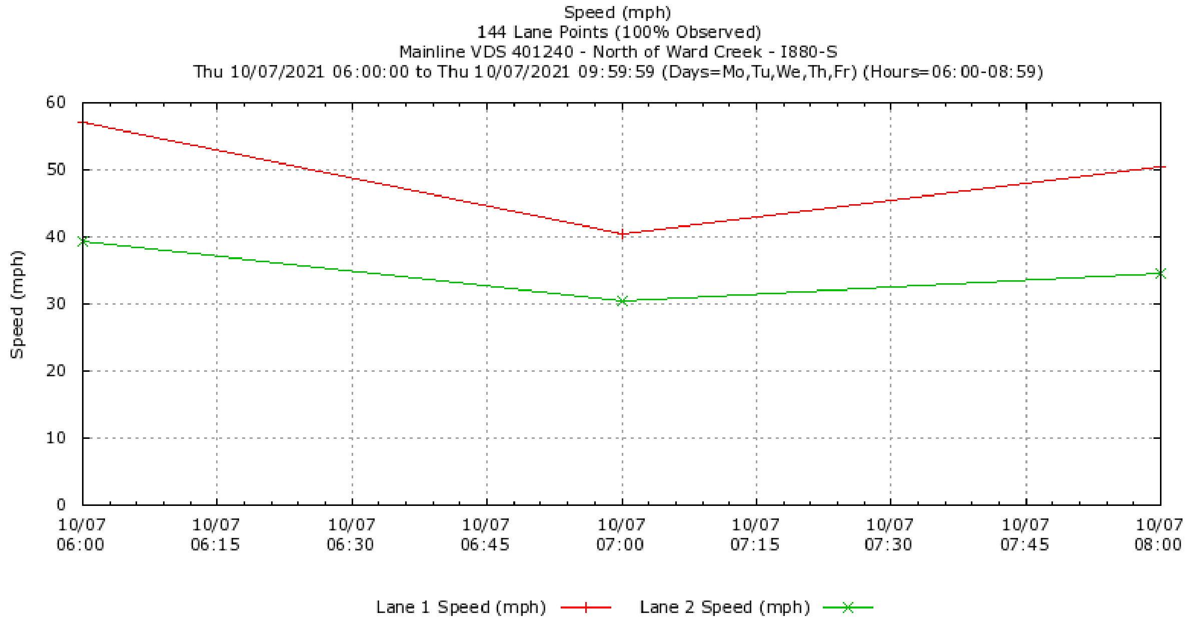
Another factor contributing to the low express lane speeds is express lane demands that are frequently at or near the effective capacity of the express lane facility in order to maintain a speed of 45 mph or greater. See the table below for express lane and average general purpose lane volumes and speeds in the area of the Alvarado-Niles Road interchange.

Date	Time	EL Flow	EL Speed	Avg GP Flow	Avg GP Speed
10/7/2021	17:00	1641	17.6	1291	27.9
10/7/2021	18:00	1796	29.5	1297	29.8
10/7/2021	19:00	1870	52.2	1387	47.9
10/8/2021	17:00	1539	19.8	1287	29.3
10/8/2021	18:00	1749	46.9	1388	32.3
10/8/2021	19:00	1576	53.1	1132	61.4
10/13/2021	17:00	1575	41.8	1414	21.4
10/13/2021	18:00	1505	45.5	1383	37.2
10/13/2021	19:00	1699	60.1	1340	56.8
10/14/2021	17:00	1522	32.2	1245	29.5
10/14/2021	18:00	1571	48.2	1258	39.0
10/14/2021	19:00	1681	59.0	1317	52.1
10/15/2021	17:00	1516	19.1	1345	31.4
10/15/2021	18:00	1518	18.9	1280	26.2
10/15/2021	19:00	1614	40.5	1321	35.0

I-880 southbound, Hegenberger Road to US 101

Multiple bottlenecks develop on southbound Route 880 during the AM peak period; however, two primary bottlenecks generally control traffic operations at the height of the peak. A northern bottleneck between the A Street on-ramp and the Winton Avenue off-ramp and a southern bottleneck between the Stevenson Boulevard on-ramp and the Auto Mall Parkway off-ramp. Queues associated with the northern bottleneck typically extend north for about 2 miles through the State Route 238 interchange. Queues from the southern bottleneck extend as far north as the State Route 92 interchange, a distance of about 12 miles. Friction between express lane and general purpose lane vehicles results in degraded express lane operations in the open access portions of the facility from the State Route 92 interchange to south of the Tennyson Road interchange and south of the Whipple Road interchange. It should also be noted that degradation did occur in the buffered express lane segment from south of the Tennyson Road interchange to north of the Whipple Road interchange. This, however, may have been due to the lane split on southbound I-880 during reconstruction of the Patterson Sough bridge deck to the south, which resulted in increased weaving and congestion upstream during a portion of the data collection period.



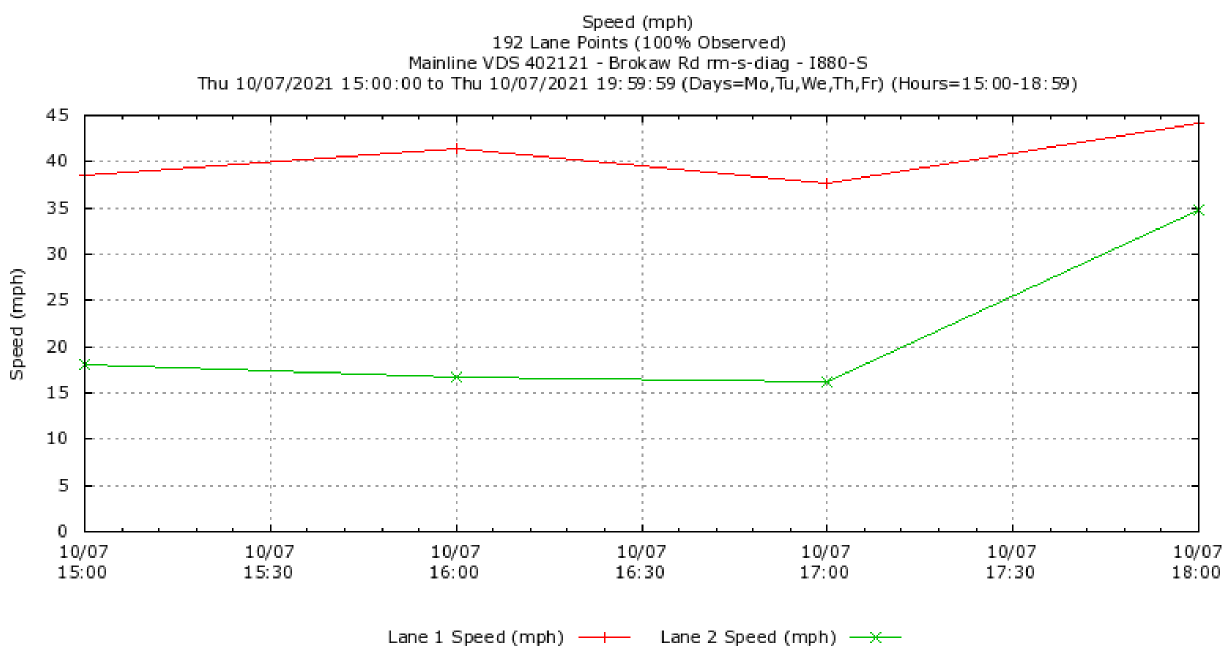


Another factor contributing to the low express lane speeds is express lane demands that are frequently at or near the effective capacity of the express lane facility in order to maintain a speed of 45 mph or greater. See the table below for express lane and average general purpose lane volumes and speeds in the area of the Alvarado-Niles Road interchange.

Date	Time	EL Flow	EL Speed	Avg GP Flow	Avg GP Speed
10/4/2021	06:00	1723	43.8	1273	44.1
10/4/2021	07:00	1419	23.5	1293	27.44
10/4/2021	08:00	1331	21.9	1143	23.3
10/4/2021	09:00	1622	58.7	975	53.1
10/5/2021	06:00	1689	63.2	1182	54.5
10/5/2021	07:00	1552	33.3	1336	30.9
10/5/2021	08:00	1337	22.0	1168	23.5
10/5/2021	09:00	1560	40.6	1016	42.8
10/6/2021	06:00	1603	34.9	1313	36.6

10/6/2021	07:00	1505	33.0	1365	35.9
10/6/2021	08:00	1030	15.4	956	19.1
10/6/2021	09:00	1438	43.8	942	41.0
10/7/2021	06:00	1606	47.0	1199	46.4
10/7/2021	07:00	1547	34.1	1338	34.8
10/7/2021	08:00	1367	23.9	1191	26.6
10/7/2021	09:00	1543	55.2	963	50.7
10/8/2021	06:00	1733	56.6	1167	50.1
10/8/2021	07:00	1505	37.9	1289	36.1
10/8/2021	08:00	1445	27.6	1178	31.1
10/8/2021	09:00	1727	62.5	1018	51.4

On southbound I-880 in the PM peak period a bottleneck develops between the North First Street diagonal on-ramp and the Coleman Avenue off-ramp. This bottleneck along with a right lane overload due to the queue on the southbound US 101 loop off-ramp spilling back onto southbound I-880 causes a queue to extend upstream to the Montague Expwy interchange.



B. REMEDIATION STRATEGIES:

I-880 northbound, south of SR 262 to south of SR 238

Adaptive ramp metering is being implemented between Mowry Avenue and State Route 238 in May 2022. This project will improve general purpose speeds within those limits and reduce friction between HOT lane and general-purpose lane traffic.

The I-880/Winton Avenue/A Street Interchange Improvements project will provide a northbound auxiliary lane between the Winton Avenue and the A Street interchanges, reducing the congestion associated with the primary corridor bottleneck between the interchanges and further reducing friction between HOT lane and general-purpose lane traffic.

The District will work with the Metropolitan Transportation Commission to increase pricing of the express lane during peak traffic periods to better manage demand.

I-880 southbound, Hegenberger Road to US 101

Adaptive ramp metering is being implemented between Mowry Avenue and State Route 238 in May 2022. This project will improve general-purpose speeds within those limits and reduce friction between HOT lane and general-purpose lane traffic.

The I-880/Winton Avenue/A Street Interchange Improvements project will provide a southbound auxiliary lane between the Winton Avenue and the A Street interchanges, reducing the congestion associated with the primary corridor bottleneck between the interchanges and further reducing friction between HOT lane and genera-purpose lane traffic.

MTC conducted a pilot project (Video Occupancy Detection) to increase enforcement on Route 880; this pilot was completed in May 2018. Results showed an accuracy rate at about 75 percent. This was too low to use as an occupancy enforcement tool. MTC is also exploring additional technology for occupancy enforcement, including mobile based applications which could help reduce degradation. The District will work with the Metropolitan Transportation Commission to increase pricing of the express lane during peak traffic periods to better manage demand.

4.3. DISTRICT 5 2021 DEGRADATION ACTION PLAN

4.3.1 SUMMARY OF DEGRADATION ON HOV FACILITIES IN DISTRICT 5

APPENDIX A provides the list of degraded facilities in District 5 that were identified in the *2021 California High Occupancy Vehicle Facilities Degradation Report*. The speed and degradation profiles for each degraded facility are provided in APPENDIX B.

4.3.2 ACTION PLAN FOR HOV FACILITIES ON ROUTE U.S. ROUTE 101

A. ANALYSIS:

Northbound U.S. Route 101 in Santa Barbara County was identified as having a slightly degraded HOV facility between the Ventura County Line and Bailard Avenue in 2021. The analysis conducted by District 5 identified a common cause resulting in the slight degradation of the Northbound U.S. Route 101 HOV Facility in Santa Barbara County in the Year 2021. The Degradation of the NB U.S. Route 101 HOV Facility in 2021 was due to construction activities coupled with a three to two lane drop bottleneck which produced congestion and slow traffic conditions. Our analysis concluded that the vehicle demand of 3,176 (1,588 VPHPL) vehicles per hour during the AM peak hour commute period exceeded the construction zone capacity of 2,660 vehicles per hour (1,330 VPHPL) resulting in a 1.28-mile length of vehicle queue. Within the existing three lane facility, the U.S. Route 101 Northbound HOV Facility was carrying 1,080 vehicles per hour during the AM peak hour commute period which is under the established threshold of 1,650 vehicles per hour. To ensure that HOV lanes continue to offer a time-savings incentive to carpool, Caltrans has traditionally set 1,650 vehicles per hour as the maximum capacity of HOV lanes.

B. REMEDIATION STRATEGIES:

In June 2022, District 5 completed Phase 4A construction of 5.28 additional lane-miles of HOV lanes on U.S. Route 101 in Santa Barbara County between the Ventura County Line (PM R0.00) and Carpinteria Avenue (PM 4.34). Of the 5.28 additional lane-miles, 3.0 lane-miles were added in the northbound direction of travel. The additional lane-miles of HOV lanes are open for use as of June 2022 and will remedy the slight degradation experienced by road users in 2021. It should be noted that District 5 currently has three additional phases (4B, 4C, & 4D) encompassing 14.9 additional HOV lane-miles (7.5 NB & 7.4 SB) under construction or in the late stages of Plans, Specifications, and Estimates (PS&E) within this U.S. Route 101 corridor. The anticipated completion date of these 14.9 additional lane-miles is slated for July 2026.

As noted above, Phase 4A was completed in June 2022. The directional breakdown of new HOV lane-miles open to traffic is provided below.

- District 5 has increased the HOV lane-miles in the northbound direction of travel by 3.005 lane miles (265%). Total number of northbound HOV lane-miles in operation as of July 1, 2022, is 4.14 lane-miles.
- District 5 has increased the HOV lane-miles in the southbound direction of travel by 2.271 lane miles (118%). Total number of southbound HOV lane-miles in operation as of July 1, 2022, is 4.19 lane-miles.
- District 5 has increased the HOV lane-miles in both directions of travel by 5.276 lane miles (173%). Total number of northbound and southbound HOV lane-miles in operation as of July 1, 2022, is 8.33 lane-miles.

4.4. DISTRICT 7 2021 DEGRADATION ACTION PLAN

4.4.1 SUMMARY OF DEGRADATION ON HOV FACILITIES IN DISTRICT 7

APPENDIX A provides the list of degraded facilities in District 7 that were identified in the 2021 California High Occupancy Vehicle Facilities Degradation Report and Action Plan. The speed and degradation profiles for each degraded facility are provided in APPENDIX B.

4.4.2 DISTRICT-WIDE APPROACH TO HOV/HOT LANE DEGRADATION

During 2021, HOV degradation in District 7 was reduced on Routes 5, 91, 105, 118, 134, 405, and 605, compared to 2019 (Appendix D, Table 4.4-1). Although the Managed Lanes Branch within the Office of System Performance collaborated and coordinated with internal and external partners to bring awareness concerning degradation causes and potential remedial strategies, District 7's HOV/HOT lane operations continue to be significantly impacted by common causes, which have been documented in previous degradation action plans. Poor detection has also been an area of concern. However, this matter should steadily improve over time, as the Division of Traffic Operations is seeking to establish a new Office of Transportation Management Systems (TMS) which will focus on improving the health of the various TMS elements within District 7. Below are some of the aforementioned common causes:

- Single occupant vehicles (SOV) utilizing the Clean Air Vehicle (CAV) Decal program. The CAV decal rate (CAV volume/total HOV volume) in HOV lanes continues to increase each year. Presently, the rate exceeds 10 percent on Routes 57, 60, 91,134, 210, and 405. Other routes are approaching 10 percent. The detailed future HOV degradation approaches are discussed in Appendix C.

- Congestion on the general-purpose (GP) lanes causes "friction" between GP and HOV lanes [(HOV motorists tend to drive less than 45 mph (federal HOV degradation minimum threshold), next to very congested/stopped GP lane traffic)], which causes slow speeds in the HOV lanes. In fact, the Georgia Institute of Technology, states that "A friction factor may exist along the boundary between two adjacent lanes when a speed differential exists between them. If drivers in the faster-moving lane anticipate that drivers in the slower-moving lane may move into their lane (i.e., in front of them), drivers in the faster-moving lane may leave larger reaction gaps between their vehicle and the vehicle in front of them to reduce the likelihood of collision. Again, the lower traffic density for a given speed would reduce traffic flow and lower the effective capacity of the roadway (Guin, Hunter, and Guensler, 2008)." (Link provided in Appendix C).

- A lack of speed harmonization at bottleneck locations have also contributed to degradation (Detailed future approaches are discussed in Appendix C).

- Data coverage and quality issues occur district wide. District 7's PeMS data indicates that only 39% of the detection sensors are "healthy" overall. Several HOV facilities only have a few "healthy" detection sensors. The extreme cases are SR-170 and SR-57, and the Expresslanes on I-110 with one functional sensor in 2021. The Degradation and Action Plan Reports use PeMS as the sole source of data.

- Degradation worsened after the HOV lanes were converted to Expresslanes. In fact, over 70 and 84 percent of vehicles found in the I-10 and I-110 Expresslanes respectively, are single occupant vehicles. Approximately 30 to 60 percent of users (occupancy violators) are not setting the transponder correctly, to the correct number of people in the vehicle. As the owner of state highways, Caltrans has only an advisory role on these Expresslanes. Pursuant to California Senate Bill 1298 (SB 1298) approved on September 21, 2014, LA Metro has the authority to operate Expresslanes on the I-10 (Alameda Street to Route 605) and on I-110 (Adams Boulevard to Harbor Gateway Transit Center) indefinitely.

4.4.3 ACTION PLAN FOR HOV FACILITIES ON ROUTE 5

A. ANALYSIS

- Afternoon peak period recurrent extreme congestion (degradation) in all lanes reduces northbound HOV lane performance at Branford St. (PM 153.4) and Roxford St. (PM 159.4). The rest of the northbound HOV lane was slightly degraded. The average volume is 1,534 vehicles/hour in the HOV lane during the 1-hour-peak period. The average volume of the GP fast lane (#1 lane) is 1,600 vehicles/hour, but the GP slow lanes' volumes and speeds (#3, 4, and 5 lanes) are less and slower than the HOV lane.

- Northbound GP Lane drops at San Fernando Mission Blvd (PM 156.0), causes a bottleneck.

- Vehicle weaving conflicts along northbound ingress/egress (I/E) locations (6 I/E's in the southbound direction and 7 I/E's in the northbound direction) due to congestion in the GP lane and HOV direct connector traffic from Route 170.

- Volume exceeds capacity north of the junction of Route 405 (PM 158.5). The entire volume of the northbound Route 405 merges onto the Route 5 freeway. This merging point shows the highest percentage of degradation on the northbound HOV lane due to the volume of vehicles.

- High truck volumes (6.3-8.7%) from Westbound Route 210 merging onto Northbound Route 5, cause degradation. The NB truck lane begins at approximately PM 160.0 and rejoins the GP lanes at approximately PM 162.6.

- CAV decal rate has increased to 6 percent. The solo violation rate has increased to 8.8 percent.

- The right lane drops just upstream of the end of the northbound HOV lane. Then within one mile from the end of HOV lane, the separate designated truck route merges into the northbound Route 5.

- Morning peak period recurrent congestion in all lanes reduces southbound HOV lane performance. HOV lane was slightly and very degraded between Osborne St. and Paxton St (PM 154.0-155.7). Vehicle weaving conflicts at ingress/egress locations due to congestion in the GP lane. The average percentage of degraded days (speeds below 45 mph) southbound during the AM 3-hour peak period decreased by 6.6% compared to 2019 (Appendix D, Table 4.4-1).

- There is no HOV lane detection on this segment (PM 148-153). Consequently, District 7 conducts annual manual counts at PM 151.758 (Peoria St.). The AM and PM peak hour flows were 1,090 and 1,106 vehicles/hour respectively for 2021, which were observed to be at free-flow conditions. The detailed information is contained in the 2021 Caltrans District 7 Managed Lanes Annual Report.

Figures 4.4-1 and 4.4-2 provide plots of northbound HOV and GP lane speeds during the fourth quarter of 2021. Figures 4.4-3 and 4.4-4 provide plots of southbound HOV and GP lane speeds during the same quarter. Note that HOV lane detection does not cover the entire length of the HOV facility.

FIGURE 4.4-1. AVERAGE HOV LANE SPEEDS – NORTHBOUND ROUTE 5, Q4 2021

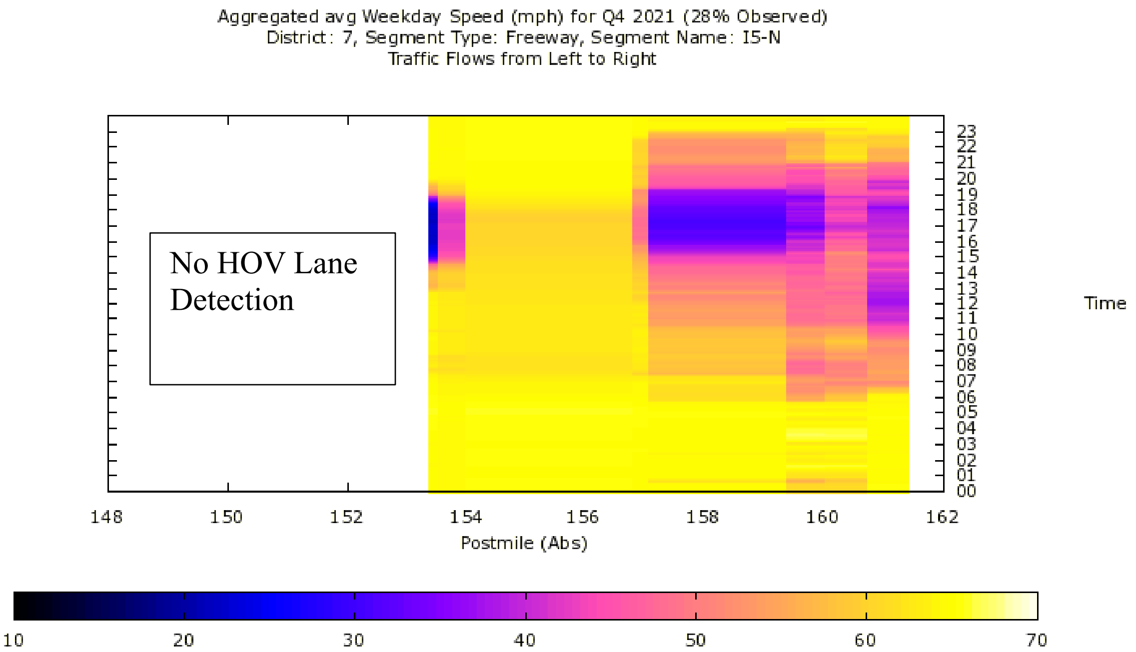


FIGURE 4.4-2. AVERAGE GP LANE SPEEDS – NORTHBOUND ROUTE 5, Q4 2021

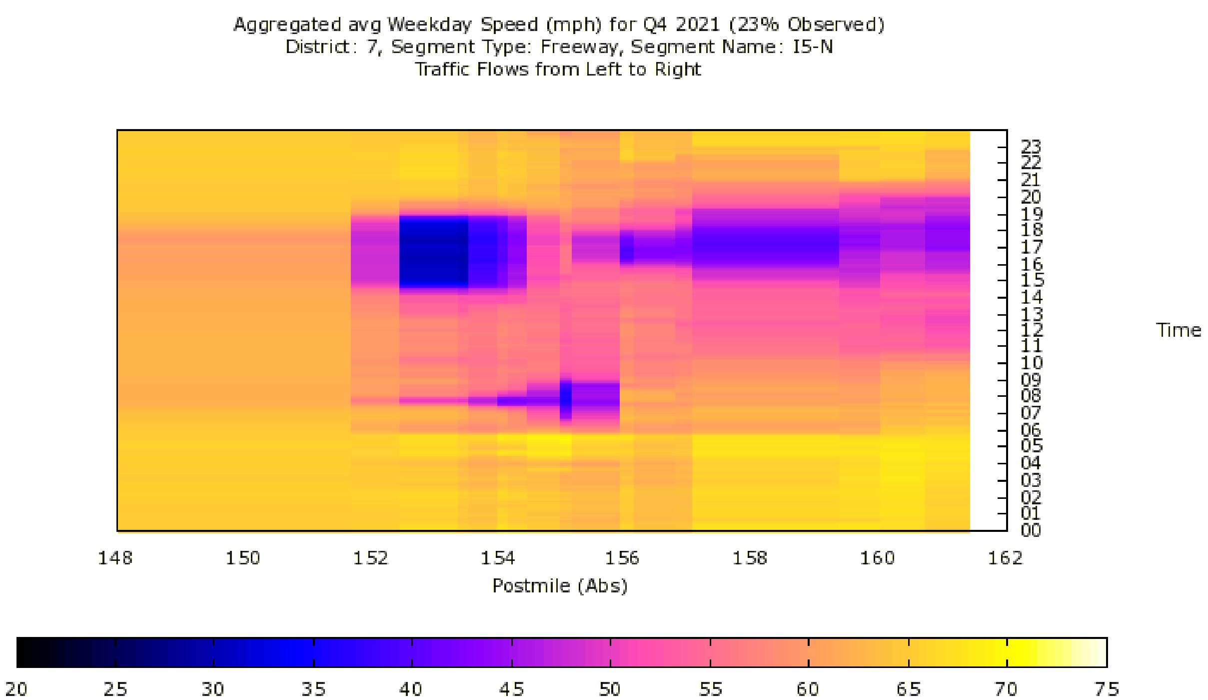


FIGURE 4.4-3. AVERAGE HOV LANE SPEEDS – SOUTHBOUND ROUTE 5, Q4 2021

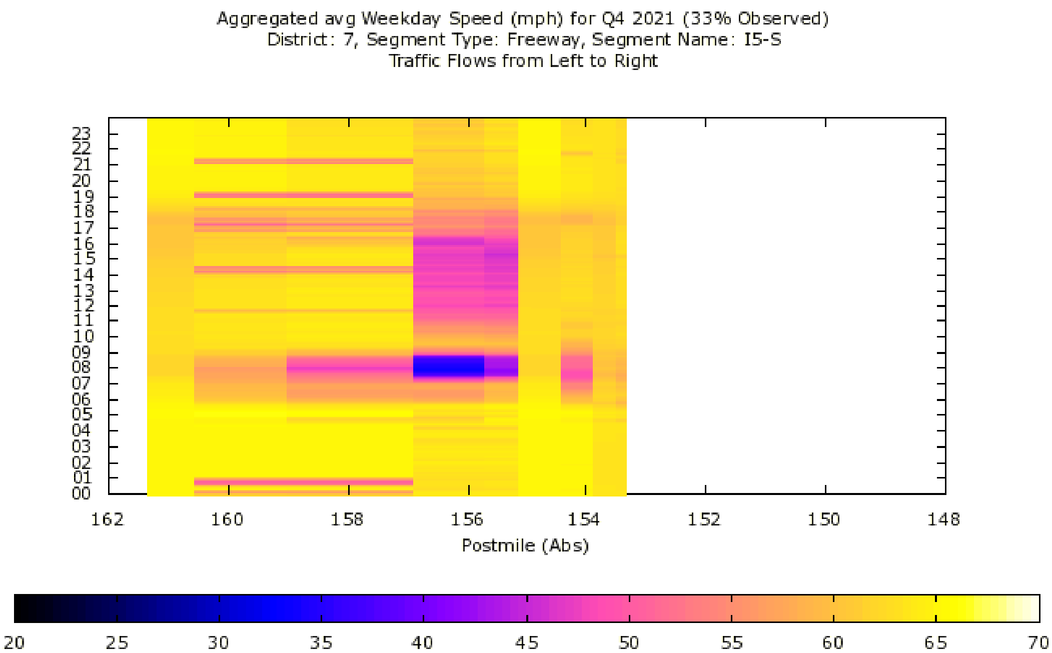
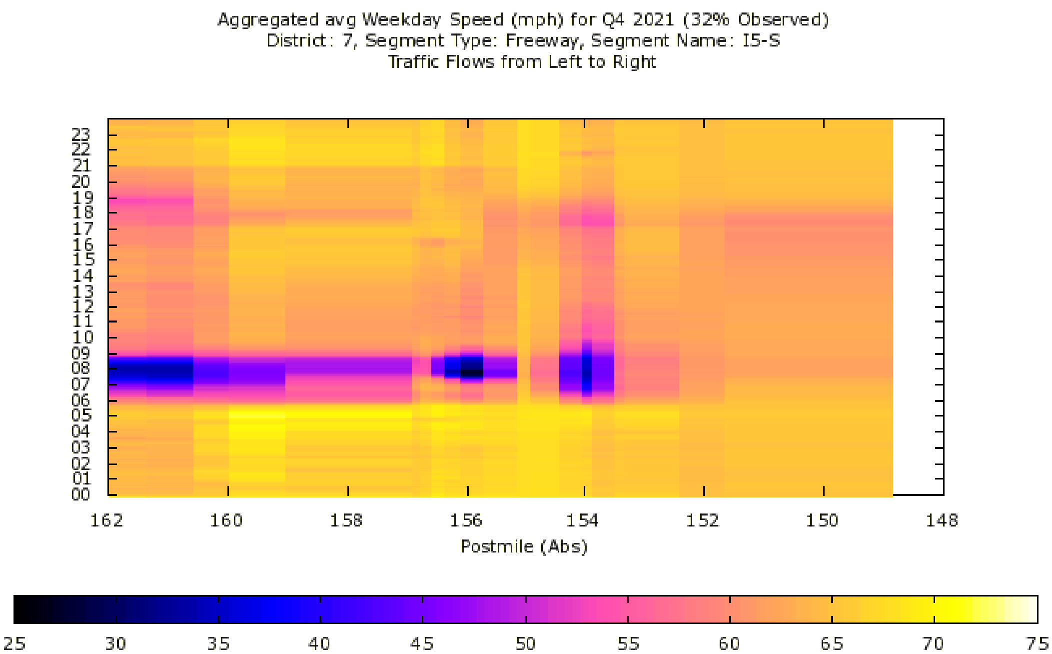


FIGURE 4.4-4. AVERAGE GP LANE SPEEDS – SOUTHBOUND ROUTE 5, Q4 2021



B. REMEDIATION STRATEGIES

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.

- The East San Fernando Valley Transit Corridor Project (ESFV, Los Angeles Metro) consists of a Light Rail Transit (LRT) system that will travel north of the Van Nuys Orange Line Station to the Sylmar/San Fernando Metrolink Station, a total of 9.2 miles and will operate in the median of Van Nuys Boulevard for 6.7 miles to San Fernando Road. Construction groundbreaking is scheduled to begin in 2022 and is expected to be completed in time for the 2028 Summer Olympic and Paralympic Games. $1.3 billion has been identified for the project, most coming from local Measures M and R, as well as State gas tax funds. This project is expected to reduce traffic demand on Routes 5 and 405, especially relieving congestion on Route 5 between Van Nuys Blvd and Polk St (approx. PM 154-157, Fig. 4.4-3, 4.4-4).

- Project 07-2332E will extend the HOV and truck lanes between Antelope Valley Freeway (Route 14) and Parker Rd. on Route 5, which will ease traffic delays and absorb traffic growth due to increased population and surrounding communities – both residential and commercial. This project is expected to reduce the congestion on the northbound HOV lane during PM peak hours. Construction began in 2020, and completion is expected in March 2026. The estimated construction cost is $525 million.

- District 7 shared vehicle occupancy counts and violation data with the California Highway Patrol (CHP), so they can prioritize their enforcement efforts.

- Metrolink developed the Southern California Optimized Rail Expansion (SCORE) plan in partnership with freight and intercity rail operators as a roadmap to increased rail service to accommodate expected population and job growth in advance of 2028, when Los Angeles will host the Olympics. SCORE will fund the Antelope Valley Line (AVL) Capacity and Service improvements. This project aims to improve service frequency and reliability along the 76.6-mile long AVL commuter rail corridor between Lancaster and downtown Los Angeles and is expected to reduce traffic demand on Routes 5 and 14. The forecasted opening is expected in 2028-2030.

- In 2022, District 7 evaluated possible pavement delineation restriping to continue/widen to four lanes in the northbound direction, on a segment after the truck lane branches off to a separate alignment, and the GP lanes drop down from four to three lanes. It is a bottleneck location that causes HOV degradation. The results of the study determined that it is not feasible to widen to four lanes at this time.

4.4.4 ACTION PLAN FOR EXPRESSLANE/HOV FACILITIES ON ROUTE 10

HOV facilities on Route 10 are split into two segments: Alameda Street to Route 605 as express lane facilities and Route 57 to San Bernardino County Line as HOV facilities. These action plans cover the entire route. The segment between 605 to 57 was fully opened in 2021. The data quality still needs to be monitored before processing. District 7 will incorporate this segment in next year's report.

A. ANALYSIS

Alameda Street to Route 605 (Expresslane)

- Afternoon peak period recurrent extreme congestion between Santa Anita Ave and Durfee Ave (PM 27.3-29.2) in all lanes, reduces eastbound HOT lane performance.

- The existing HOV lane in each direction was converted to two HOT lanes in each direction by LA Metro on February 23, 2013. Vehicle volume has increased because of the addition of toll-paying vehicles and an increase in violation rates. LA Metro's Pricing Algorithm cannot control demand, even under "HOV Only" mode due to high occupancy violations. The occupancy violation rate with the self-declaring FasTrak flex transponder has increased over time, as SOVs set the transponder to HOV to avoid paying tolls. Approximately 30 to 60 percent of users are not setting the transponder correctly. Manual counts show over 70 percent of vehicles in the HOT lane are SOVs and only 15 percent carpools.

Figures 4.4-5 and 4.4-6 provide plots of eastbound HOV and GP lane speeds during the fourth quarter of 2021. Figures 4.4-7 and 4.4-8 provide plots of westbound HOV and GP lane speeds during the same quarter.

Route 57 to San Bernardino County Line

- Afternoon peak period recurrent extreme congestion in all lanes reduces eastbound HOV lane performance between Fairplex Dr. and College Ave

(PM 42.2-46.7), due to "friction" between slow/congested GP lanes and HOV lanes.

- High truck traffic volumes (4.5 to 8.0 percent) reduce the capacity of the freeway, especially along the right two lanes; other vehicles tend to maneuver into the left most lanes, increasing weaving and the friction factor with the HOV lanes.

- New HOV lanes on Route 10 opened to traffic connecting the gap in the HOV lane network between Puente Ave and Route 57. The stretch from Puente Ave to Citrus Ave opened to traffic in August of 2020; the segment from Citrus Ave to Route 57 opened in April of 2021. These projects will reduce/eliminate HOV degradation at the previous HOV lane endings.

Figures 4.4-9 and 4.4-10 provide plots of eastbound HOV and GP lane speeds during the fourth quarter of 2021. Figures 4.4-11 and 4.4-12 provide plots of westbound HOV and GP lane speeds during the same time.

FIGURE 4.4-5. AVERAGE EXPRESSLANE SPEED – EASTBOUND ROUTE 10 (ALAMEDA ST TO ROUTE 605), Q4 2021

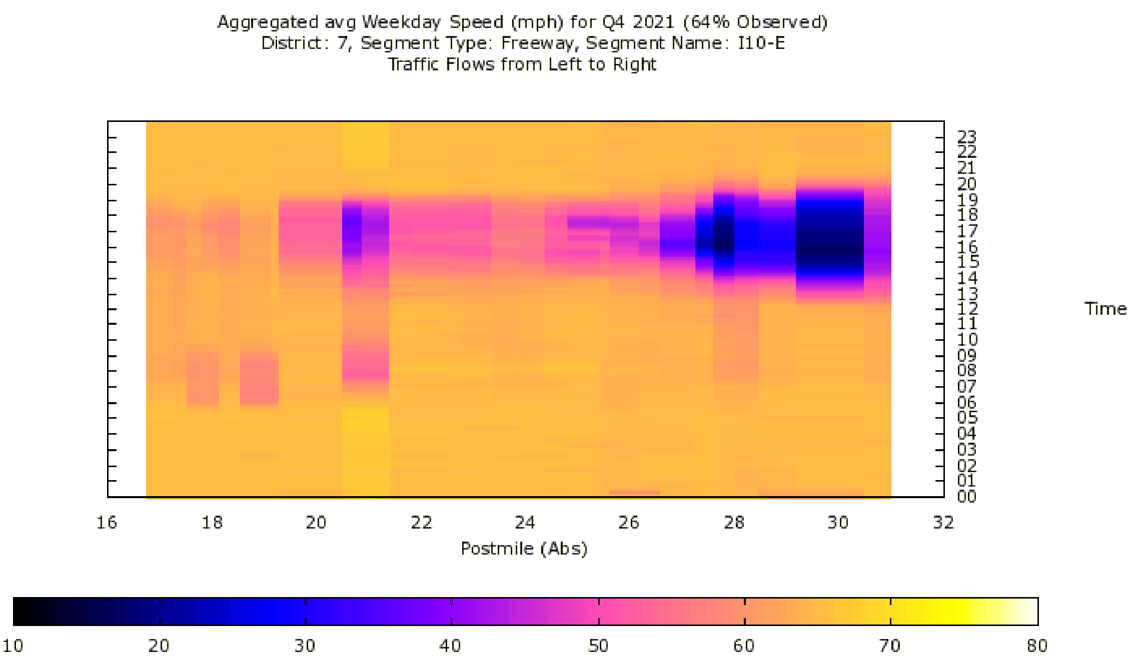


FIGURE 4.4-6. AVERAGE GP LANE SPEED – EASTBOUND ROUTE 10 (ALAMEDA ST TO ROUTE 605), Q4 2021

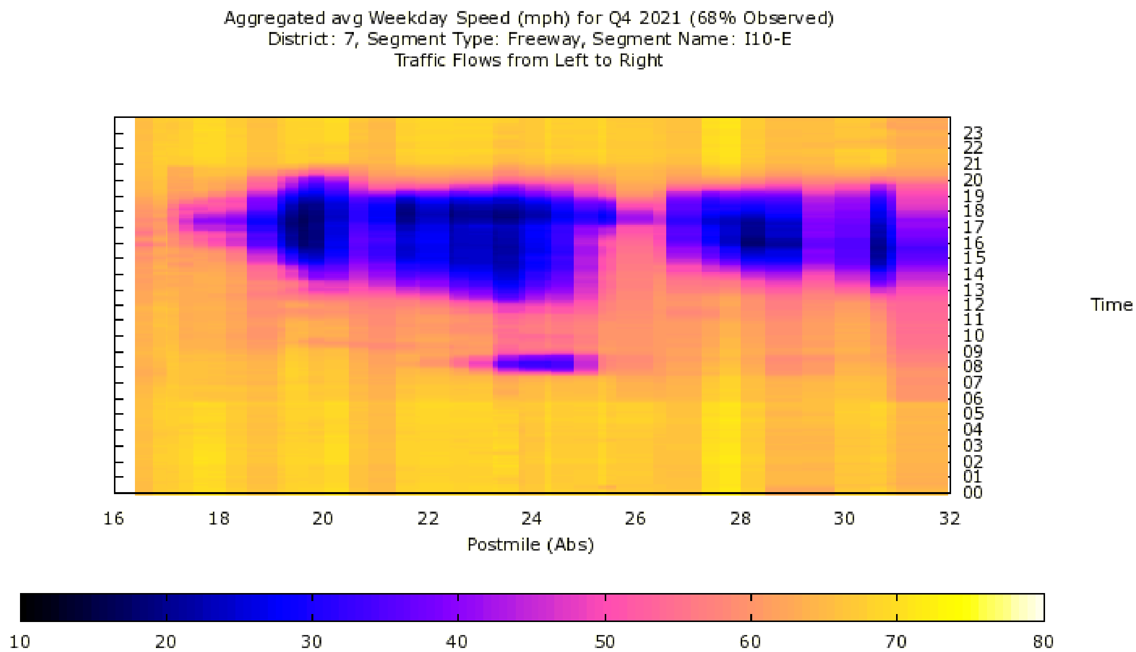


FIGURE 4.4-7. AVERAGE EXPRESSLANE SPEED – WESTBOUND ROUTE 10 (ROUTE 605 TO ALAMEDA ST), Q4 2021

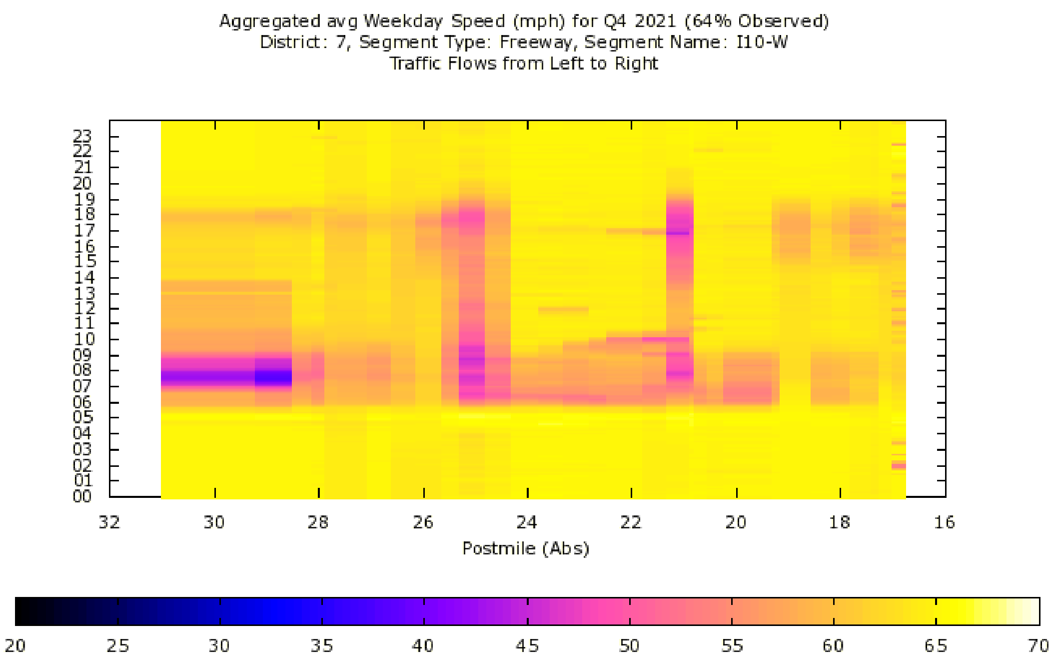


FIGURE 4.4-8. AVERAGE GP LANE SPEED – WESTBOUND ROUTE 10 (ROUTE 605 TO ALAMEDA ST), Q4 2021

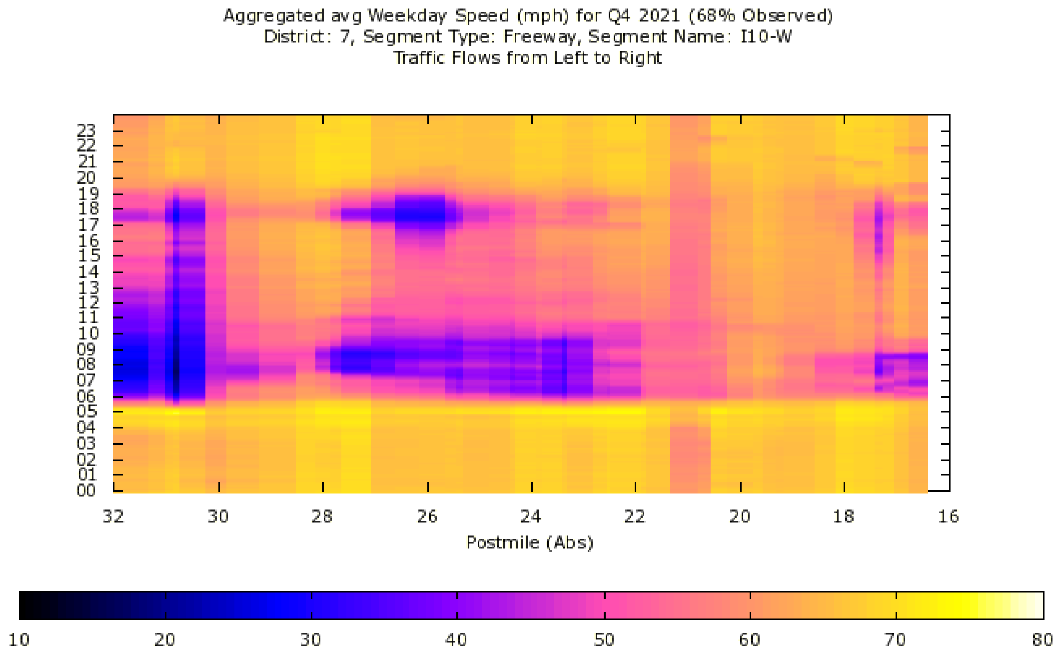


FIGURE 4.4-9. AVERAGE HOV LANE SPEED – EASTBOUND ROUTE 10 (ROUTE 57 TO SAN BERNARDINO COUNTY LINE), Q4 2021

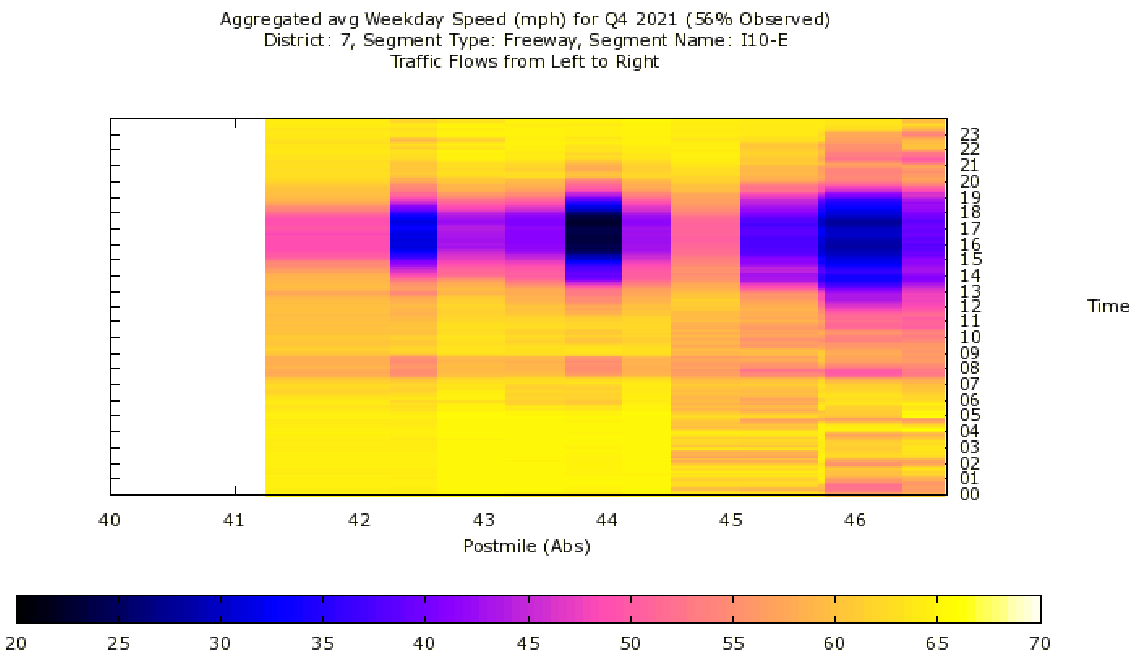


FIGURE 4.4-10. AVERAGE GP LANE SPEED – EASTBOUND ROUTE 10 (ROUTE 57 TO SAN BERNARDINO COUNTY LINE), Q4 2021

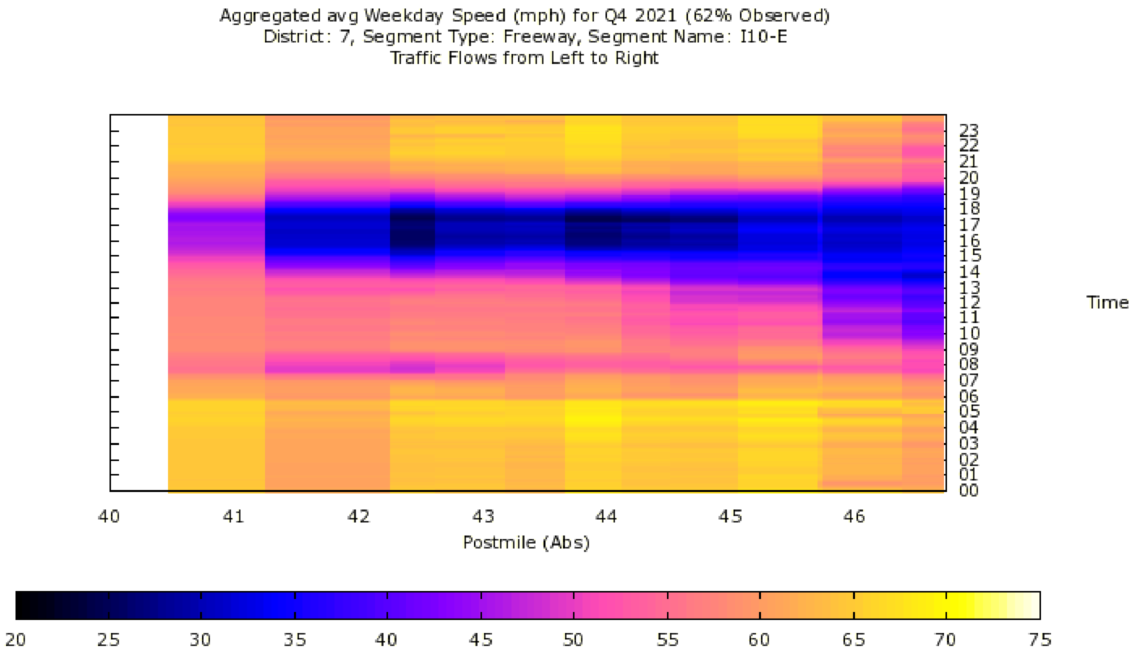


FIGURE 4.4-11. AVERAGE HOV LANE SPEED – WESTBOUND ROUTE 10 (SAN BERNARDINO COUNTY LINE TO ROUTE 57), Q4 2021

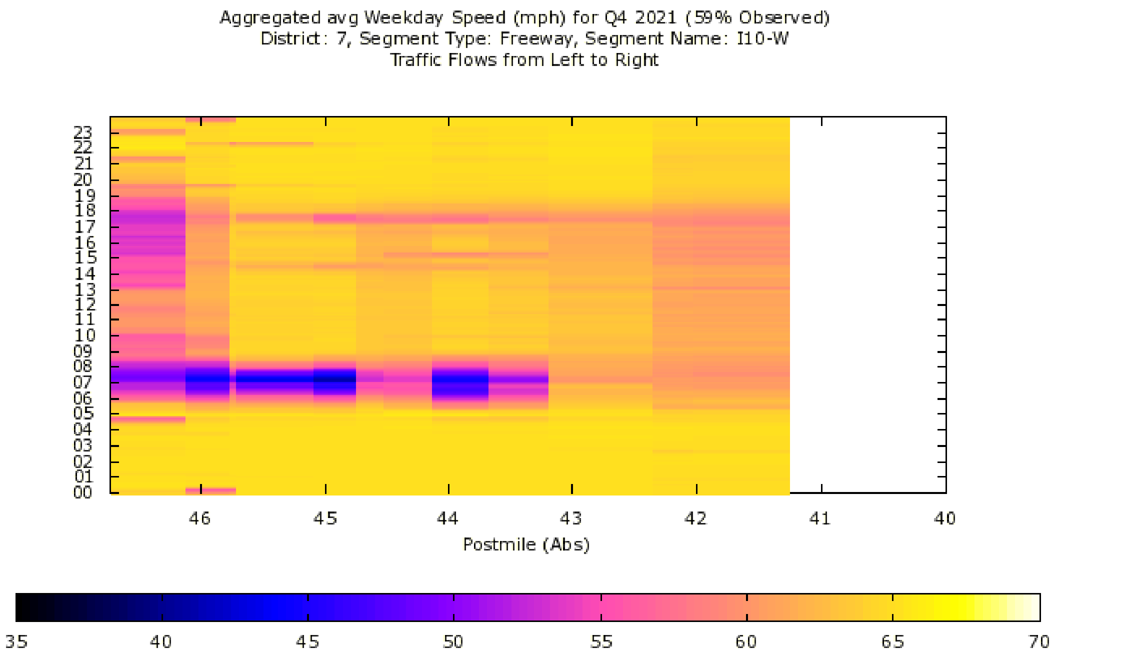
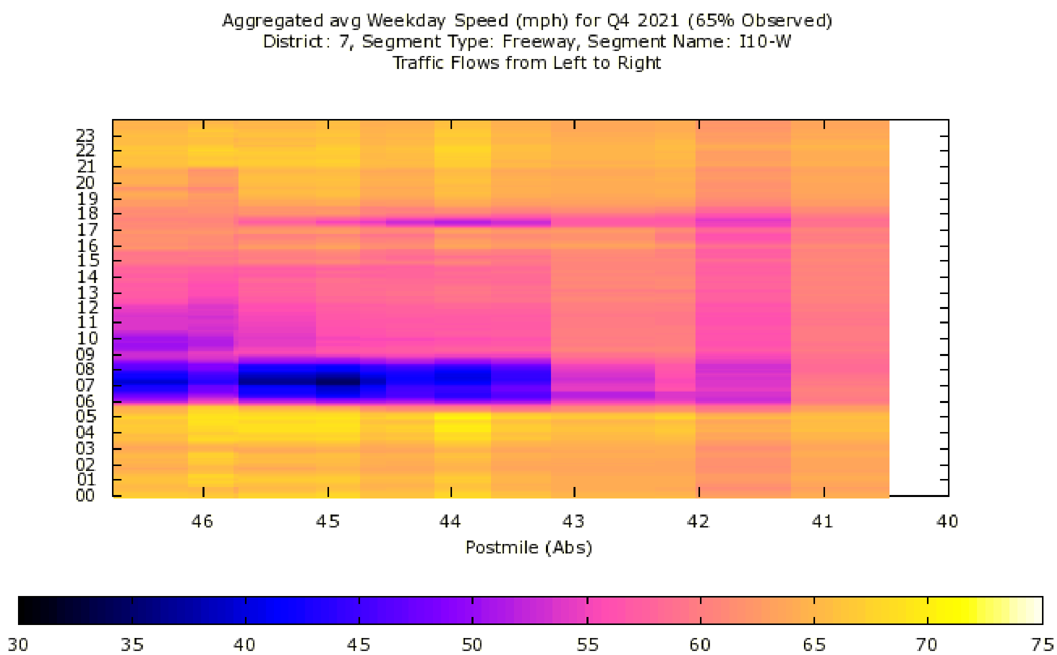


FIGURE 4.4-12. AVERAGE GP LANE SPEED – WESTBOUND ROUTE 10 (SAN BERNARDINO COUNTY LINE TO ROUTE 57), Q4 2021



B. REMEDIATION STRATEGIES

Alameda Street to Route 605 (Expresslane)

- Caltrans, in partnership with LA Metro, implemented the following strategies to improve performance:
  - o Work is ongoing to repair and update the detector system to improve data collection.
  - o LA Metro installed the Automatic Vehicle Occupancy Detection System (AVODS) in late 2019, based on Caltrans' violation data, and it has been in the testing phase since June 2020. LA Metro has notified the transponder holders that the new occupancy enforcement system is in place. However, due to software and back-office communication issues, etc., LA Metro is still not using it for enforcement, which entails sending a letter indicating that the transponder is set wrong, and in the future, the toll would be charged.
  - o Digital occupancy sign panels that display the transponder setting to assist CHP to enforce vehicle occupancy or toll violations, were installed in 2019 and can be seen from both sides of the display. CHP

indicates that they are very helpful and more useful than the flashing white and blue lights on the transponder readers.

- LA Metro reports their HOT lanes are degraded because of too many carpools and planned to implement a 5+ occupancy requirement Pilot on the Route 10 HOT lanes (ELs) in 2022. According to the latest LA Metro's update, the HOT 5+ Pilot is not expected before June of 2023. Manual occupancy counts show over 70 percent of EL vehicles are SOVs and only 15 percent are carpools. LA Metro would require all 5+ to be registered vanpools in Phase I, during the peak hours. LA Metro plans to perform a before/after study.
- Enhanced, dedicated, and targeted CHP enforcement along HOT lanes, including the establishment of enforcement zones.
- LA Metro Gold Line Foothill Extension to Claremont (with the ability to extend to Montclair) will be completed in 2025 and is expected to reduce traffic demand on Routes 10, 60, and 210. Carpooling has been touted as one of the first steps in encouraging people These off-system improvements could attract some of the current HOV lane users.
- Beginning in 2023, LA Metro will prepare the Route 10 HOT Lane Degradation Action Plan.

Route 57 to San Bernardino County Line

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.
- New HOV lanes on Route 10 opened to traffic connecting the gap in the HOV lane network between Puente Ave. and Route 57. The stretch from Puente Ave. to Citrus Ave. opened to traffic in August of 2020; The stretch from Citrus Ave. to Route 57 opened in April of 2021. These projects will reduce/eliminate HOV degradation at the previous HOV lane endings.
- The Alameda Corridor-East (ACE) Project, funded by the San Gabriel Valley Council of Governments, will mitigate the impacts of significant increases in freight rail traffic on over 70 miles of mainline railroad in the San Gabriel Valley. The ACE Project consists of a comprehensive program of safety improvements and mobility upgrades at an estimated cost of $1.9 billion. It is anticipated to be completed by summer 2025. This project will relieve truck traffic from Long Beach and San Pedro to Inland Empire region,

thereby reducing truck traffic and congestion on the GP lanes; hence, reducing HOV lane degradation.

- The HOV facility between Route 605 and the San Bernardino County Line will be converted to HOT lanes by December 2026 (EA 354310). If properly enforced for occupancy and toll violations, the new HOT lanes should operate at free-flow conditions using the pricing algorithm.

4.4.5 ACTION PLAN FOR HOV FACILITIES ON ROUTE 14

A. ANALYSIS

- Peak period recurrent extreme congestion in the GP lanes reduces HOV lane performance between Placerita Canyon Road and Sand Canyon Road (PM 3.0-8.5) southbound in the AM, merging with vehicle volumes from I-5 and northbound in the PM due to lane drops as mentioned below.

- In 2019, the HOV lane buffer striping was replaced with continuous access striping for approximately 29 miles beginning 1.2 miles north of Via Princessa to Palmdale Blvd/Avenue P-8 (Technology Dr) (PM 32.06-60.7). This change increased solo violators using the continuous access portion of the HOV lane. The violation rate was 5.6 percent in 2018. After converting, it went to 8.6 percent in 2019, and 8.8 percent in 2021. The peak hour southbound/northbound flow was 1,257/1,498 vehicles/hour respectively in 2018, and 1,207/1,461 vehicles/hour respectively in 2021, with HOV degradation going from slightly/moderately to extremely degraded.

- A lane drop at Newhall Avenue creates a bottleneck in the northbound direction.

- Demand exceeds capacity when three lanes drop to two, causing friction between HOV and GP lanes. During 1-hour-peak peak hour, volumes on the two GP lanes and one HOV lane are 3,277 and 1,643 vehicles/hour, respectively.

- Several lane-drops southbound close to Sand Canyon Road.

- Non-metered on-ramps allow platoons of vehicles to enter the freeway. When the opportunity occurs (local projects and/or dedicated funding), ramp metering equipment is installed.

- Route 14 merging to the southbound Route 5 HOV lane causes delays in the southbound direction during morning peak traffic hours.

Figures 4.4-13 and 4.4-14 provide plots of Northbound HOV and GP lane speeds during the fourth quarter of 2021. Figures 4.4-15 and 4.4-16 provide plots of southbound HOV and GP lane speeds during the same time.

FIGURE 4.4-13. AVERAGE HOV LANE SPEED – NORTHBOUND ROUTE 14, Q4 2021

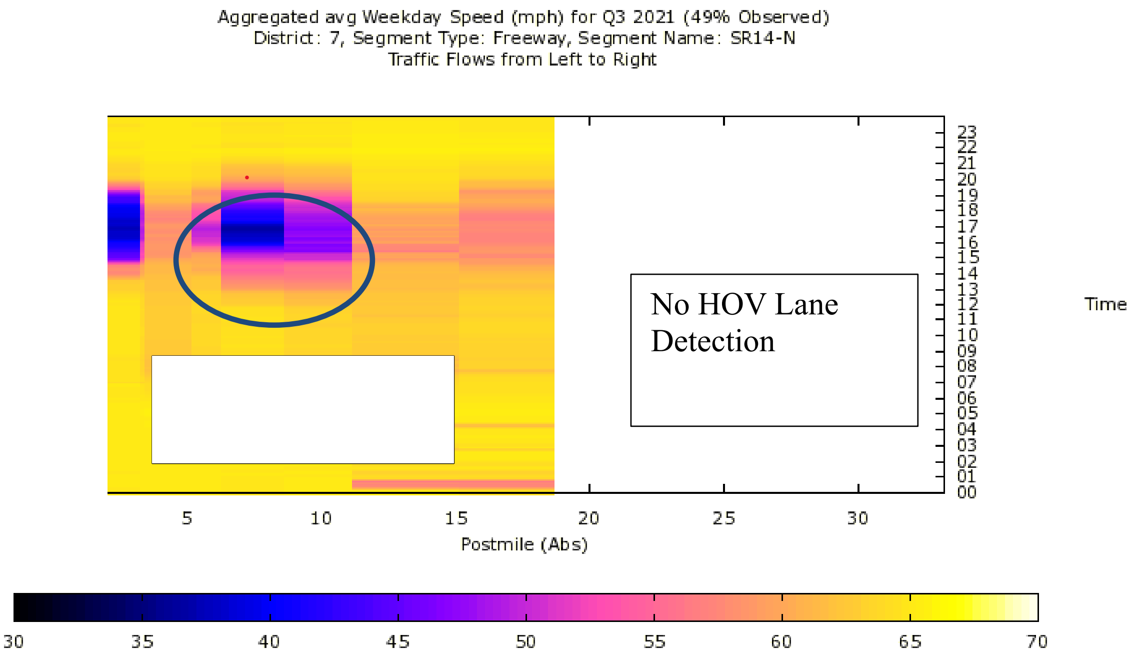


FIGURE 4.4-14. AVERAGE GP LANE SPEED – NORTHBOUND ROUTE 14, Q3 2021

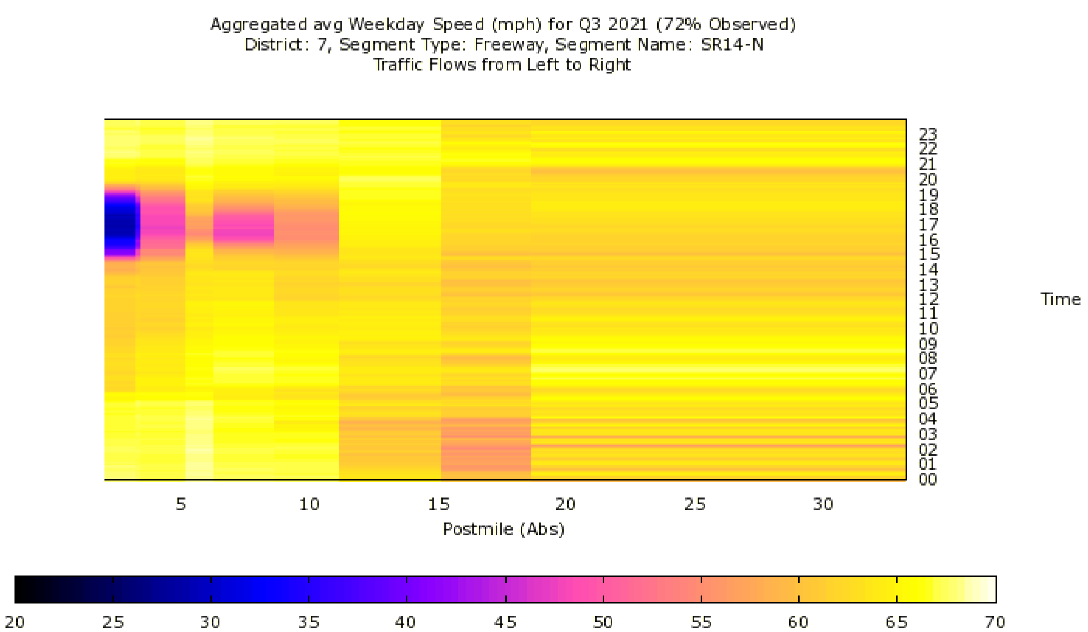


FIGURE 4.4-15. AVERAGE HOV LANE SPEED – SOUTHBOUND ROUTE 14, Q3 2021

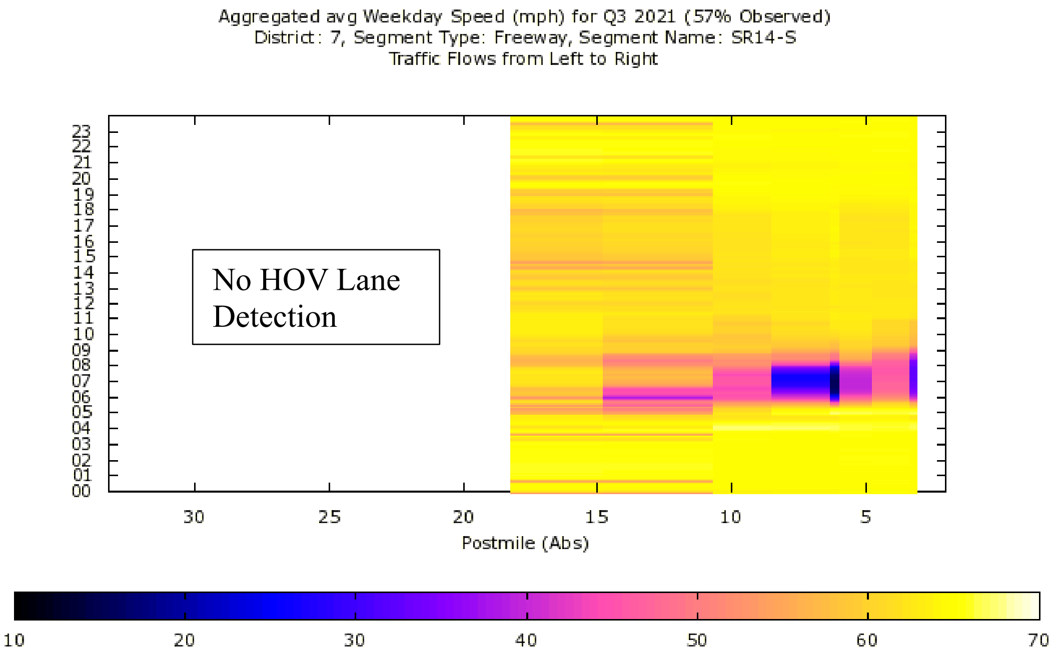
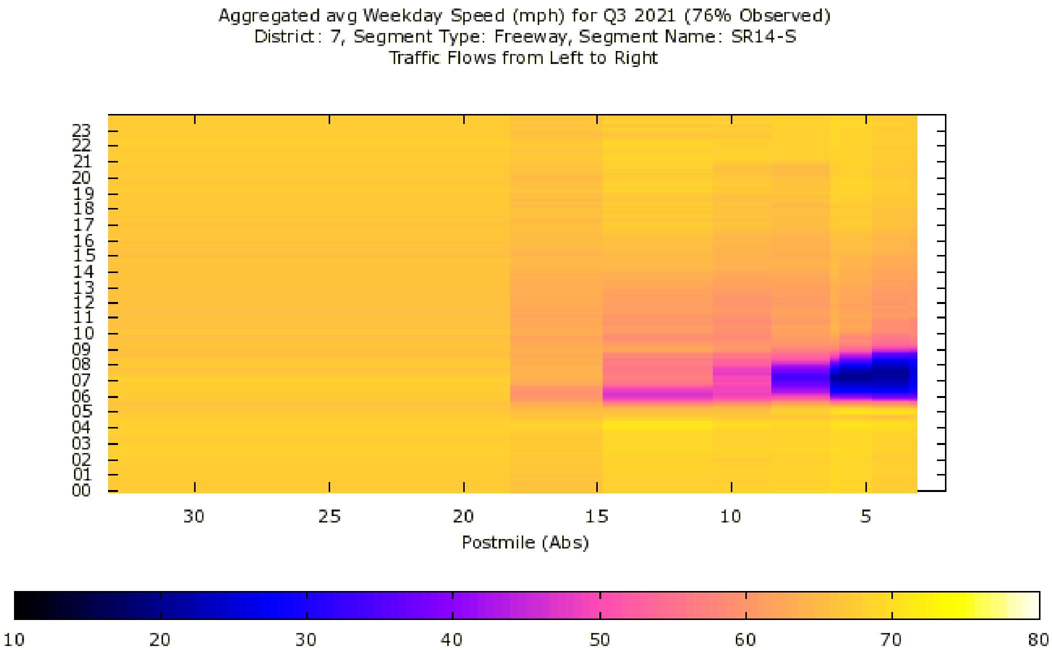


FIGURE 4.4-16. AVERAGE GP LANE SPEED – SOUTHBOUND ROUTE 14, Q3 2021



A. REMEDIATION STRATEGIES

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.

- Revert HOV striping to a limited access buffer, which existed before July 2019. Before being converted to continuous access, the limited access facility generated free-flow "green" speeds throughout the northern segment. The SR-14 HOV lane operations before (with a limited access buffer) and after (with continuous access/no buffer) traffic analysis indicates that if the HOV limited access buffer is restored onto SR-14, it will result in at least 94 DVHD savings (14%) in the NB HOV lane, and 209 DVHD savings (37%) in the southbound HOV lane. The SR-14 Buffer reinstatement project has been entered into the Asset Management Tool for the 2024 SHOPP, and the DVHD calculations have been approved by Caltrans HQ. Project 07-39060 was initiated in June 2022 and it will convert continuous HOV access buffers to limited access buffers, between I-5 and Rancho Vista Blvd. The project initiation document (PID) is expected to be completed by June 2023.

- Increase public awareness. Update HOV violation fine amount on the existing signs to the current amount. Improve HOV signage (regulatory and enforcement signs) and pavement marking on SR-14. Additional or enhanced signing and markings at the beginning and along the HOV lanes need to be installed, if the HOV buffer is not re-instated. (Note, the SR-14 Buffer reinstatement project has been entered into the Asset Management Tool for the 2024 SHOPP, and the DVHD calculations have been approved by Caltrans HQ.)

- District 7 evaluated possible pavement delineation restriping to eliminate the lane-drop configuration. Unfortunately, this was found to be not feasible at this time.

- Project 07-29890 includes widening the Route 14 mainline from Technology Drive to Palmdale Boulevard and widening northbound Rancho Vista Boulevard off-ramp after deceleration segment. The project plans also include realigning the off-ramp terminus, replacing signals at the ramp terminus, and synchronizing signal timing. The project is in the construction phase and is led by the City of Palmdale. Construction completion is expected in October 2025. This should reduce congestion in the GP lanes, thereby reducing HOV degradation caused by the friction factor between

HOV and GP lanes.

- Metrolink developed the Southern California Optimized Rail Expansion (SCORE) plan in partnership with freight and intercity rail operators as a roadmap to increase rail service to accommodate expected population and job growth in advance of 2028, when Los Angeles will host the Olympics. SCORE will fund the construction of a new station in Santa Clarita. This should reduce demand for the SR-14 freeway, thereby reducing congestion in the GP lanes, and hence reducing HOV degradation.

- Meter HOV preferential lanes at on-ramps. Work is in progress. Various routes are in different stages subject to project funding within the corridor. District 7 will receive approximately $8 million in the 2024 SHSMP/SHOPP funding. District 7 has been entering HOV Degradation Mitigation into the Asset Management Tool for existing projects involving ramp work and estimates that about 15 percent of the total DVHD reduction would come from metering the HOV preferential lanes.

- Construction of HOV and truck lanes on Route 5 (07-2332E4) will ease traffic delays and absorb the growth of traffic due to increased population and surrounding communities – both residential and commercial. Construction began in 2020; construction completion is expected in early 2025. The estimated construction cost is $525 million.

- District 7 shared vehicle occupancy counts and violation data with the California Highway Patrol (CHP), so they can prioritize their enforcement efforts.

4.4.6 ACTION PLAN FOR HOV FACILITIES ON ROUTE 57

A. ANALYSIS

- AM peak period slight congestion and PM peak period recurrent extreme congestion between Cold Spring Ln. and Pathfinder Rd. (PM 14.4-15.2) in northbound direction reduces HOV lane performance.

- The 2021 Manual Occupancy Data indicates up to a 6 percent solo violation rate and an 11.5 percent CAV decal rate. The average truck percentage is 7.6.

- High volume from Route 60 merges to Route 57.

- Poor data quality. HOV degradation is over-estimated due to sensor misconfiguration and insufficient quality data. Only four out of the total seven detectors have usable data on northbound Route 57.
- No data was available for southbound Route 57. A total of five detectors are along southbound Route 57, and none of them are functional.

B. REMEDIATION STRATEGIES

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.
- Project 07-27912 proposes freeway improvements to Route 57/60 confluence at the Grand Avenue interchange in Los Angeles County. During the peak periods, demand exceeds the capacity for both routes in the vicinity of the interchange, resulting in delays with Level of Service (LOS) at 'F' for many hours. The project plans to significantly modify the GP lanes for Northbound SR-57 and Eastbound SR-60 to ease congestion and delays on the mainline and reduce weaving at the Grand Avenue interchange. This LA Metro project began construction in 2021. The estimated construction cost is $263 million. Construction completion is expected in 2027. This project will also eliminate the existing lane drops.
- The ongoing construction project (EA 07-30450) is rehabilitating the mainline which is expected to be completed by the Spring of 2025. This project plans to replace the loop detectors on the mainline, including the HOV lane, and install ramp meters for the on-ramp HOV lanes. Repairing the vehicle detector systems will improve data coverage and traffic monitoring on SR-57.
- District 7 shared vehicle occupancy counts and violation data with the California Highway Patrol (CHP), so they can prioritize their enforcement efforts.

4.4.7 ACTION PLAN FOR HOV FACILITIES ON ROUTE 60

A. ANALYSIS

- Afternoon peak period recurrent extreme congestion in all lanes reduces eastbound HOV lane performance and speed between Fairway Dr. and Brea Canyon Rd. (PM 21.1-23.4). Morning peak period recurrent congestion in all lanes reduces westbound HOV lane performance and operating speeds which causes slight/moderate degradation on westbound HOV lane.

- High truck volume (12-15 percent average, 22 percent at Nogales Street (PM 20.4)) affecting HOV due to reduced freeway operating speeds and friction factor; truck congestion on uphill grades.

- High volume due to the merging of Route 57 and Route 60 together. Field occupancy counts provide visual observations of traffic patterns, whereby the right two lanes are congested with two continuous lanes of trucks, leaving other vehicles with only the two left lanes to use. This results in increased violation rates in the HOV lane.

- Demand exceeds capacity. Especially eastbound at Grand Avenue (HOV lane is 1,624 vehicles/hour during a 1-hour peak period). The CAV decal rate is up to 10.9 percent during peak hours and the solo violation rate is up to 8 percent.

Figures 4.4-17 and 4.4-18 provide plots of eastbound HOV and GP lane speeds on Route 60 during the third quarter of 2021. Figures 4.4-19 and 4.4-20 provide plots of westbound HOV and GP lane speeds on Route 60 during the third quarter of 2021.

FIGURE 4.4-17. AVERAGE HOV LANE SPEED – EASTBOUND ROUTE 60, Q3 2021

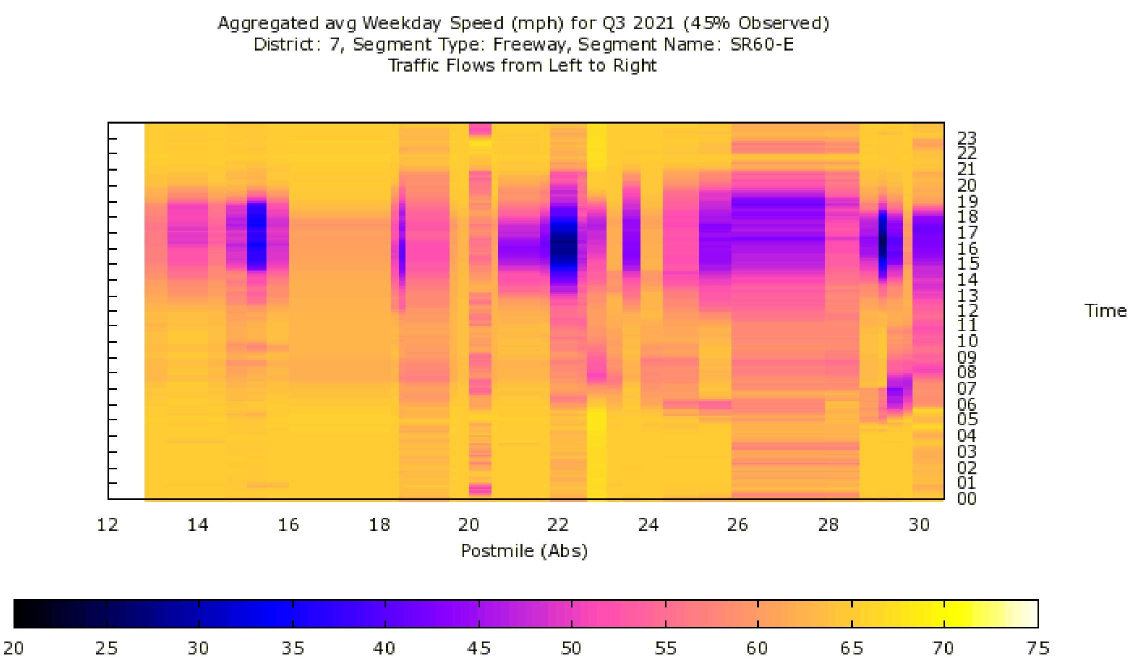


FIGURE 4.4-18. AVERAGE GP LANE SPEED – EASTBOUND ROUTE 60, Q3 2021

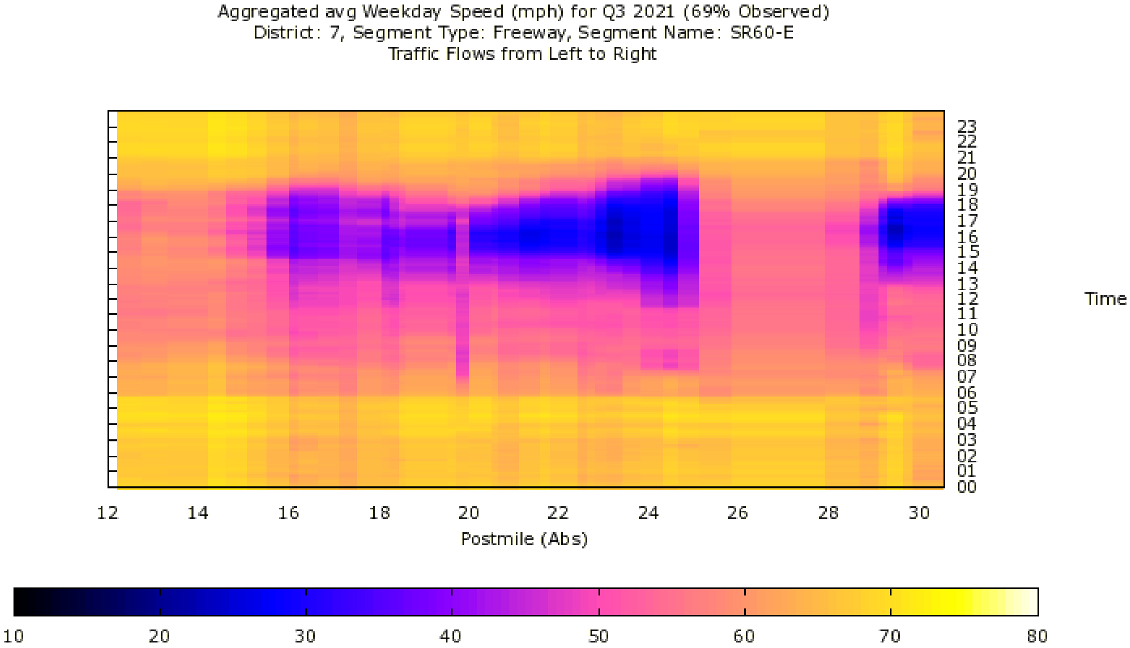


FIGURE 4.4-19. AVERAGE HOV LANE SPEED – WESTBOUND ROUTE 60, Q3 2021

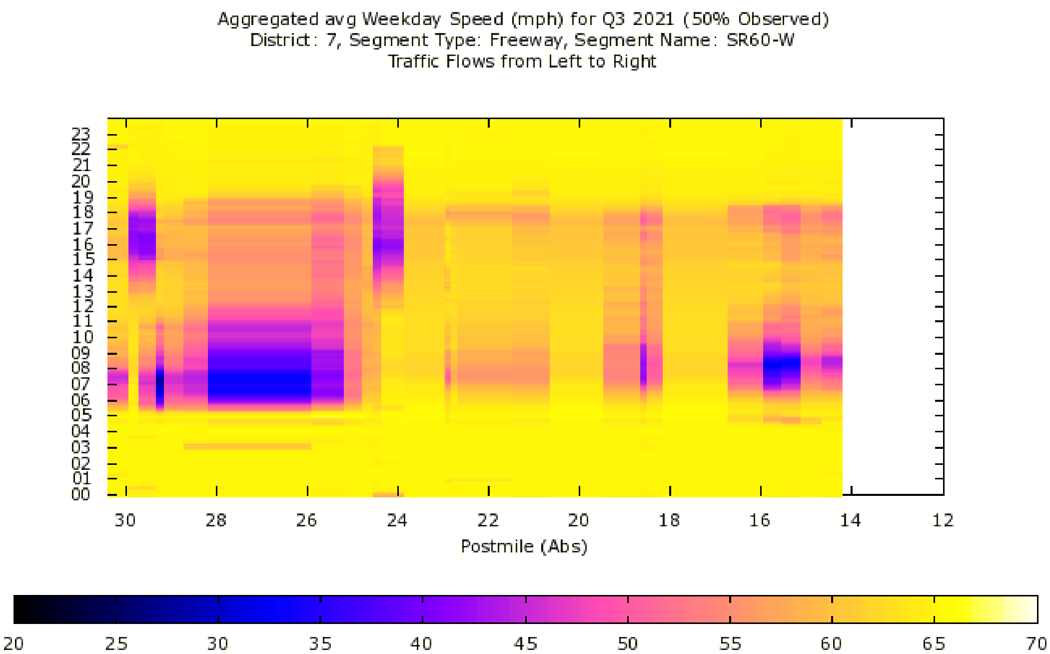
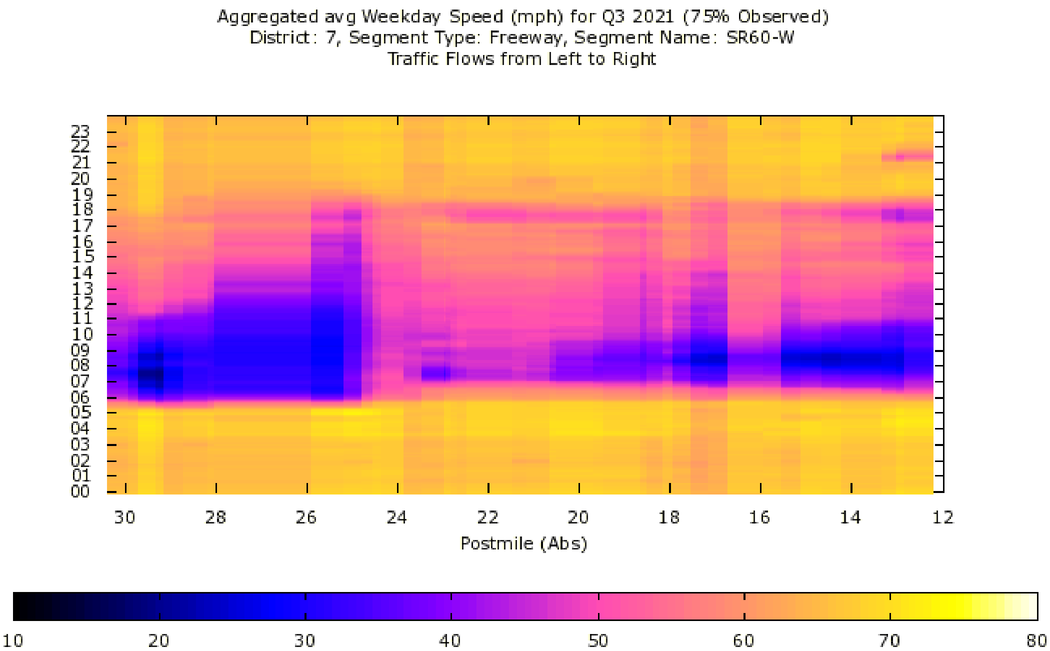


FIGURE 4.4-20. AVERAGE GP LANE SPEED – WESTBOUND ROUTE 60, Q3 2021



B. REMEDIATION STRATEGIES

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.
- Project 07-3101U, Route 605/Route 60 Corridor Improvement Project (CIP), will make the following improvements:
  - Add through-lane at Route 605/Route 60 interchange on Route 60, add through-lane within the Route 605/Route 60 system interchange on Route 60 in the westbound direction.
  - Add eastbound Route 60 auxiliary for Route 605 northbound and southbound connectors.
  - Add eastbound Route 60 auxiliary lane from northbound Route 605 connector to the Crossroads Parkway off-ramp.
  - Existing eastbound Route 60 auxiliary lane from northbound Route 605 connector will be extended through the Crossroads Parkway interchange to 7th Avenue off-ramp.

- An additional westbound Route 60 auxiliary lane is proposed from Hacienda Boulevard to 7th Avenue interchange where it joins an existing auxiliary lane (previously from 7th Avenue to Crossroads Parkway).
- An additional westbound Route 60 auxiliary lane is proposed through Crossroads Parkway interchange until it reaches the northbound and southbound Route 605 connectors.

Dates for this project: RTL 2025, construction to begin 2028, and completion 2031. The estimated construction cost is $2.8 billion. This project will reduce congestion on GP lanes, and increase connectivity with the 605 freeway, thereby reducing HOV degradation.

- Project 07-27912 proposes freeway improvements to Route 57/60 confluence at the Grand Avenue interchange in Los Angeles County. During the peak periods, demand exceeds the capacity for both routes in the vicinity of the interchange, resulting in delays with Level of Service (LOS) at 'F' for many hours. This project is led by LA Metro and began construction in 2021. The estimated construction cost is $263 million. Construction completion is expected in 2027. The project plans to significantly modify the GP lanes for Northbound SR-57 and Eastbound SR-60 to ease congestion and delays on the mainline, reduce weaving at the Grand Avenue interchange, and improve HOV speed due to reduced GP freeway operating speeds and friction factors.
- Project 07-30110 (PM 2.8R/11.8) includes pavement rehabilitation and stormwater treatment facilities that the Route 605 CIP team has been coordinating. Anticipated completion in 2025. The estimated construction cost is $135 million. This project should improve the detector systems for Route 60 GP and HOV monitoring.
- Project 07-32780 proposes two dedicated truck lanes along the median of Route 60, freeway widening, interchange re-configurations, intersection re-configurations, ramp realignments, structure widening and replacement, retaining wall construction, and Right of Way acquisition. Anticipated completion in 2031. This project should reduce truck traffic and congestion on the GP lanes, and hence reduce HOV degradation.
- The Alameda Corridor-East (ACE) Project, funded by the San Gabriel Valley Council of Governments, will mitigate the impacts of significant increases in freight rail traffic on over 70 miles of mainline railroad in the San Gabriel

Valley. The ACE Project consists of a comprehensive program of safety improvements and mobility upgrades at an estimated cost of $1.9 billion. This project will relieve truck traffic from Long Beach and San Pedro to the Inland Empire region. It is anticipated to be completed by summer 2025. This project should reduce truck traffic and congestion on the GP lanes, and hence reduce HOV degradation.

4.4.8 ACTION PLAN FOR HOV FACILITIES ON ROUTE 91

A. ANALYSIS

- Demand exceeds capacity. The average volume is 1,400 vehicles/hour in the HOV lane during the 1-hour peak period. The CAV decal rate is up to 11.9 percent.
- The average truck rate is 7.3 percent, up to 9.7 percent at Carson, Avalon Boulevard Interchange (PM R7.426).
- Afternoon period recurrent extreme congestion in all lanes reduces HOV lane performance and speed on eastbound, between S Central Ave. and Downey Ave (PM 2.3-8.2). The rest of the eastbound HOV facilities are slightly/very degraded during PM peak hours. The average percentage of degraded days (speeds below 45mph) EB during the PM 3-hour peak period decreased by 16% compared to the year 2019 (Appendix D, Table 4.4-1).
- Morning and afternoon peak period recurrent congestion in all lanes reduces HOV lane performance and speed on westbound. During AM and PM peak hours, most of the westbound HOV lane is slightly/very degraded. The extremely degraded segment is between Pioneer Blvd and 183rd St. (PM 12.2-14.1) during PM peak hours. The average percentage of degraded days (speeds below 45 mph) WB during the AM 3-hour peak period decreased by 16.8% (and slightly increased by 2.1% during the PM 3-hour peak period) compared to the year 2019 (Appendix D, Table 4.4-1).
- GP lane drops at Route 710 interchange and Route 605 interchange reduce capacity resulting in a bottleneck.
- Vehicle weaving conflicts at ingress/egress locations due to congestion in the GP lanes.
- High solo violation rates in the westbound direction, at Bloomfield Ave (PM

19.17), are up to 8.6 percent.

Figures 4.4-21 and 4.4-22 provide plots of eastbound HOV and GP lane speeds on Route 91 during the fourth quarter of 2021. Figures 4.4-23 and 4.4-24 provide plots of westbound HOV and GP lane speeds on Route 91 during the fourth quarter of 2021.

FIGURE 4.4-21. AVERAGE HOV LANE SPEED – EASTBOUND ROUTE 91, Q4 2021

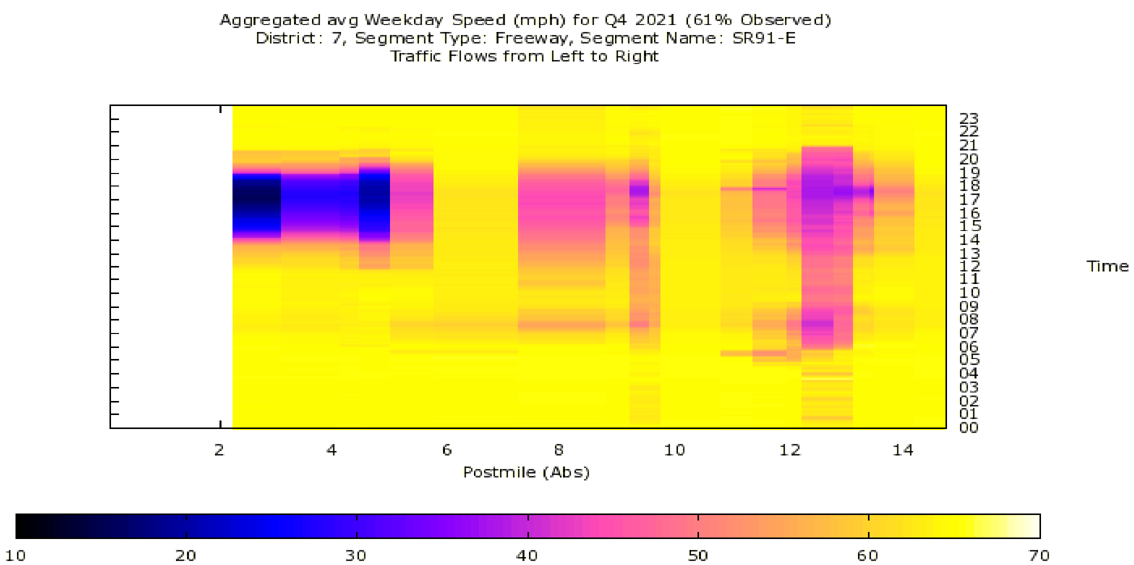


FIGURE 4.4-22. AVERAGE GP LANE SPEED – EASTBOUND ROUTE 91, Q4 2021

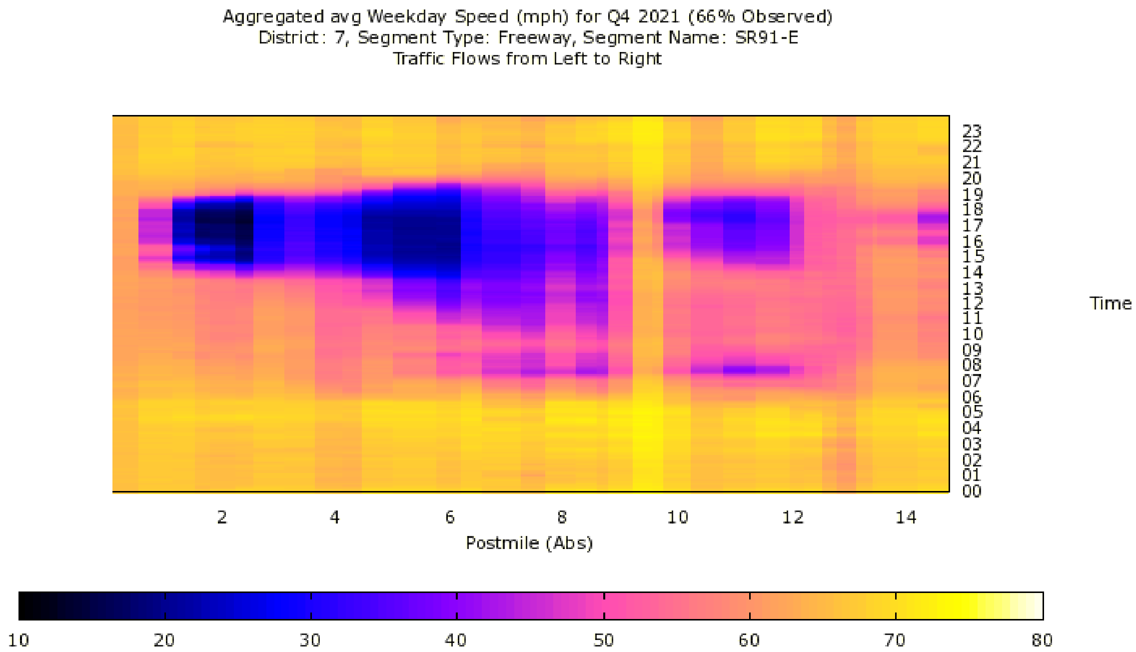


FIGURE 4.4-23. AVERAGE HOV LANE SPEED – WESTBOUND ROUTE 91, Q4 2021

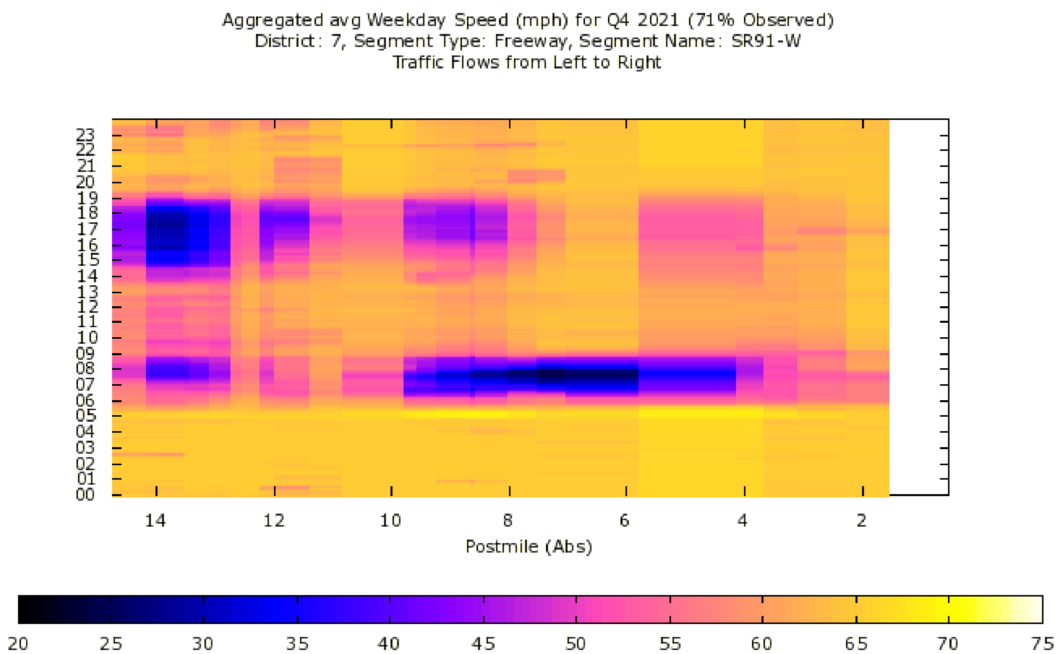
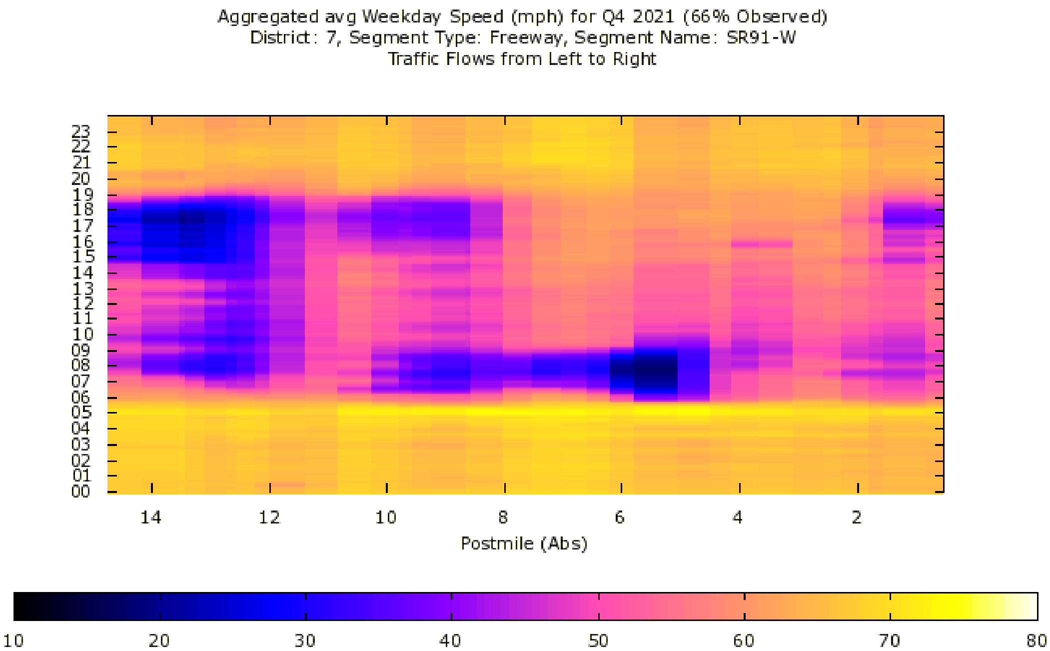


FIGURE 4.4-24. AVERAGE GP LANE SPEED – WESTBOUND ROUTE 91, Q4 2021



B. REMEDIATION STRATEGIES

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.

- Project 07-29810 will widen the freeway by adding one to two lanes along Route 91 from Paramount Boulevard to Shoemaker Avenue. Construction will begin in 2021, with anticipated completion in 2025. The estimated project cost is $450 million. This project should reduce congestion on the GP lanes, and hence reduce HOV degradation caused by the friction factor.

- The LA Metro West Santa Ana Branch Transit Corridor (WSAB) light rail transit (LRT) line will connect southeast LA County to downtown Los Angeles, serving the cities and communities along Route 5. The WSAB Project is a 19-mile corridor undergoing an Environmental Impact Statement (EIS)/Environmental Impact Report (EIR) process. The current project cost is estimated to be $6.5-$6.6B (in 2018 dollars). This project should reduce demand and congestion on the GP lanes, and hence reduce HOV degradation.

- Project 07-35460 will add one auxiliary lane in the eastbound direction, extending the outside #5 lane beyond the Atlantic Avenue eastbound off-ramp to Cherry Avenue then dropping it before the Cherry Avenue undercrossing, and widening the Orange Avenue and Walnut Avenue The estimated project cost is $6.7 million. Construction will begin in April 2023, with anticipated completion in 2026. This project should reduce congestion on the GP lanes, and hence reduce HOV degradation caused by the friction factor.

- Project 07-35920 proposes to add two frontage road lanes mainly for trucks. This project will address the weaving issues caused by a closely spaced on/off- ramp near the system interchange. Closely spaced ramps have created vehicle weaving conflict at ingress/egress locations due to congestion on the GP lanes and frontage road. The estimated project cost is $120 million. Construction will begin in 2024, with anticipated completion in 2025. This project should reduce truck traffic and congestion on the GP lanes, and hence reduce HOV degradation caused by the friction factor.

- District 7's occupancy count locations are selected to avoid the ingress/egress locations to obtain continuance occupancy rates/volumes in the annual report. District 7 will seek funding to conduct special studies to obtain data on vehicle weaving movements at the facility's ingress/egress locations.

- District 7 shared vehicle occupancy counts and violation data with the California Highway Patrol (CHP), so they can prioritize their enforcement efforts.

- HOT lanes are planned for Route 605 between the Orange County Line and Route 10 by 2027. Construction will be funded by Measure R funds and the forthcoming Transportation Strategic Plan-Phase II. The project would also be eligible for federal-aid funding. If properly enforced for occupancy and toll violations, the new 605 HOT lanes should operate at free-flow conditions using the pricing algorithm, thereby reducing HOV degradation on SR-91 near the 605 interchange.

- The future GP lane projects (07-29810, 07-35460, and 07-35920) create collector road arterials, eliminating multiple on/off ramps within close proximity of one another, which will reduce the weaving maneuvers between the HOV and GP lanes.

4.4.9 ACTION PLAN FOR HOV FACILITIES ON ROUTE 105

A. ANALYSIS

- Demand exceeds capacity. During the peak period, the average volume is around 1,400 vehicles/hour. At some locations, the volume is 1,700 vehicles/hour. The CAV decal rate is up to 7.9 percent during peak hours.

- High HOV violation rates from motorists entering/exiting Route 110 HOT lanes on both eastbound and westbound. District 7's 2021 Manual Occupancy Data at Long Beach Boulevard (PM 11.5), near the Route 110 HOT lanes, indicates that SOV's generate violation rates of 14.5 percent in the morning westbound and 14.2 percent in the afternoon eastbound.

- Afternoon peak period recurrent congestion in all lanes reduces HOV lane performance and speed on eastbound, and morning peak period recurrent congestion in all lanes reduces HOV lane performance and speed on westbound. The average percentage of degraded days (speeds below 45mph) EB during the PM 3-hour peak period decreased by 5.6% compared to the year 2019 (Appendix D, Table 4.4-1).

- Vehicle weaving conflict at ingress/egress locations due to congestion in the GP lanes on westbound.

- GP lane drops eastbound at Prairie Avenue, and South Vermont Avenue, causing bottlenecks eastbound.

- Congestion in the GP lanes extends into the HOV lane at the end termini on eastbound.

- Non-metered on-ramps allow platoons of vehicles to enter the freeway. When the opportunity occurs (local projects and/or dedicated funding), ramp metering equipment is installed.

- Many defective sensors. There was no data coverage at the end of eastbound between Paramount Boulevard to Carfax Avenue (PM 14.6-17.3) in 2019. In 2020, the segments without data coverage spread to the beginning and end of the HOV facilities in both directions. There is a significant drop in the number of “healthy” sensors in 2021 (I-105E from 19/18 healthy sensors in 2019/2020 down to only 5; the I-105W from 20/16 in 2019/2020 down to only 8).

B. REMEDIATION STRATEGIES

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.

- District 7 shared vehicle occupancy counts and violation data with the California Highway Patrol (CHP), so they can prioritize their enforcement efforts.

- Enhanced, dedicated, and targeted HOV enforcement including the establishment of enforcement zones. During the early development of the proposed HOT lanes discussed below, Caltrans, Metro, CHP and consultant staff performed field visits to identify potential locations and had preliminary design discussions for HOV/HOT lane enforcement.

- Modified HOT lane signs in 2019 to include "SOVs must exit" after the HOT lane connects with the 105 HOV lanes through direct connectors. Caltrans performed a before/after evaluation, using the Fall 2021 occupancy data. The westbound violation rate during peak hours dropped from 17.3 percent in 2019 to 14.5 percent in 2021.

- Project 07-31450 will convert the existing HOV lanes to HOT lanes and add a second HOT lane in each direction. Construction is expected to begin in 2024, with anticipated completion in 2028. The estimated project cost is $600 million. If properly enforced for occupancy and toll violations, the new HOT lanes should operate at free-flow conditions using the pricing algorithm.

- The LA Metro West Santa Ana Branch Transit Corridor (WSAB) light rail transit (LRT) line will connect southeast LA County to downtown Los Angeles, serving the cities and communities along Route 5. The WSAB Project is a 19-mile corridor undergoing an Environmental Impact Statement (EIS)/Environmental Impact Report (EIR) process. The current project cost is estimated to be $6.5-$6.6B (in 2018 dollars). This project is expected to reduce demand and congestion on Route 105, thereby reducing HOV degradation.

- Project 07-30460 will add active traffic management and traffic monitoring system improvements along Route 105 between Route 605 and Route 1. Project construction began in November 2017; completed in June 2022.

- Implement Coordinated Adaptive Ramp Metering strategies. District 7 will receive approximately $8 million in the 2024 SHSMP/SHOPP funding. District 7 has been entering HOV Degradation Mitigation into the Asset Management Tool for existing projects involving ramp work and estimates that about 15 percent of the total DVHD reduction would come from metering the HOV preferential lanes.

- District 7 will evaluate defective sensors and begin initiating projects to repair defective sensors.

4.4.10 ACTION PLAN FOR HOV FACILITIES ON ROUTE 110

A. ANALYSIS

- The HOV lane was changed to a HOT lane in 2012 by LA Metro. Vehicle volume has increased because of the addition of toll-paying vehicles and an increase in violation rates. LA Metro's Pricing Algorithm cannot control demand, even under "HOV Only" mode due to high occupancy violations. The occupancy violation rate with the self-declaring FasTrak flex transponder has increased over time, as SOVs set the transponder as HOV to avoid paying the toll. Approximately 30 to 60 percent of users are not setting the transponder correctly. Manual counts show over 84 percent of vehicles in the HOT lane are SOVs and only 11 percent carpools in 2021.

- The conversion of the Route 110 HOV lane into the HOT lanes increased the vehicle volume at the northbound terminus at Adams Boulevard. The location was not upgraded to sustain the increase in traffic volumes. Adams Boulevard will continue to be a bottleneck because the release of vehicles depends on traffic signals.

- Congestion in the GP lanes extends into the HOT lane at the northbound terminus.

- Poor data quality. Route 110 northbound only has 2 functional detection sensors. Route 110 southbound only has 1 functional detection sensor in 2021.

- Southbound 110 HOT direct connector to the eastbound 105 HOV lane is congested during peak hours.

B. REMEDIATION STRATEGIES

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.

- Caltrans, in partnership with LA Metro, has implemented the following strategies to improve performance:
  - o Modified the HOT lane operation by adding channelizers on the buffer striping. The channelizers were almost immediately hit and caused them to dislodge. This became a safety issue for motorists and for maintenance crews. LA Metro is currently deciding whether to remove the channelizers on the 110 HOT lanes. Channelizers have already been removed from the 10 HOT lanes.
  - o Work is ongoing to repair and update the detector system to improve data collection.
  - o LA Metro installed the Automatic Vehicle Occupancy Detection System (AVODS) in late 2019, based on Caltrans' violation data, and it has been in the testing phase since June 2020. LA Metro has notified the transponder holders that the new occupancy enforcement system is in place. However, due to software and back-office communication issues, etc., LA Metro is still not using it for enforcement, which entails sending a letter indicating that transponder is set wrong, and in the future, the toll would be charged.
  - o Digital occupancy sign panels on the overhead toll transponder readers that display the transponder setting to assist CHP to enforce vehicle occupancy or toll violations were installed in 2019. These sign panels can be seen from both sides of the display. CHP indicates the sign panels are very useful and more effective than the flashing white and blue lights that were previously used.
  - o Increase the minimum toll rate.
  - o Place additional signs along the HOT lane to inform motorists of regulations and to deter violators. LA Metro has added additional signs notifying motorists that FasTrak transponders are required to access the HOT lane.
- LA Metro West Santa Ana Branch Transit Corridor (WSAB) light rail transit (LRT) line will connect southeast LA County to downtown Los Angeles, serving the cities and communities along LA-5. WSAB Project is a 19-mile corridor undergoing an Environmental Impact Statement (EIS)/Environmental Impact Report (EIR) process. The current project cost is estimated to be

$6.5-$6.6B (in 2018 dollars). This project is expected to relieve traffic congestion on Route 110, thereby reducing HOV degradation.

- District 7 is assessing the viability of implementing Dynamic Active Traffic Management through the installation of Dynamic Message Signs above the freeway to display advisory speed limits and actively manage vehicle platoons.
- Caltrans requested that LA Metro repair all the defective sensors on northbound Route 110 HOT lanes. With the upcoming project of HOT lanes Corridors Incident Management Improvement (ECIM) on Route 10 and Route 110, Caltrans will have access to traffic data, cameras, and changeable message signs operated by LA Metro; expected to be completed by the end of 2022.
- Project 07-31450 will convert the existing HOV lanes on Route 105 to HOT lanes and add a second HOT lane in each direction. Construction is expected to begin in 2024, with anticipated completion in 2028. The estimated project cost is $600 million. This project will relieve congestion between southbound Route 110 HOT direct connectors to eastbound Route 105 HOV. If properly enforced for occupancy and toll violations, the new HOT lanes should operate at free-flow conditions using the pricing algorithm.
- Beginning in 2023, LA Metro will prepare the Route 110 HOT Lane Degradation Action Plan.
- District 7 will evaluate defective sensors and begin initiating projects to repair defective sensors.

4.4.11 ACTION PLAN FOR HOV FACILITIES ON ROUTE 118

A. ANALYSIS

- Afternoon peak period recurrent congestion in all lanes reduces HOV lane performance and speed on eastbound. The average percentage of degraded days (speeds below 45mph) EB during the PM 3-hour peak period decreased by 6.7% compared to the year 2019 (Appendix D, Table 4.4-1).
- Because the HOV lane ends, the added demand from the Route 405, and the motorists transitioning to Route 5 and/or continuing to Route 210 cause multiple weaving maneuvers across the freeway.

- Two lane drops on GP lanes (on southbound Route 5) contribute to congestion on GP lanes and then cause the friction factor for the HOV lane.
- Route 118 HOV lane ends and merges into the GP lane before Route 5.
- High weaving volumes from Route 405.

Figures 4.4-25 and 4.4-26 provide plots of eastbound HOV and GP lane speeds along the length of the HOV facility on Route 118 during the fourth quarter of 2021.

FIGURE 4.4-25. AVERAGE HOV LANE SPEED – EASTBOUND ROUTE 118, Q4 2021

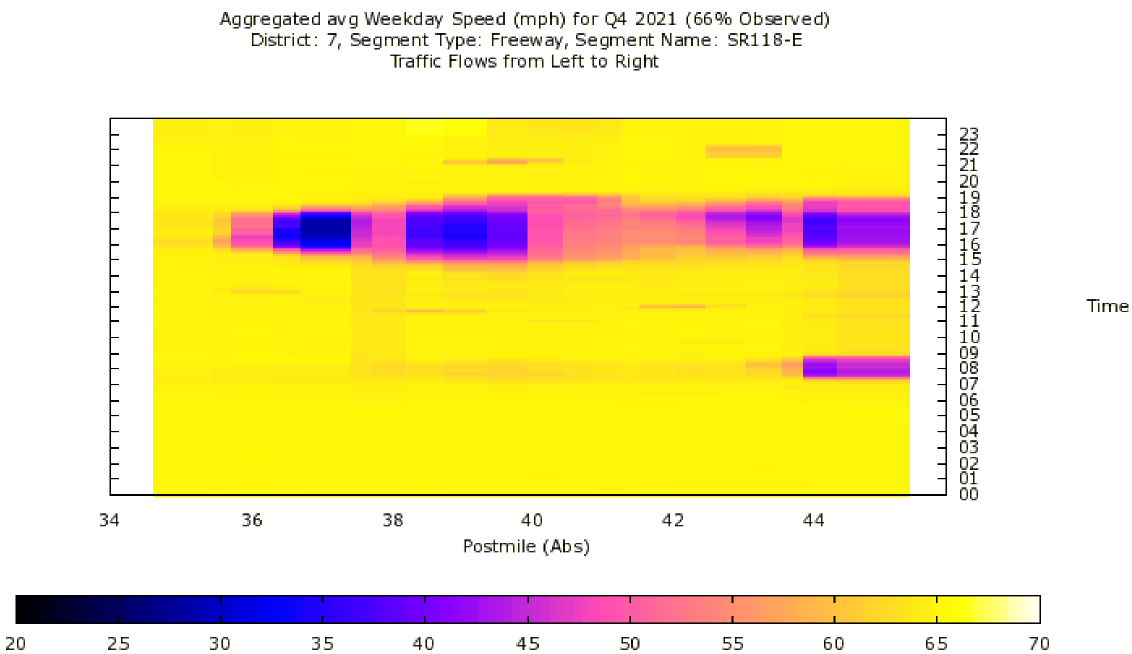
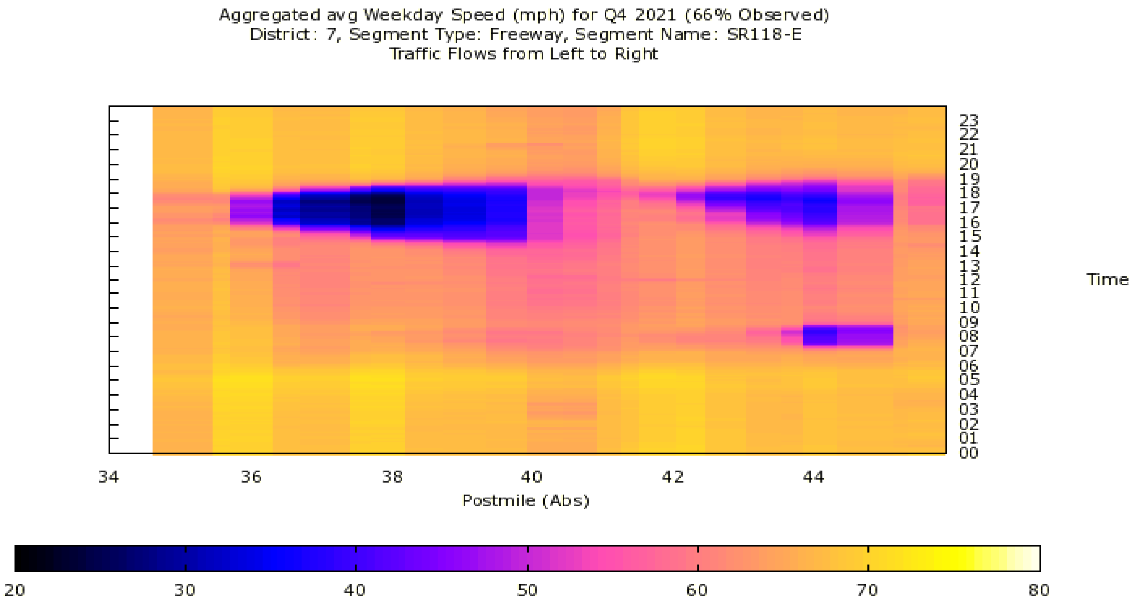


FIGURE 4.4-26. AVERAGE GP LANE SPEED – EASTBOUND ROUTE 118, Q4 2021



B. REMEDIATION STRATEGIES

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.
- LA Metro is implementing the North Hollywood to Pasadena Bus Rapid Transit (BRT) Corridor, an 18-mile-long BRT project which will be a key regional connection between the San Fernando and San Gabriel Valleys with connections to the Metro Red, Orange, and Gold Lines, as well as Metrolink and other municipal bus lines. LA Metro has added a Route 134 route option in the Eagle Rock portion of the study area. This project is funded by Measure M and Senate Bill 1, which provide $267 million in funding. The Project has an anticipated opening date in 2024. This project is expected to relieve traffic congestion on Route 118, hence reducing HOV degradation.
- District 7 will review the existing lane configuration by December 2022, of the Route 118 eastbound to Route 5 southbound connector ramp, to possibly eliminate the lane drops on the connector, through re-striping of the pavement delineation.

4.4.12 ACTION PLAN FOR HOV FACILITIES ON ROUTE 134

HOV facilities on Route 134 are split in two at the interchange with Route 5. These action plans cover the entire route.

A. ANALYSIS

- Afternoon peak period recurrent congestion in all lanes reduces HOV lane performance and speed on eastbound. The average percentage of degraded days (speeds below 45mph) EB during the PM 3-hour peak period decreased by 11.3% compared to the year 2019 (Appendix D, Table 4.4-1).
- High solo violation rates (approximately 10 percent). District 7's 2021 Manual Occupancy Data indicates that the HOV violation rate is between 10 and 12 percent during AM/PM peak hours at Pass Avenue (PM 1.82).
- High CAV decal rates. District 7's 2021 Manual Occupancy Data shows the rate is up to 11 percent in both directions during peak hours.
- Eastbound Route 134 has no direct freeway connector to northbound Route 5. Motorists must exit the freeway onto local streets to get onto northbound Route 5. Off-ramp back up, lane reduction, and end of HOV lane, causes congestion on GP lanes and HOV lane.
- Vehicle weaving conflict at Route 5 interchange.
- The westbound 134 HOV lane ends as the #1 general purpose lane near Route 101; motorists from the GP lane jump in front of the carpoolers while the number of GP lanes reduces from five lanes down to two causing traffic congestion, which then impedes the carpoolers in the HOV lane. This decrease in capacity is due to the westbound 134 to westbound 101 connector structure that has already been restriped to utilize full capacity; any further improvements would require extensive construction and funding.

Figures 4.4-27 and 4.4-28 provide plots of eastbound HOV and GP lane speeds along the length of the HOV facility on Route 134 during the third quarter of 2021. Figures 4.4-29 and 4.4-30 provide plots of the westbound HOV and GP lane speeds along the length of the HOV facility on Route 134 during this same period.

FIGURE 4.4-27. AVERAGE HOV LANE SPEED – EASTBOUND ROUTE 134, Q3 2021

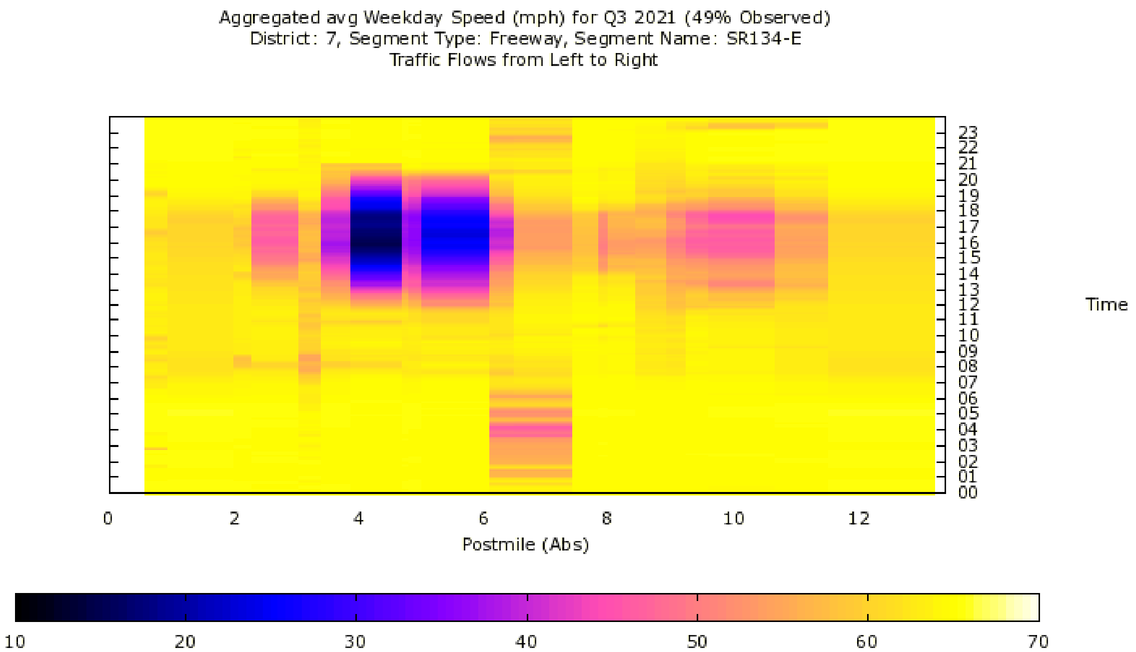


FIGURE 4.4-28. AVERAGE GP LANE SPEED – EASTBOUND ROUTE 134, Q3 2021

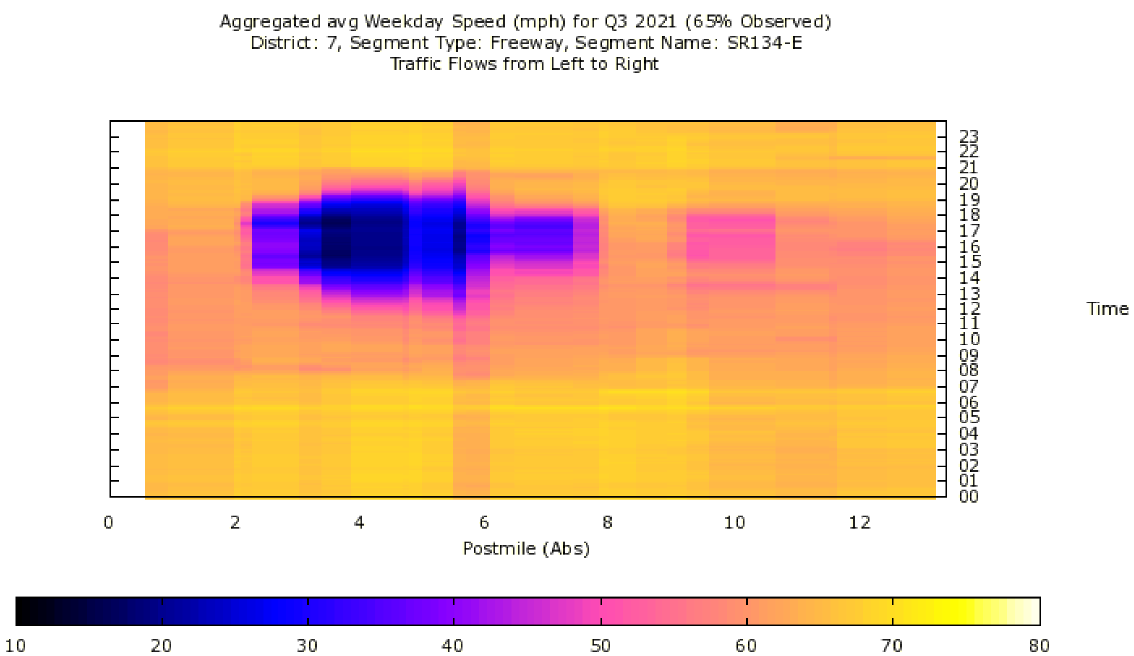


FIGURE 4.4-29. AVERAGE HOV LANE SPEED – WESTBOUND ROUTE 134, Q3 2021

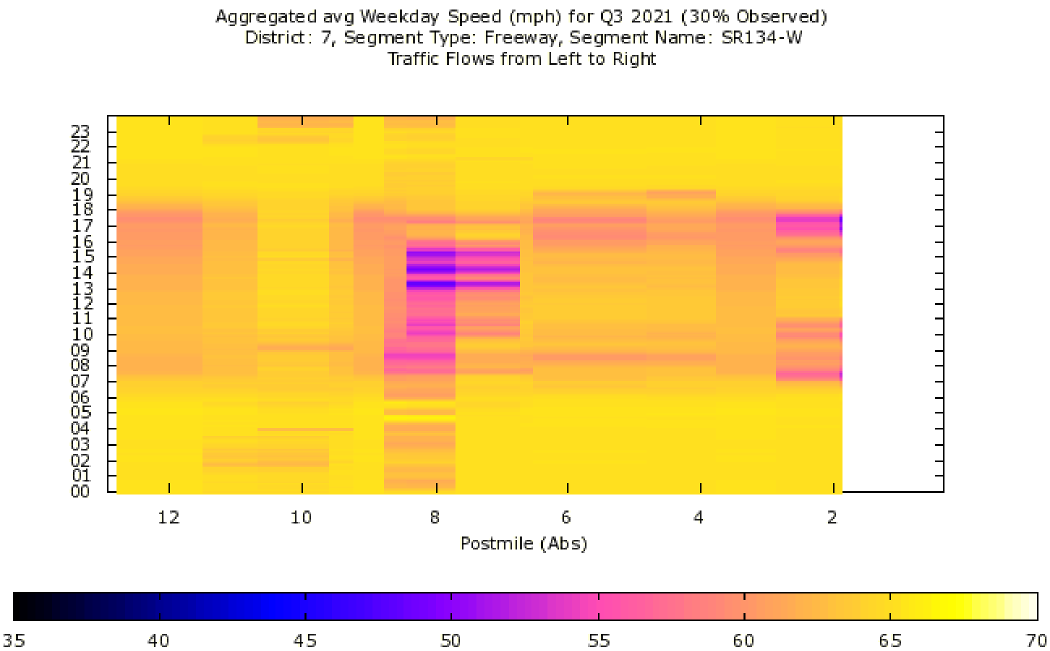
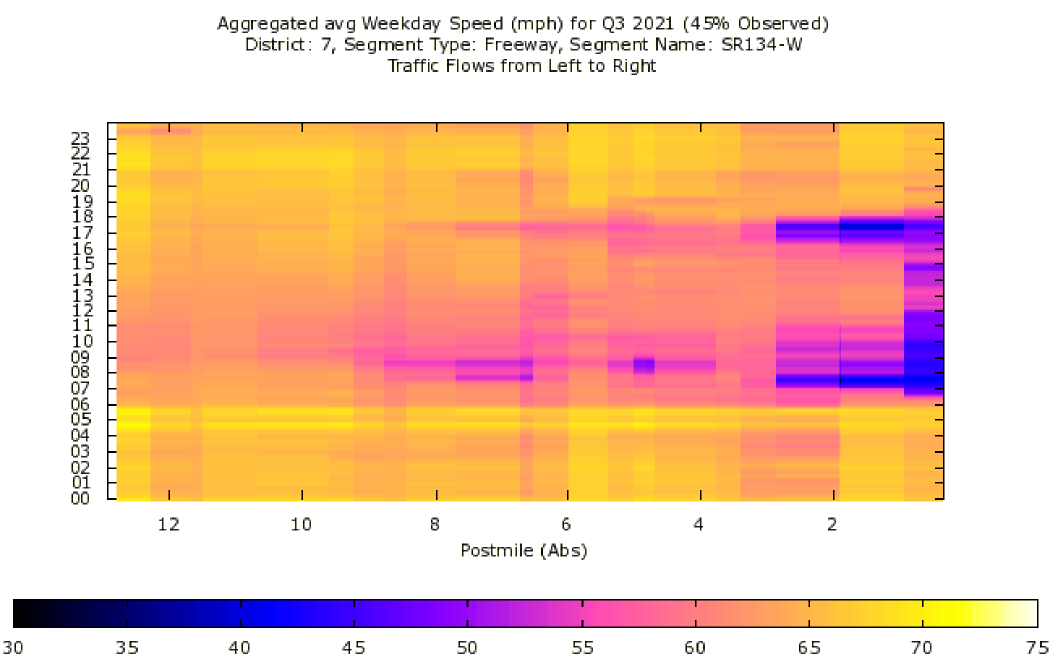


FIGURE 4.4-30. AVERAGE GP LANE SPEED – WESTBOUND ROUTE 134, Q3 2021



B. REMEDIATION STRATEGIES

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.

- LA Metro is implementing the North Hollywood to Pasadena Bus Rapid Transit (BRT) Corridor, an 18-mile-long BRT project which will be a key regional connection between the San Fernando and San Gabriel Valleys with connections to the Metro Red, Orange, and Gold Lines, as well as Metrolink and other municipal bus lines. LA Metro has added a Route 134 route option in the Eagle Rock portion of the study area. This project is funded by Measure M and Senate Bill 1, which provide $267 million in funding. The Project has an anticipated opening date in 2024. This project is expected to relieve traffic congestion on Route 134.

- District 7 shared vehicle occupancy counts and violation data with the California Highway Patrol (CHP), so they can prioritize their enforcement efforts.

- Interchange improvements at Route 5 include, but are not limited to, the construction of direct HOV connectors, ramp widening, or truck climbing lanes. Project (EA 07-12184) will widen I-5 and construct HOV lanes from I-5/SR-134 separation to Magnolia Blvd. This project is expected to complete in 2025 and will reduce the congestion on SR-134 close to I-5.

4.4.13 ACTION PLAN FOR HOV FACILITIES ON ROUTE 210

A. ANALYSIS

- Demand exceeds capacity. During the peak period, the average volume of the HOV lane is 1,630 vehicles/hour in congested locations.

- Afternoon peak period recurrent congestion in all lanes reduces HOV lane performance and speed on eastbound, and morning peak period recurrent congestion in all lanes reduces HOV lane performance and speed on westbound.

- Eastbound GP lane drops at El Molino Avenue, Rosemead Boulevard, and San Dimas Avenue cause bottlenecks.

- Vehicle weaving conflicts at ingress/egress locations due to congestion in the GP lanes.

- High CAV decal rates. District 7's 2021 Manual Occupancy Data shows the decal rate is up to 10.9 percent in both directions during peak hours. The solo violation rate is up to 8.6 percent in some locations westbound during morning peak hours.
- Route 210 also has a very high truck volume (approximately 6 percent) that connects the Port of Los Angeles to northern Los Angeles County.

Figures 4.4-30 and 4.4-31 provide plots of eastbound HOV and GP lane speeds on Route 210 during the fourth quarter of 2021. Figures 4.4-32 and 4.4-33 provide plots of westbound HOV and GP lane speeds on Route 210 during the fourth quarter of 2021.

FIGURE 4.4-30. AVERAGE HOV LANE SPEED – EASTBOUND ROUTE 210, Q4 2021

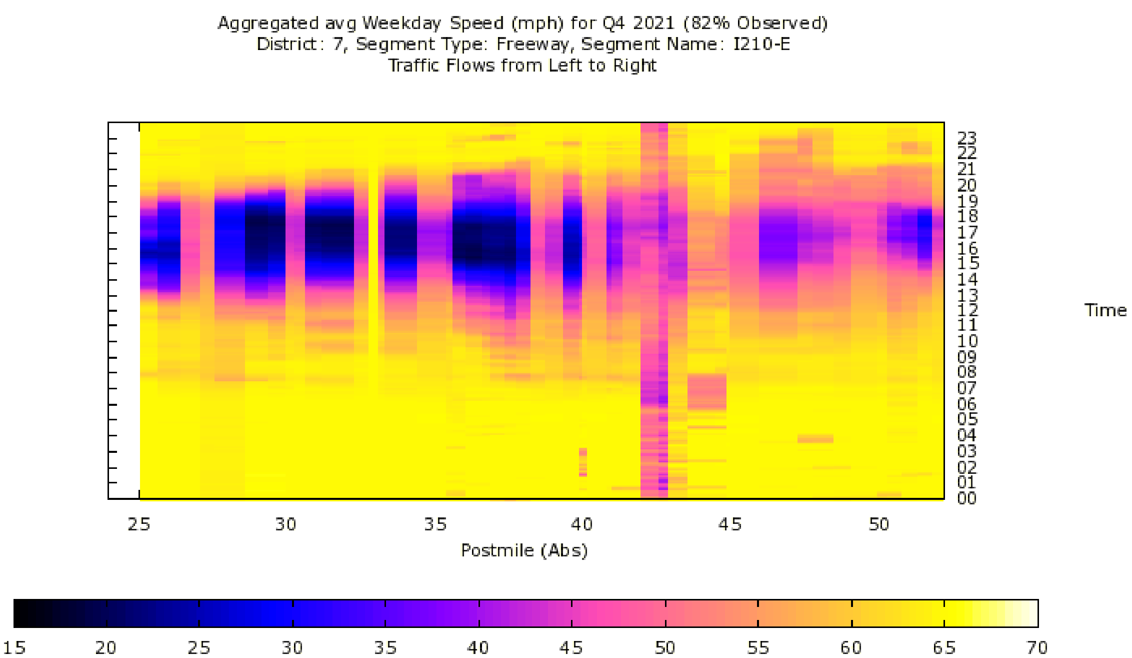


FIGURE 4.4-31. AVERAGE GP LANE SPEED – EASTBOUND ROUTE 210, Q4 2021

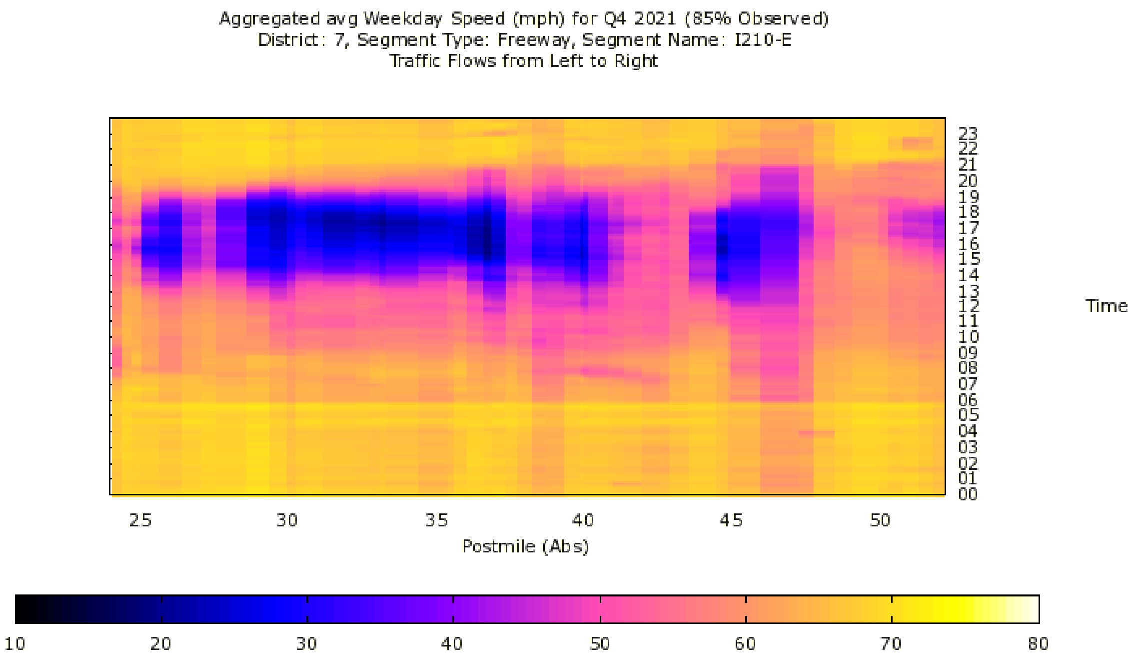


FIGURE 4.4-32. AVERAGE HOV LANE SPEED – WESTBOUND ROUTE 210, Q4 2021

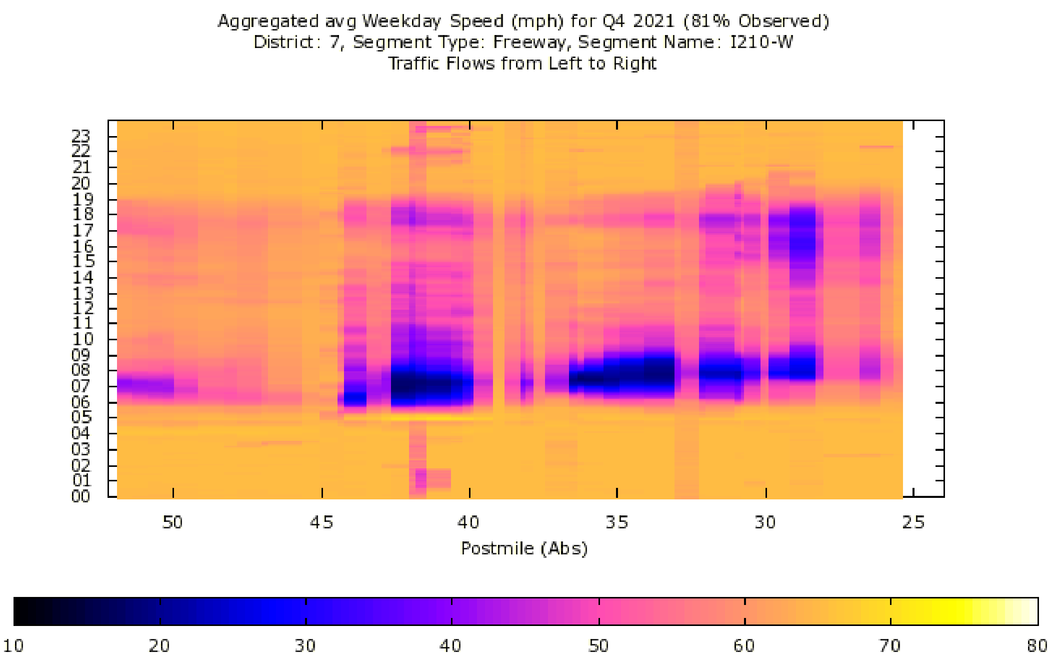
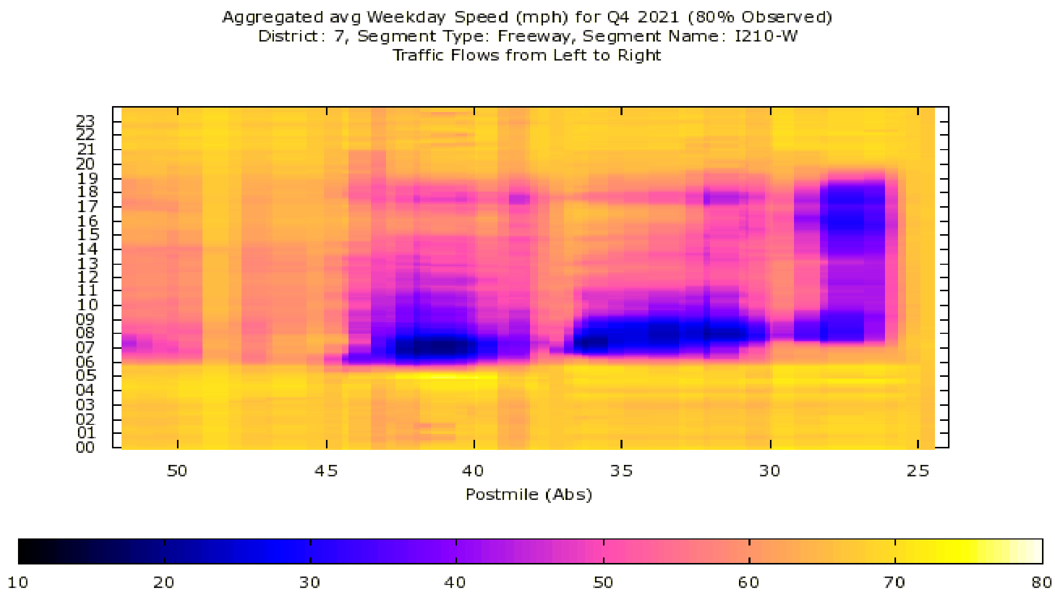


FIGURE 4.4-33. AVERAGE GP LANE SPEED – WESTBOUND ROUTE 210, Q4 2021



B. REMEDIATION STRATEGIES

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.

- District 7 is establishing a Connected Corridor Integrated Corridor Management on I-210 (EA32910). This will involve the coordination between Caltrans, local agencies, CHP, and first responders for incident management, construction activities, and special events. The project includes ramp metering synchronization, traffic signal synchronization, Transportation Management Systems, and Intelligent Transportation Systems. Completion is expected in July 2023. This project will allow the proactive traffic and transportation management of the Corridor, hence reducing traffic congestion due to incidents and events.

- Increase public awareness. Update HOV violation fine amount on the existing signs to the current amount.

- District 7 shared vehicle occupancy counts and violation data with the California Highway Patrol (CHP), so they can prioritize their enforcement efforts.

- The Foothill Gold Line project from Glendora to Montclair will extend the Metro Gold Line 12.3 miles and add stations in the cities of along LA-210. Major construction began in mid-July 2020 and is expected to be completed to Pomona in 2025 (and to Montclair in 2028, if funding is secured in time to move forward with the contract option). Completion of the Glendora to Montclair segment is now estimated to cost $2.1 billion. Gold Line Foothill Extension's (LA-210-36/53 (07-33120)) expanded transit service along the Interstate 210 corridor will address transportation problems, and deficiencies and help relieve traffic congestion.

- Implement access strategies, including increasing the length of access area or frequency of access, continuous access, or modification/elimination of bottlenecks such as ingress/egress locations. These improvements have been incorporated into LA Metro's design plans for the 210 Median Barrier Replacement Project.

- Alameda Corridor-East (ACE) Project founded by The San Gabriel Valley Council of Governments (SGVCOG) will mitigate the impacts of significant increases in freight rail traffic on over 70 miles of mainline railroad in the San Gabriel Valley. The ACE Project consists of a comprehensive program of safety improvements and mobility upgrades at an estimated cost of $1.9 billion. This project will relieve truck traffic from Long Beach and San Pedro to Inland Empire region, which will reduce congestion on GP lanes and HOV lanes.

- Perform continuous analysis, keeping a record of sensors repeatedly detected as erroneous. Perform ongoing monitoring to detect misconfigurations before they are used in performance reporting. Explore a second data source to determine HOV speeds/degradation. In addition, District 7 will evaluate defective sensors, and begin initiating projects to repair defective sensors.

4.4.14 ACTION PLAN FOR HOV FACILITIES ON ROUTE 405

A. ANALYSIS

- Demand exceeds capacity. During the 1-hour-peak period, the average HOV lane volume is 1,500 vehicles/hour in congested locations. In some locations, the maximum HOV lane volume is 1,800-2,000 vehicles/hour.

- Peak period recurrent congestion in all lanes reduces HOV lane performance and speed. There are three extremely degraded segments.

One is located between Route 10 and Victory Boulevard (PM 53.2-67.6) during the afternoon peak period on northbound and morning peak period on southbound. The second one is between Woodruff Ave and Santa Monica Blvd (PM 25.4-54.6) during the afternoon peak period southbound. The third one is approximately between Vermont and Westminster (PM37.1-52.3) northbound during the morning peak period.

- The average percentage of degraded days (speeds below 45mph) NB during the AM 3-hour peak period decreased by 10.3% compared to the year 2019 (Appendix D, Table 4.4-1).
- Route 405 NB (at the northern termini) experiences degraded conditions due to the following factors: 1. A lane drop at San Fernando Mission Blvd. (freeway capacity decreases to 3+1); 2. The end of the HOV lane which becomes the #1 general purpose lane before entering the tunnel; 3. Another lane drop occurs after the freeway exits the tunnel at the joining of I-405 and I-5 freeway merge. The current pavement delineation utilizes full width through the tunnel; therefore reconstruction would need to occur for the possibility of added capacity.
- With narrow buffers between HOV and GP lanes, congestion or slow-down in GP lanes causes friction on HOV lanes. During the afternoon peak hour period, the average GP and HOV speeds northbound are 25.4 mph and 31.9 mph respectively (PM 53-64).
- Vehicle weaving conflicts at ingress/egress locations due to congestion in the GP lanes southbound.
- GP lane drops approaching the Route 110 interchange, causing a bottleneck southbound.
- Non-metered on-ramps allow platoons of vehicles to enter the freeway. When opportunity occurs (local projects and/or dedicated funding), ramp metering equipment is installed.
- The high percentage of CAV decal vehicles (exceeds 17 percent in some locations).
- Route 405 northbound and southbound through the Sepulveda Pass is uphill with a 5% grade affecting vehicle speeds in all lanes, especially trucks.

Figures 4.4-34 and 4.4-35 provide plots of northbound HOV and GP lane speeds on Route 405 during the fourth quarter of 2021. Figures 4.4-36 and 4.4-

37 provide plots of southbound HOV and GP lane speeds on Route 405 during the fourth quarter of 2021.

FIGURE 4.4-34. AVERAGE HOV LANE SPEED – NORTHBOUND ROUTE 405, Q4 2021

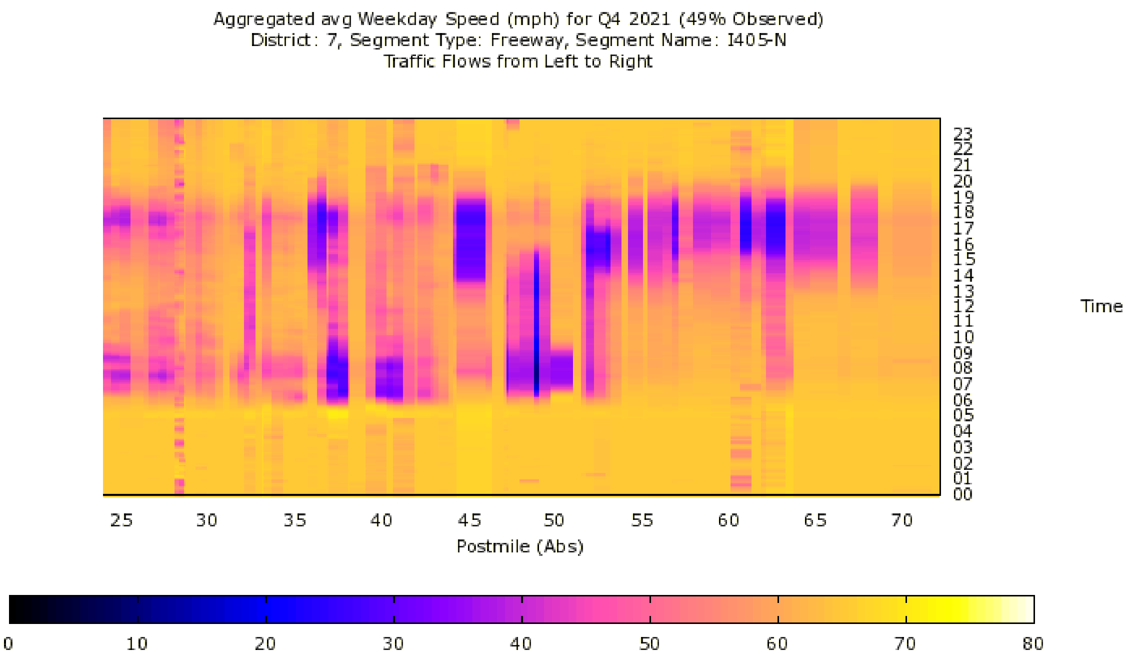


FIGURE 4.4-35. AVERAGE GP LANE SPEED – NORTHBOUND ROUTE 405, Q4 2021

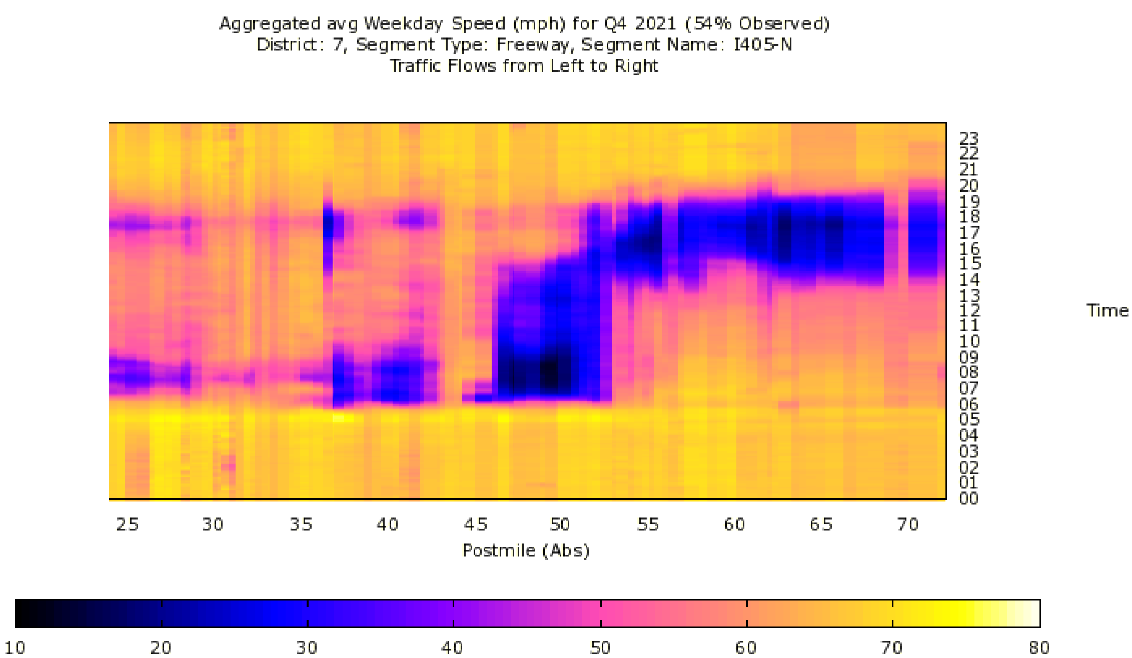


FIGURE 4.4-36. AVERAGE HOV LANE SPEED – SOUTHBOUND ROUTE 405, Q4 2021

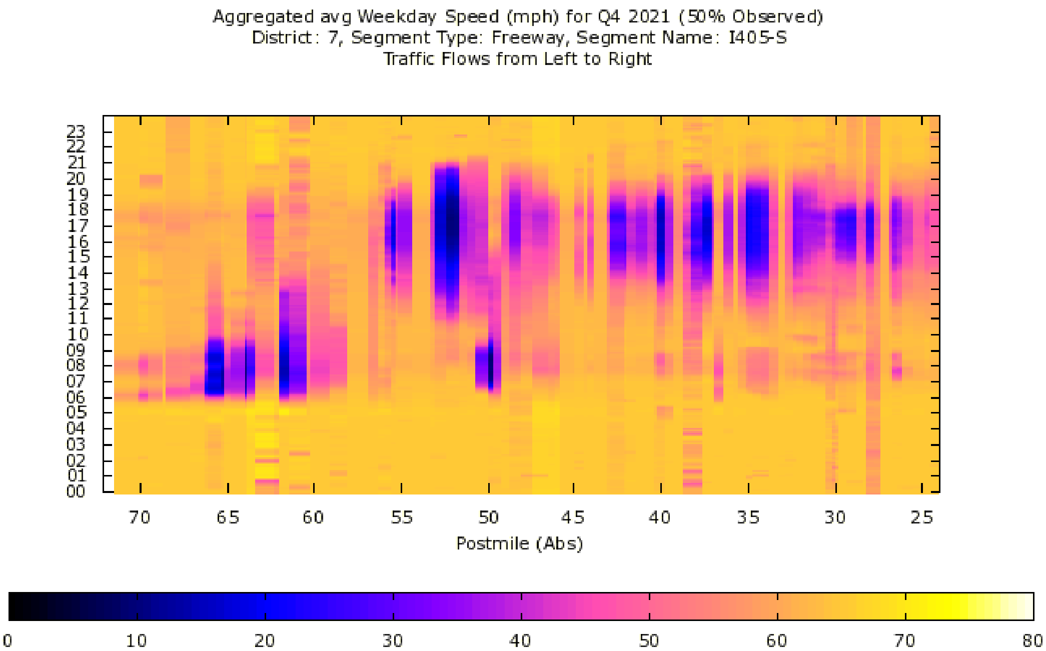
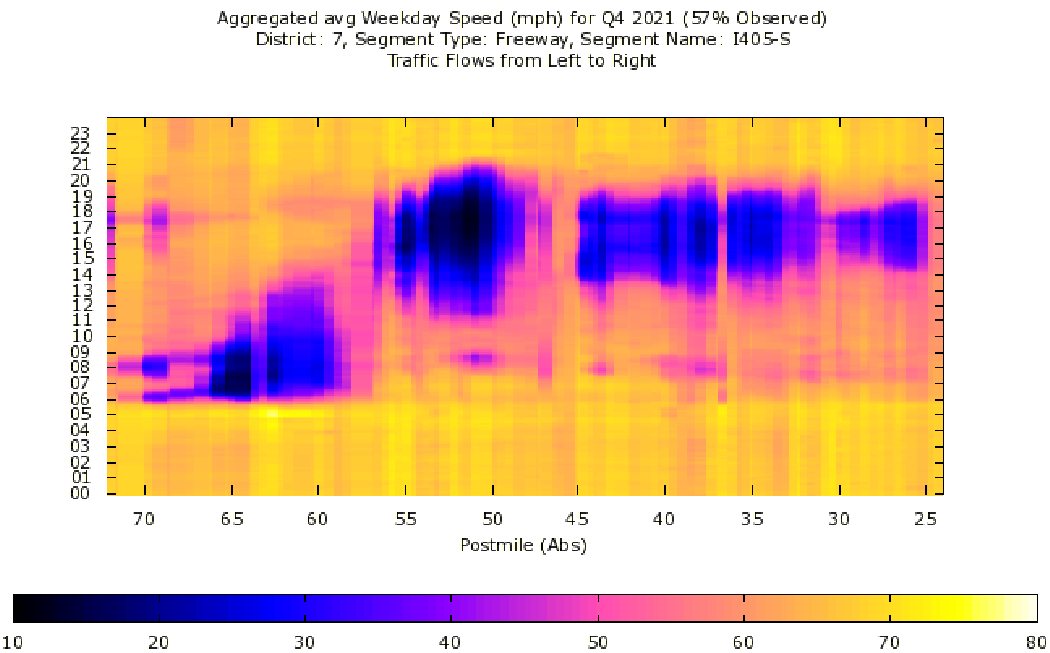


FIGURE 4.4-37. AVERAGE GP LANE SPEED – SOUTHBOUND ROUTE 405, Q4 2021



B. REMEDIATION STRATEGIES

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.
- Project 07-35310 adds auxiliary lanes in both directions of Route 405 between the interchanges of Redondo Beach and Hawthorne Boulevard, Hawthorne Boulevard and Inglewood Avenue, and Inglewood Avenue and Rosecrans Avenue to improve traffic operations and enhance safety through the corridor. The project will be developed by LA Metro. Construction is expected to begin in late 2022; expected to end in 2025. The estimated construction cost is $120 million. This project will reduce congestion on the GP lanes, and hence reduce HOV degradation caused by the friction factor.
- Project 07-29360 will improve the Route 405/Crenshaw interchange. The northbound off-ramp backs up onto the mainline. The project will include improvements to on/off ramps plus widening and adding an auxiliary lane. (Construction is expected to begin in late 2020; expected to end in 2024). The estimated construction cost is $70 million. This project will reduce congestion on the GP lanes, and hence reduce HOV degradation caused by the friction factor.
- Project 07-23400 will widen Route 405 at the Dominguez Channel (addition of auxiliary lane), including the new addition of northbound Route 405 on-ramp at Wilmington Avenue, ramp modifications and widening of Wilmington Avenue from East 223rd Street to East 220th Street, a bridge retrofit over Dominguez Channel and traffic signal synchronization. Begin construction 2014; end construction 2021. The estimated construction cost is $20 million.
- Add connector metering and ramp metering between Route 105 to Route 90 interchanges. Meter HOV preferential lanes at on-ramps. Work is in progress. Various routes are in different stages subject to project funding within the corridor. District 7 will receive approximately $8 million in the 2024 SHSMP/SHOPP funding. District 7 has been entering HOV Degradation Mitigation into the Asset Management Tool for existing projects involving ramp work and estimates that about 15 percent of the total DVHD reduction would come from metering the HOV preferential lanes.

- Project 07-35070 provides active traffic management and related traffic management system upgrades along Route 405 near LAX/Route 105, RTL is projected for October 2023, PA&ED August 2021; contract completion is anticipated by May of 2027.

- Improvements along Route 405 South Bay Curve: LA Metro plans new auxiliary lanes to improve traffic flow at on- and off-ramps. Completion would be accelerated from 2028 to 2027.

- LA Metro plans to extend service on the Green and Crenshaw/LAX Lines 4.6 miles southward to a new transit center in Torrance. This South Bay Light Rail Extension project is part of the "28 by 28" initiative. This project will relieve the congestion on Route 405.

- Project 07-35432 will convert the HOV lanes on Route 405 between the LA/Orange County Line and Route 10 to HOT lanes. Target completion 2035. If properly enforced for occupancy and toll violations, the new HOT lanes should operate at free-flow conditions using the pricing algorithm.

- Project 07-35433 will convert the one HOV lane on Route 405 between Route 10 and Route 101 to two HOT lanes. Target completion 2028. If properly enforced for occupancy and toll violations, the new HOT lanes should operate at free-flow conditions using the pricing algorithm.

- District 7 is monitoring the impact that the decal program has on the level of degradation.

- District 7 completed the study of possible pavement delineation re-striping to eliminate lane-drop configurations. The study concluded that this is not recommended, due to on-ramp to mainline merging concerns.

- Perform continuous analysis, keeping a record of sensors repeatedly detected as erroneous. Perform ongoing monitoring to detect misconfigurations before they are used in performance reporting. Explore a second data source to determine HOV speeds/degradation. In addition, District 7 will evaluate defective sensors, and begin initiating projects to repair defective sensors.

4.4.15 ACTION PLAN FOR HOV FACILITIES ON ROUTE 605

A. ANALYSIS

- Demand exceeds capacity. During the peak period, the average HOV lane volume is above 1,450 vehicles/hour in congested locations.
- Afternoon peak period recurrent congestion in all lanes reduces northbound HOV lane performance and speed between Rosecrans Avenue and Valley Boulevard (PM 9.0-20.8). The average percentage of degraded days (speeds below 45mph) NB during the PM 3-hour peak period decreased by 11.0% compared to the year 2019 (Appendix D, Table 4.4-1). Morning and afternoon peak period recurrent congestion in all lanes reduces southbound HOV lane performance and speed for the same location. (37.9/28.6 mph GP vs. 40 mph HOV). The average percentage of degraded days (speeds below 45 mph) SB during the AM and PM 3-hour peak period decreased by 11.8% and 3.3% respectively compared to the year 2019(Appendix D, Table 4.4-1).
- When there is a narrow buffer between the HOV and GP lanes, congestion or slow-down in GP lanes causes friction in HOV lanes. During the morning peak period, between Rosecrans Avenue and Valley Boulevard (PM 9.0-20.8), the average GP and HOV speeds southbound are 37.9 and 40.0 mph respectively. During the afternoon peak period for the same location and direction, the average GP and HOV speeds southbound are 23.8 and 27.6 mph respectively.
- The high CAV decal rate and high truck rate contribute to congestion on I-605. The average truck rate is 7.7 percent. District 7's 2021 Manual Occupancy Data shows the CAV decal rate is up to 9.8 percent during peak hours.
- High vehicle volumes from Route 5 cause congestion in the northbound GP lanes.
- GP lane drops southbound at Route 5 interchange cause a bottleneck.
- Vehicle weaving conflicts at ingress/egress locations due to congestion in the GP lanes.
- Non-metered on-ramps allow platoons of vehicles to enter the freeway. When the opportunity occurs (local projects and/or dedicated funding), ramp metering equipment is installed.
- There are many defective sensors, which cause no data coverage on some segments, especially southbound. Two big gaps have been found. One is

between Noyes Street and south of Route 60 (PM 16.942-19.152); the other is between Artesia Boulevard and Placia Pl (PM 7.0-13).

Figures 4.4-38 and 4.4-39 provide plots of northbound HOV and GP lane speeds on Route 605 during the fourth quarter of 2021. Figures 4.4-40 and 4.4-41 provide plots of southbound HOV and GP lane speeds on Route 605 during the fourth quarter of 2021.

FIGURE 4.4-38. AVERAGE HOV LANE SPEED – NORTHBOUND ROUTE 605, Q4 2021

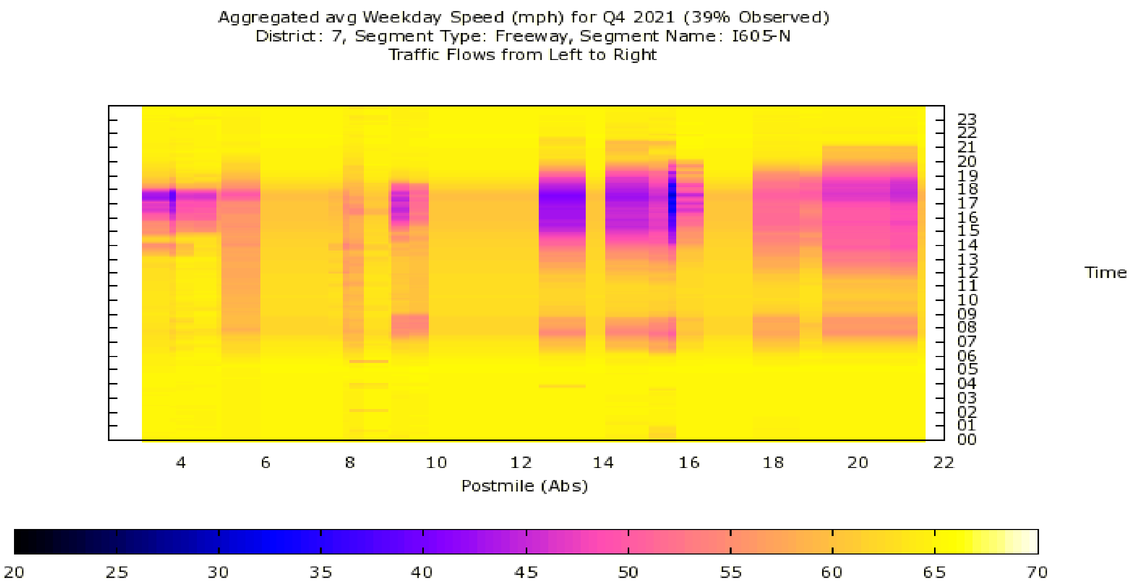


FIGURE 4.4-39. AVERAGE GP LANE SPEED – NORTHBOUND ROUTE 605, Q4 2021

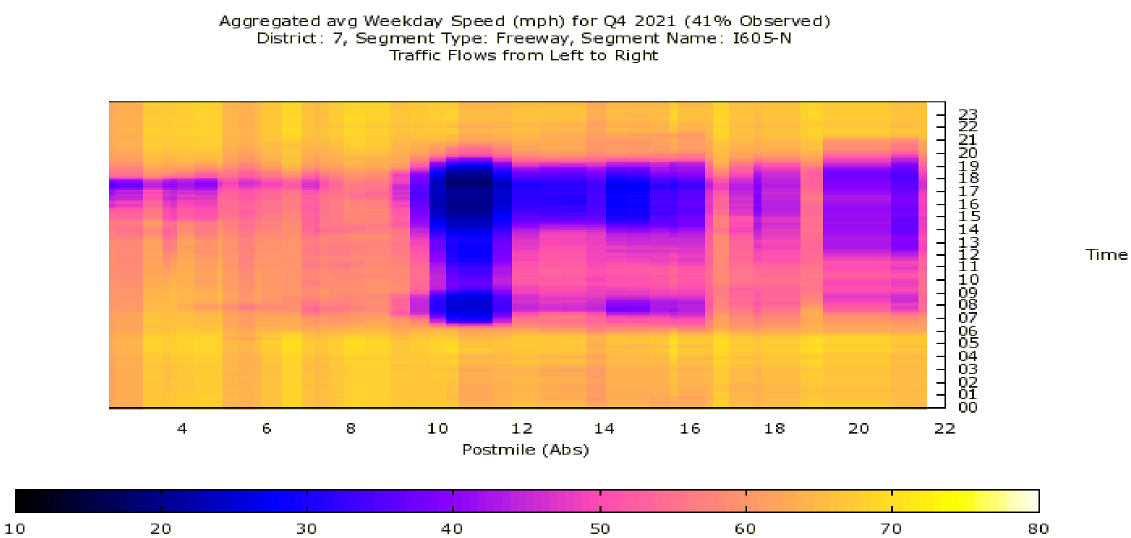


FIGURE 4.4-40. AVERAGE HOV LANE SPEED – SOUTHBOUND ROUTE 605, Q4 2021

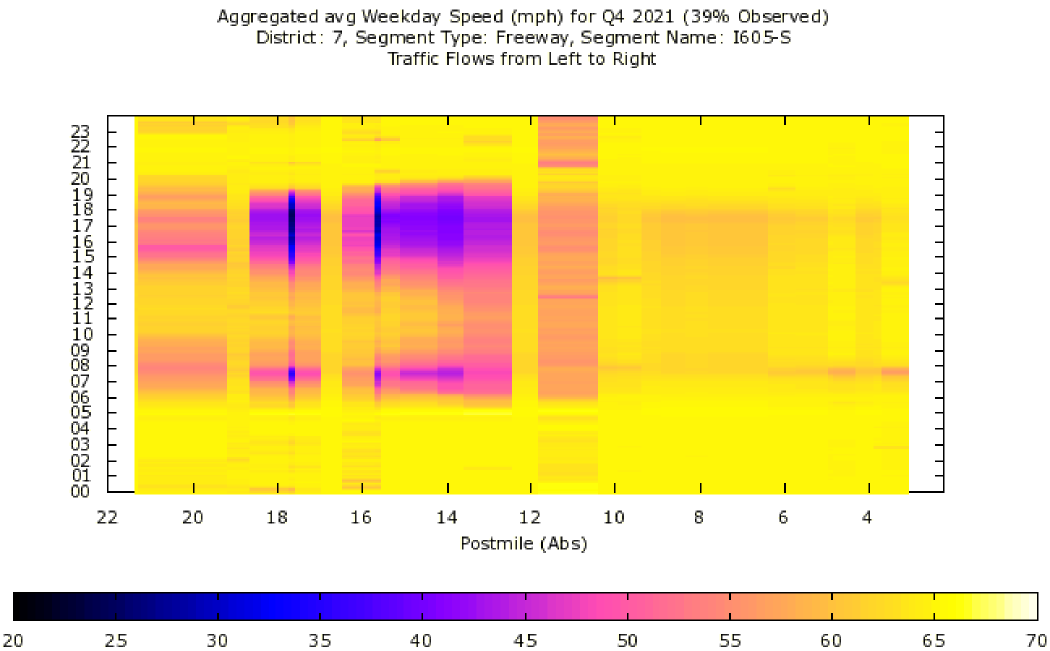
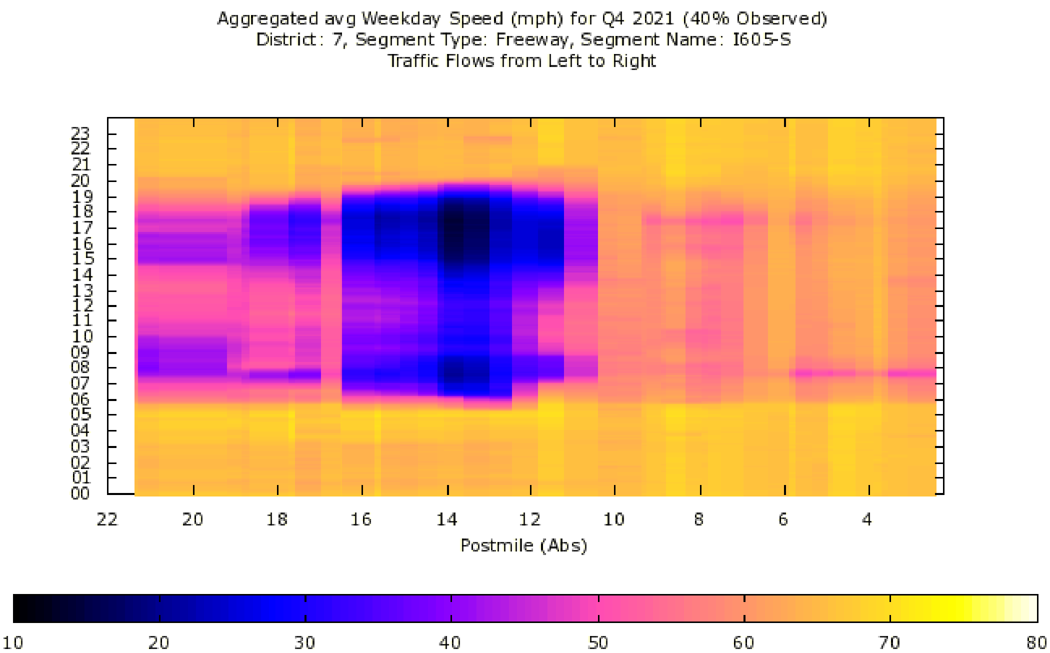


FIGURE 4.4-41. AVERAGE GP LANE SPEED – SOUTHBOUND ROUTE 605, Q4 2021



B. REMEDIATION STRATEGIES

- Degraded segments have been entered into the TIRTS for "TH" investigations, to investigate, evaluate and make any recommendations to mitigate HOV degradation.

- HOT lanes are proposed for Route 605 between the Orange County line and Route 10. Construction will be funded by Measure R funds and the forthcoming Transportation Strategic Plan-Phase II. The project would also be eligible for federal-aid funding. This project would be implemented in several stages:

  - Project 07-29821 will add one or two HOV or HOT lanes on Route 605 from Rosecrans Avenue to Slauson Avenue in the cities of Downey, Norwalk, and Santa Fe Springs. This project also includes the construction of new HOV or HOT direct connectors between the HOV/HOT lanes on Route 605 and Route 105. Begin construction February 2028; end construction January 2031. Construction cost estimate is $ 2.1billion. If properly enforced for occupancy and toll violations, the new HOT lanes should operate at free-flow conditions using the pricing algorithm.

  - Project 07-3101U will widen Route 605 to add one GP lane and one HOV or HOT lane in each direction between Slauson Avenue and Route 10. Begin construction February 2028; end construction January 2031. The construction cost estimate is $ 2.8 billion. If properly enforced for occupancy and toll violations, the new HOT lanes should operate at free-flow conditions using the pricing algorithm.

  - Project 07-29810 will widen Route 91 by adding one to two lanes along Route 91 from Paramount Boulevard to Shoemaker Avenue. The project also includes capacity enhancement on Route 605 between Centralia Street to Rosecrans Avenue. The project begins construction in August 2021 and ends construction in September 2025. Project cost is estimated at $450 million. This project should reduce congestion on GP lanes and HOV lanes.

- Alameda Corridor-East (ACE) Project founded by The San Gabriel Valley Council of Governments (SGVCOG) will mitigate the impacts of significant increases in freight rail traffic on over 70 miles of mainline railroad in the San Gabriel Valley. The ACE Project consists of a comprehensive program of safety improvements and mobility upgrades at an estimated cost of $1.7 billion. This project will relieve truck traffic from Long Beach and San Pedro to the Inland Empire region, thereby reducing congestion on GP and HOV lanes.

- Implement access strategies, including increasing the length of access area or frequency of access, continuous access, or modification/elimination of bottlenecks such as ingress/egress locations. These improvements have already been incorporated into the pavement rehabilitation project in the design stage at this time. The pavement rehabilitation project (EA 07-35660) will implement access strategies on Route 605, between Telegraph Road Undercrossing and I-605/I-10 Separation including increasing the length of access area or frequency of access and modification/elimination of bottlenecks such as ingress/egress locations. Construction is expected to begin in 2024.

- Meter HOV preferential lanes at on-ramps. Work is in progress. Various routes are in different stages subject to project funding within the area. District 7 will receive approximately $8 million in the 2024 SHSMP/SHOPP funding. District 7 has been entering HOV Degradation Mitigation into the Asset Management Tool for existing projects involving ramp work and estimates that about 15 percent of the total DVHD reduction would come from metering the HOV preferential lanes.

- District 7 has completed the study on the possible pavement delineation re-striping to eliminate lane-drop configurations on Route 605. There are two proposed projects (EAs 29821 and 3101U) that will include the construction of some auxiliary lanes at locations where the roadway will be widened. These proposed improvements would eliminate some of the lane-drop configurations.

- Perform continuous analysis, keeping a record of sensors repeatedly detected as erroneous. Perform ongoing monitoring to detect misconfigurations before they are used in performance reporting. Explore a second data source to determine HOV speeds/degradation. In addition, district 7 will evaluate defective sensors, and begin initiating projects to repair defective sensors.

4.5. DISTRICT 8 DEGRADATION ACTION PLANS

4.5.1 SUMMARY OF DEGRADATION ON HOV FACILITIES IN DISTRICT 8

APPENDIX A provides the list of degraded facilities in District 8 that were identified in the 2021 California High Occupancy Vehicle Facilities Degradation Report and Action Plan. The speed and degradation profiles for each degraded facility are provided in APPENDIX B.

4.5.2 DISTRICT-WIDE ACTIONS RELATED TO DEGRADATION

In February 2021, Caltrans, District 8, Division of Transportation Planning completed the initial Managed Lane Feasibility Study (MLFS). The purpose of this initial MLFS assessment is to identify potential managed lane concepts for Caltrans District 8 on corridors within the Inland Empire Region. This study is the steppingstone that will inform the development of a Manage Lane System Plan (MLSP), providing a comprehensive framework for the continued planning and implementation of a connected system and cohesive network of managed lanes throughout District 8.

On August 13, 2021, Caltrans D8 Operations presented D8 2020 HOV degradation action plan with Caltrans HQ and FHWA. During presentation D8 proposed to investigate all extremely degradation locations in a format of monitoring program and presented an extremely degraded location on Route 10 at Vineyard Ave. Vineyard Ave encompasses in the vicinity of Ontario Airport, Ontario Mills, I-15 Interchange and near the begin/end of HOV lane on Route 10. Caltrans HQ introduced a monitoring program TH to conduct investigations on HOV degraded locations statewide. D8 Operations identified 18 extremely HOV degraded locations on various Routes in the district vicinity to conduct investigation in a monitoring program format as approved by Caltrans HQ.

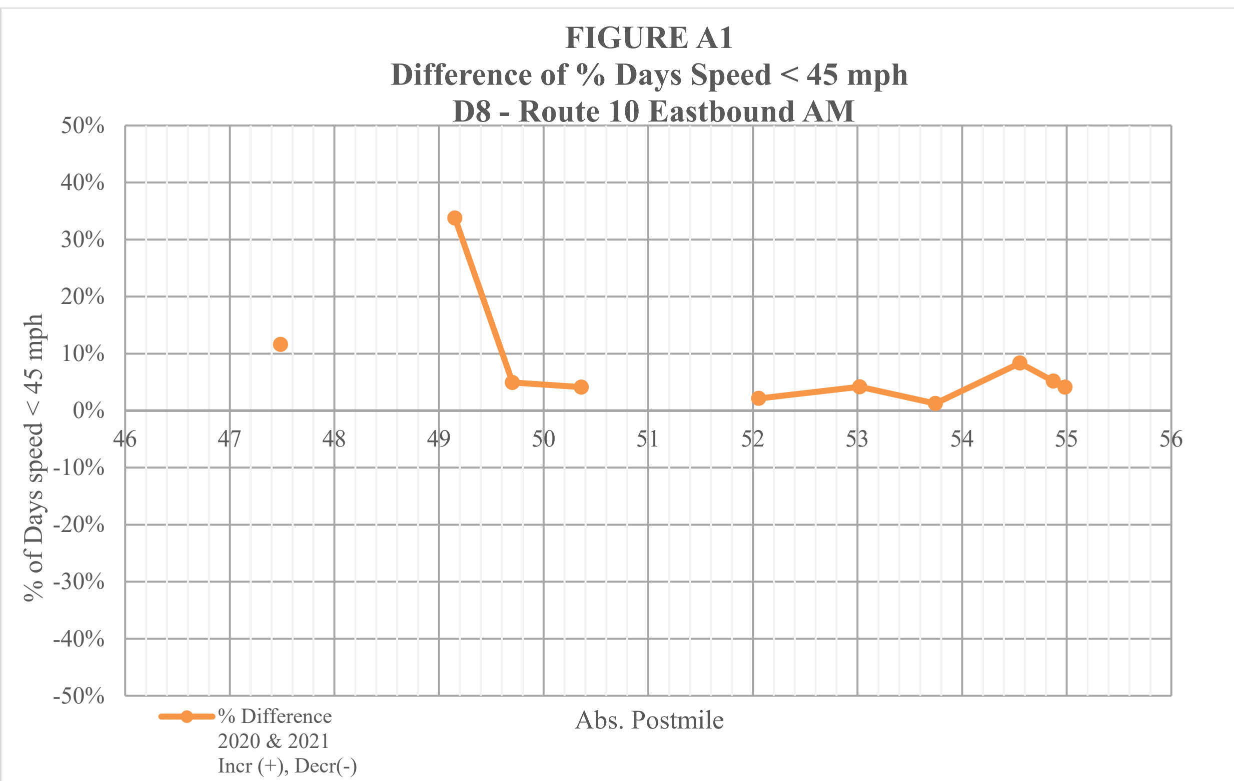
In May 2016, The San Bernardino County Transportation Authority (SBCTA) in cooperation with Caltrans proposed the addition of HOT lanes along both the Route 10 and the Route 15 freeway corridors as part of an overall long-term strategy of integrated initiatives to improve mobility, manage congestion, and increase vehicular and person throughput in San Bernardino County.

Construction of Route 10 HOT lane project Phase I from LA County Line to Etiwanda Avenue (just east of Route 15) started in March 2019 and is scheduled for completion of December 2023. This project will convert existing the HOV lanes to HOT operation and add a second HOT lane in each direction to create dual lane facilities. Occupancy requirements on the HOV lanes are currently two or more per vehicle and upon conversion, at least three occupants will be required for toll-free travel. An extension of the HOT lanes, from Route 15 to Ford Street in Redlands (Phase II & III), is currently projected to begin construction in 2025. Based on today's data from SBCTA website, the Phase II & III of this project are expected to construct in 10 years.

In March 2016, The Riverside County Transportation Commission (RCTC) in partnership with the California Department of Transportation (Caltrans) and the Federal Highway Administration (FHWA) proposed HOT lane projects to address current and future travel demand and improve traffic operations on the Route 15 corridor between Cajalco Road and the Route 15/Route 60 Interchange near the San Bernardino County line. Construction of Route 15 HOT lane project from Cajalco Road to just South of Route 60 started on April 2018 and was completed in April 2021. Direct connections from the southbound Route 15 HOT lanes to the Route 91 HOT lanes and from the Route 91 HOT lanes to the northbound Route 15 HOT lanes started construction on April 2021 and are scheduled to be completed in June 2023.

4.5.3 ACTION PLAN FOR HOV FACILITIES ON ROUTE 10

A. ANALYSIS



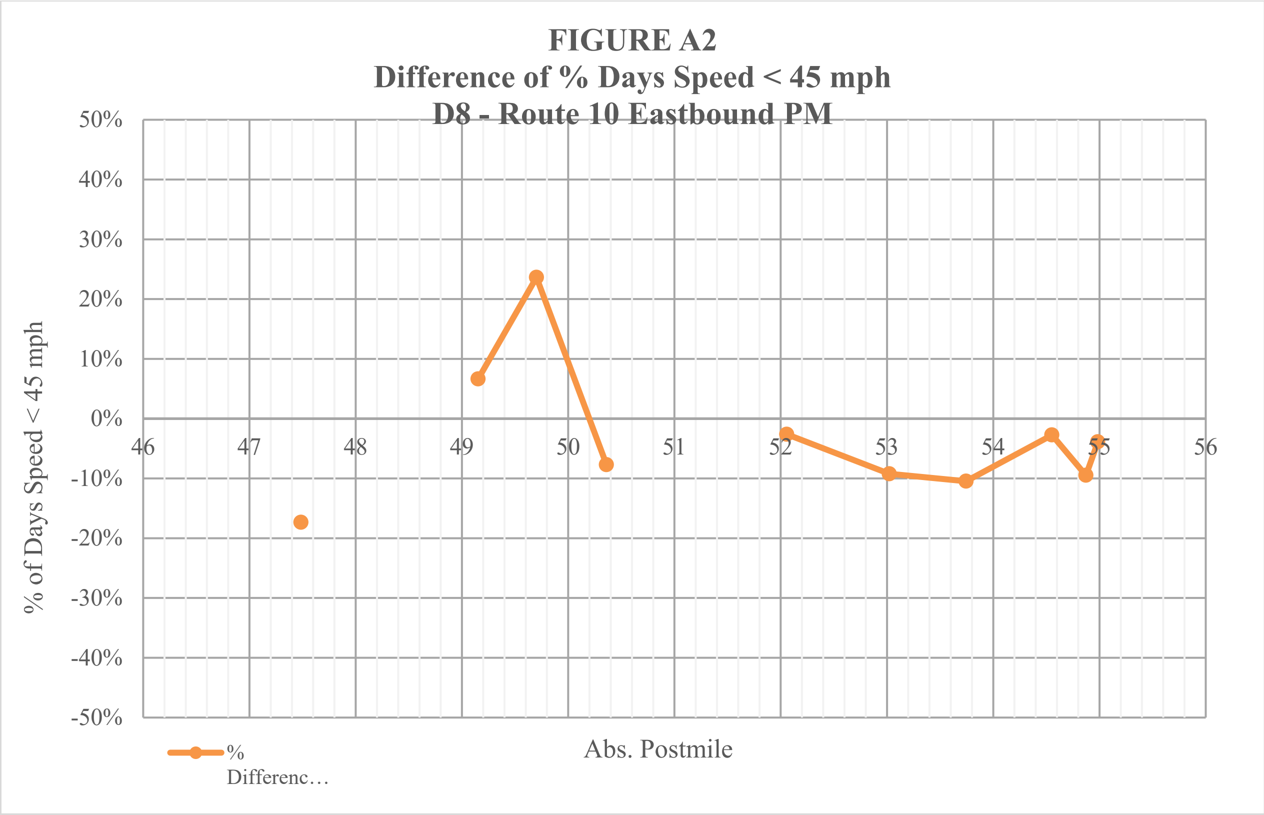


FIGURE A2
Difference of % Days Speed < 45 mph
D8 - Route 10 Eastbound PM
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
% of Days Speed < 45 mph
46
47
48
49
50
51
52
53
54
55
56
Abs. Postmile
% Differenc…

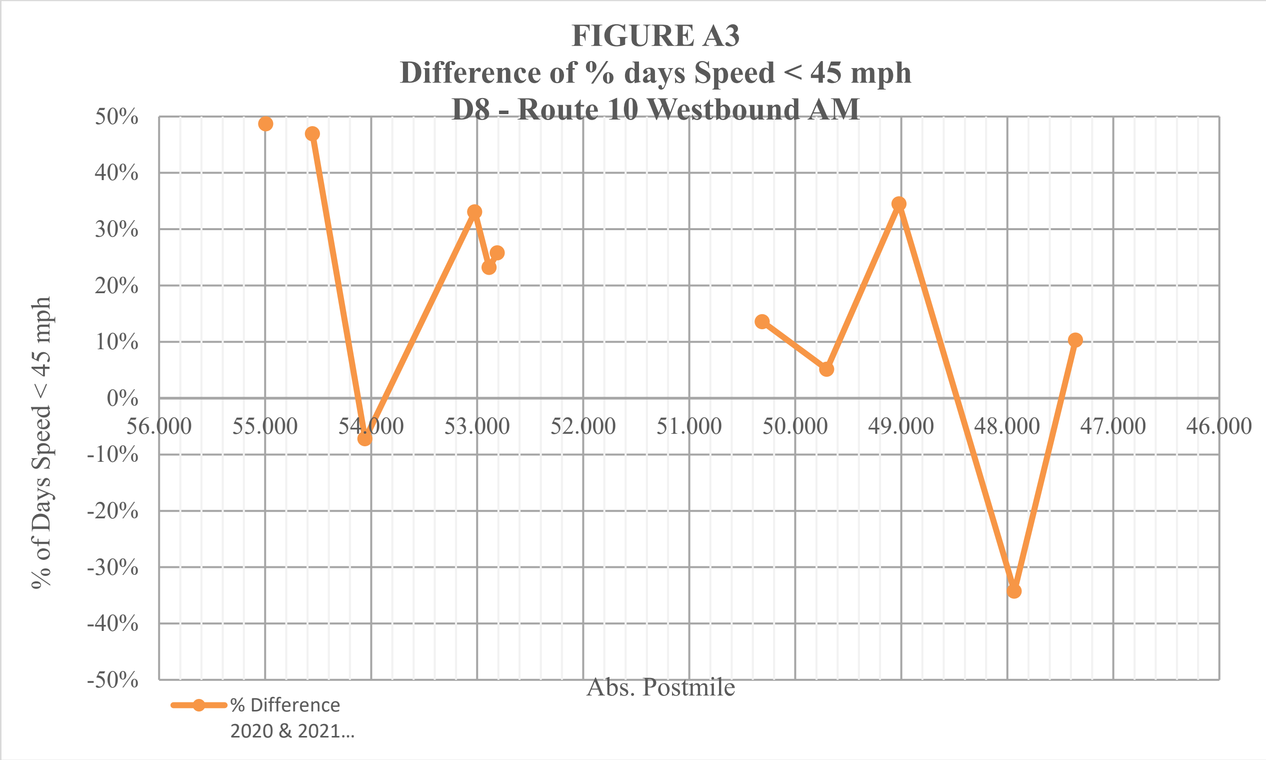
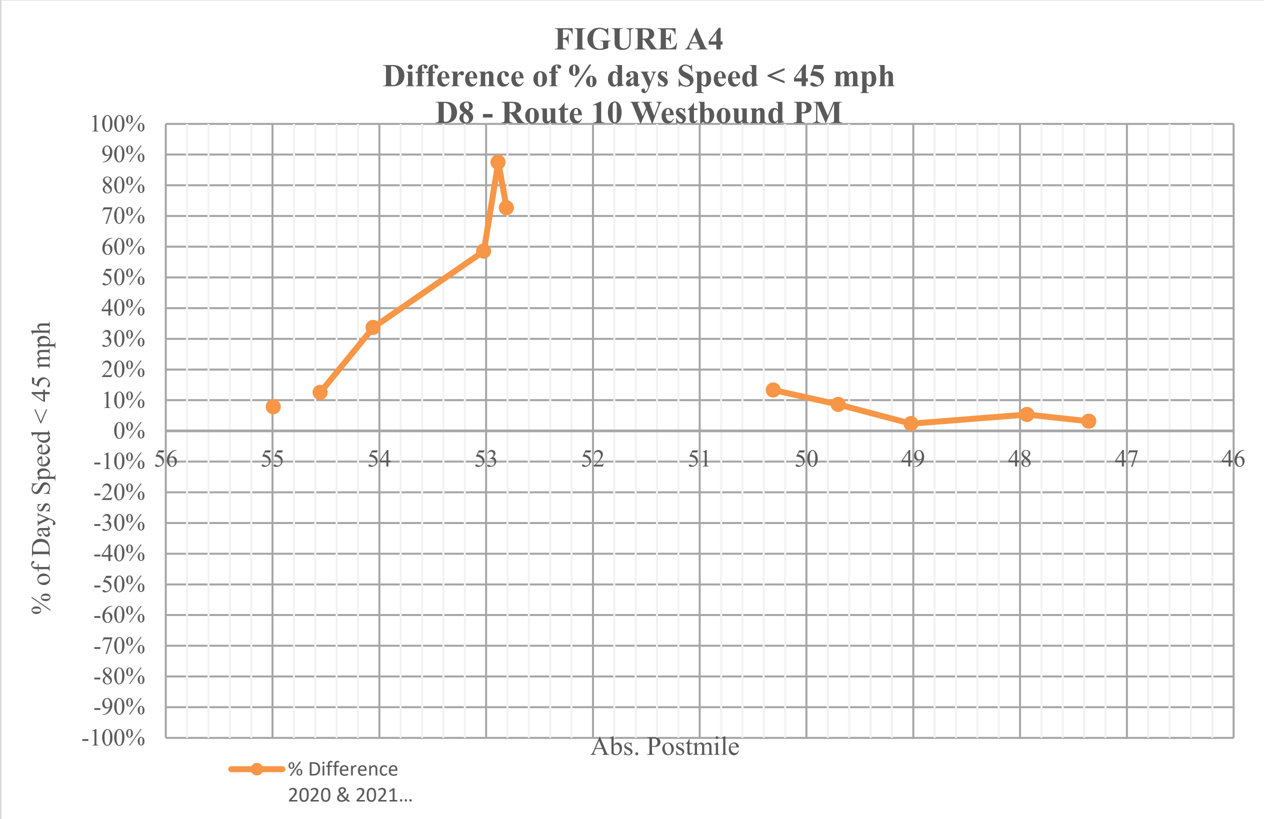


FIGURE A3
Difference of % days Speed < 45 mph
D8 - Route 10 Westbound AM
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
% of Days Speed < 45 mph
56.000
55.000
54.000
53.000
52.000
51.000
50.000
49.000
48.000
47.000
46.000
Abs. Postmile
% Difference 2020 & 2021…



By comparing the "2020- and 2021-% of Days Speed < 45 mph graph" along a segment, we could deduce the trend of the degradation along the segment itself in 2021.

Please refer to Figures A1, A2, A3 & A4. These graphs represent the difference between "2020- and 2021-% of Days Speed < 45 mph." Part of the graph above horizontal axis shows that the degradation is increased and the opposite shows that the degradation is diminished. Gap on the graphs show that no data is available along the pertaining gap either in 2020 or 2021.

Above graphs show that the degradation at majority of the detected locations (75%) along the segment of I-10 AM & PM in both directions is increased. This increased most likely due to the construction of HOT lanes along the segment during the recurrent AM- & PM-peak hours.

B. REMEDIATION STRATEGIES

- Increasing the available capacity of the HOV facility by constructing additional lanes on Route 10 will improve the minimum operating speed as mandated by FHWA. 08-0C251 (phase 1), LA PM 44.9-48.3 & SBD PM 0.00-13.20 to convert from a single HOV-2+ lane in each direction to two HOT-

3+ lanes in each direction from East of Dudley Street in Los Angeles County to Route 15 in San Bernardino County. Project cost estimate is $625.4 million. Construction to begin in September 2018 until August 2024. Desired Outcome: This project is anticipated to increase the freeway capacity and thereby eliminating recurrent congestion both in HOV and GP lane.

- District 8 Traffic Operations is in the process of installing Route Shield Pavement Markings near major interchanges on this Route to assist confused drivers to stay on their desired lanes and Routes. This approach will have some impact to alleviate degradation on HOV lane near major interchanges. Desired Outcome: It improves safety and reduces weaving conflict.

4.5.4 ACTION PLAN FOR HOV FACILITIES ON ROUTE 60

HOV lanes in Route 60 are covered in two segments. The first segment is from the Los Angeles/San Bernardino County Line to the junction of Routes 60, 91, and 215 in Riverside County. The second segment is from the junction of Routes 60 and 215 to Redlands Boulevard in City of Moreno Valley. There was no data for the portion between Route 15 and the junction of Routes 60, 91, and 215 due to construction.

A. ANALYSIS

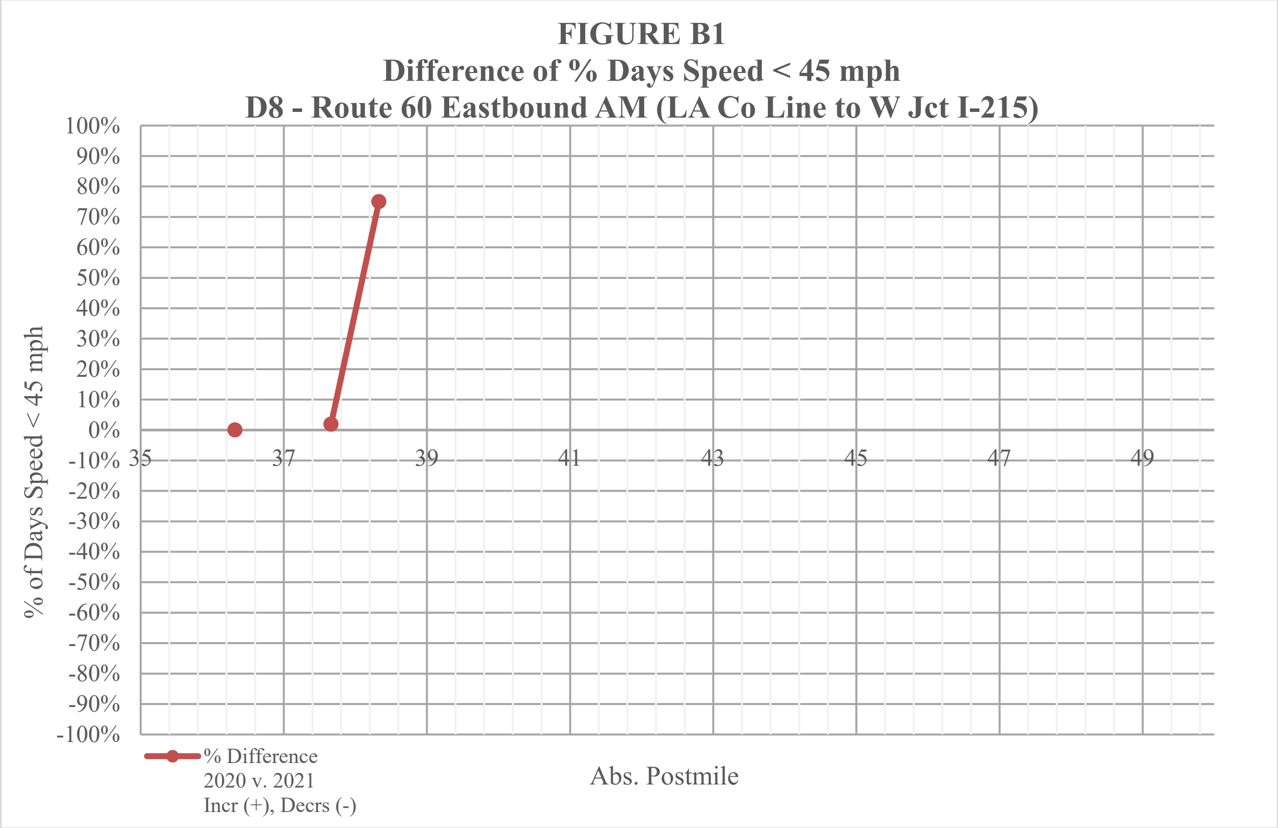


FIGURE B1
Difference of % Days Speed < 45 mph
D8 - Route 60 Eastbound AM (LA Co Line to W Jct I-215)
% of Days Speed < 45 mph
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
-80%
-90%
-100%
35
37
39
41
43
45
47
49
% Difference 2020 v. 2021 Incr (+), Decrs (-)
Abs. Postmile

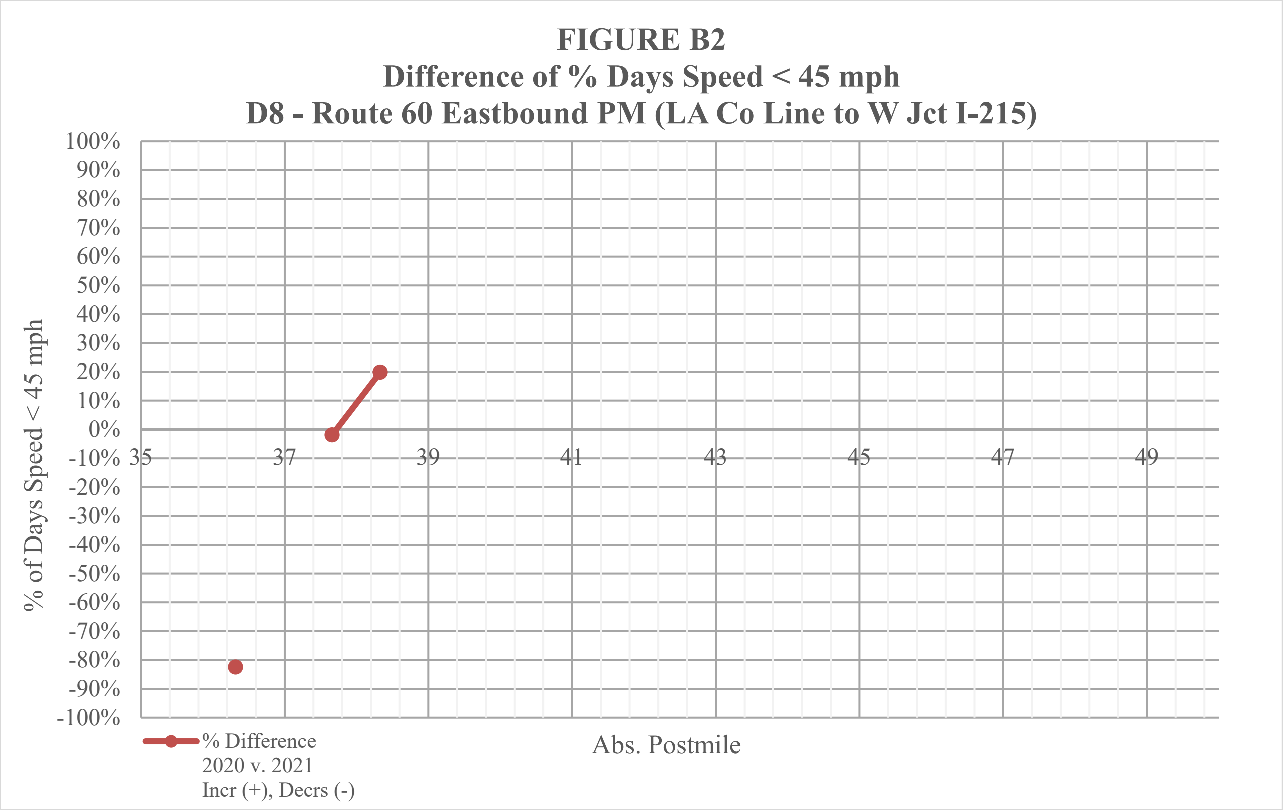


FIGURE B2
Difference of % Days Speed < 45 mph
D8 - Route 60 Eastbound PM (LA Co Line to W Jct I-215)
% of Days Speed < 45 mph
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
-80%
-90%
-100%
35
37
39
41
43
45
47
49
% Difference 2020 v. 2021 Incr (+), Decrs (-)
Abs. Postmile

FIGURE B3
Difference of % Days Speed < 45mph
D8 - Route 60 Westbound AM (LA Co Line to W Jct I-215)

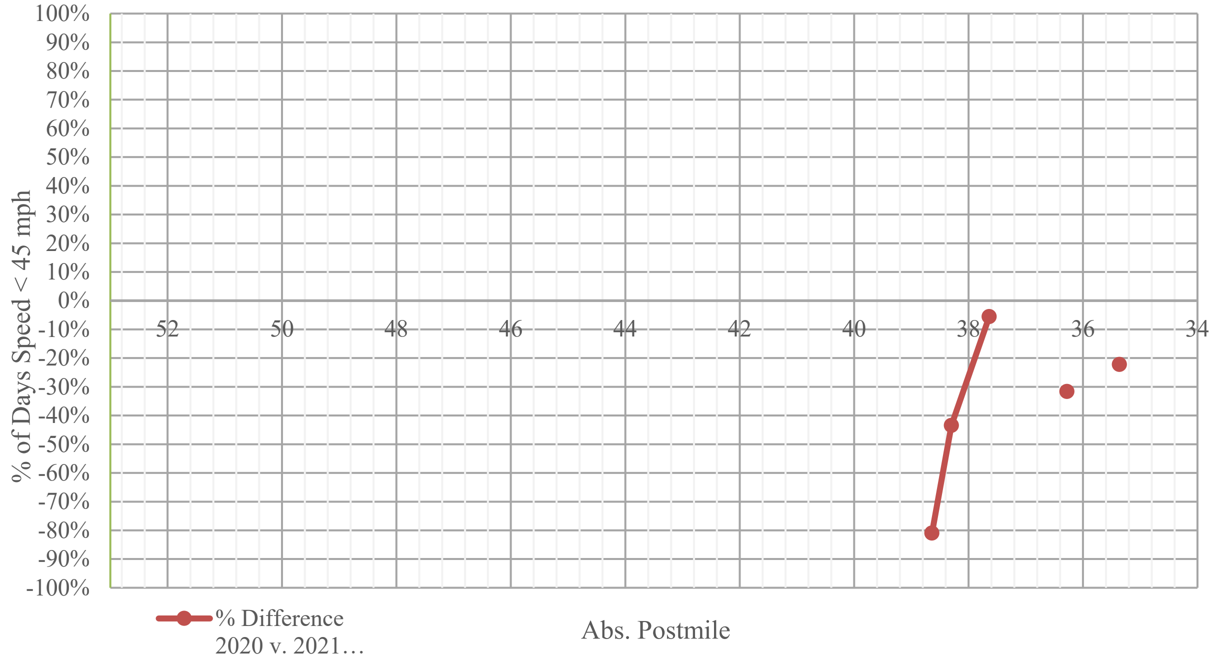
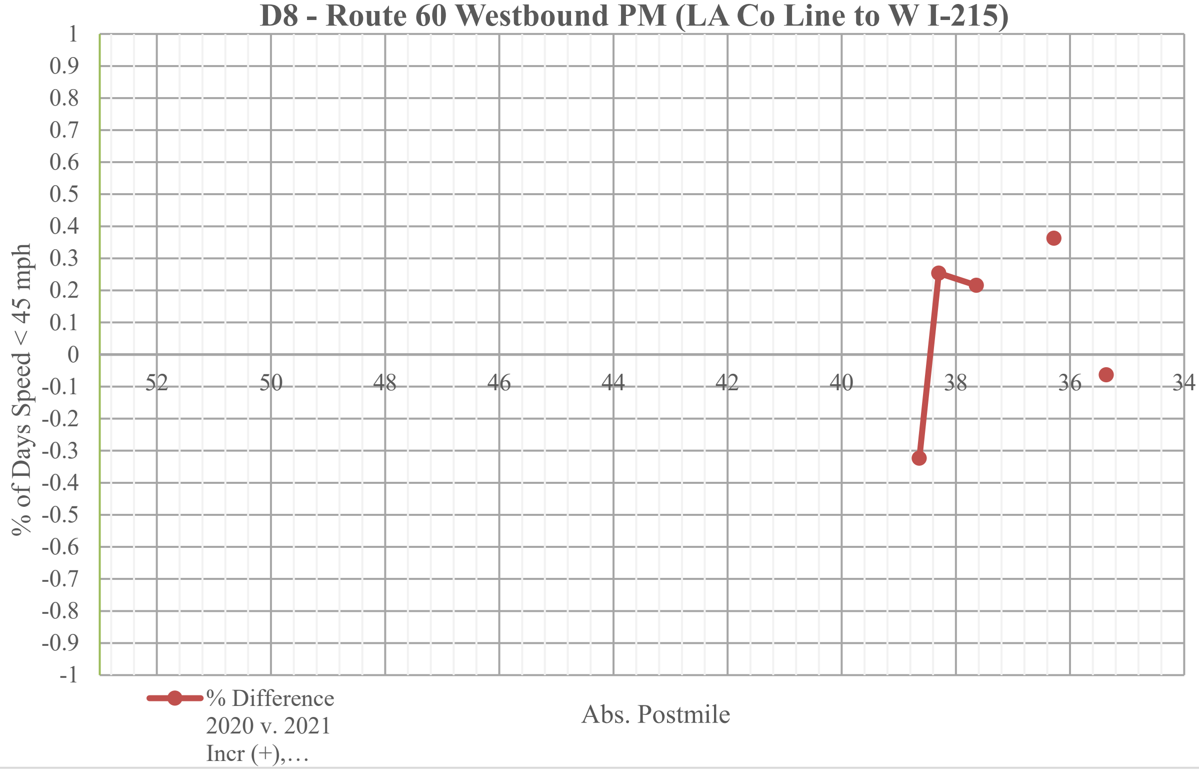


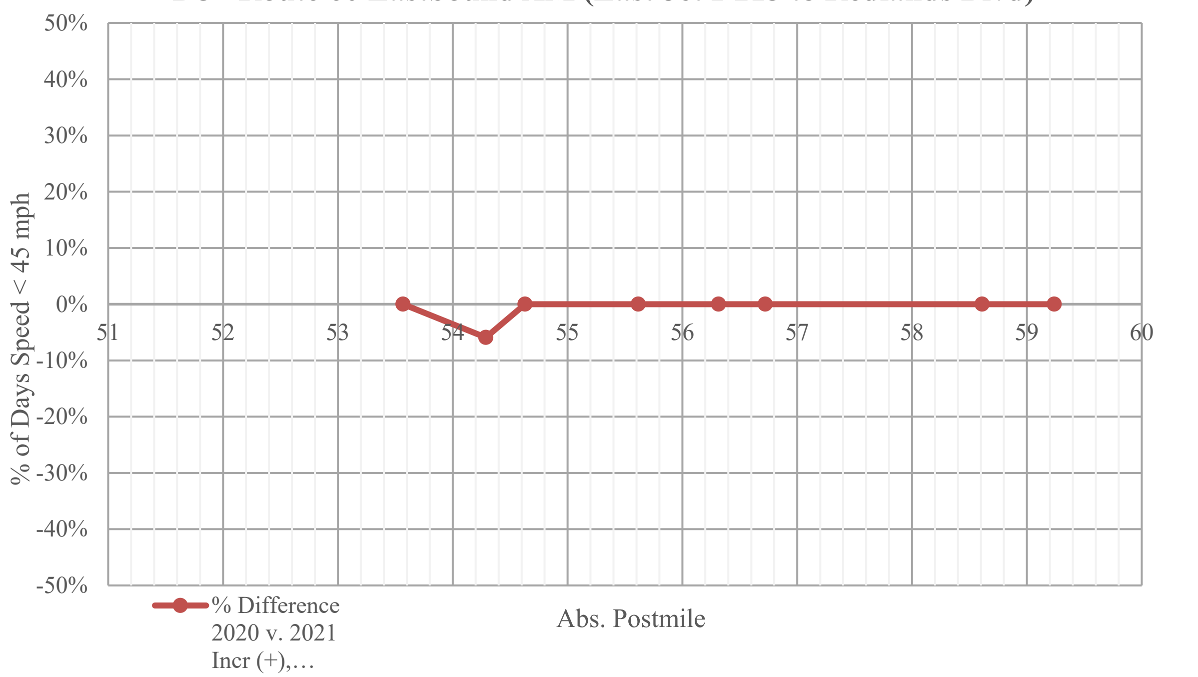
FIGURE B4
Difference of % Days Speed < 45mph
D8 - Route 60 Westbound PM (LA Co Line to W I-215)



By comparing the "2020- and 2021-% of Days Speed < 45 mph graph" along a segment, we could deduce the trend of the degradation along the segment itself in 2021.

Please refer to Figures B1, B2, B3 & B4. These graphs represent the difference between "2020- and 2021-% of Days Speed < 45 mph." Part of the graph above horizontal axis shows that the degradation is increased and the opposite shows that the degradation is decreased. Gaps on the graphs show that no data is available along the pertaining gaps either in 2020 or 2021. Unfortunately, within this segment of Route 60 with the length of more than 21 miles (more than 42 lane miles), we have only data from 16 detector locations. Due to this minimal amount of data, we could not conclude the trend of the degradation along this segment.

FIGURE B5
Difference of % Days Speed < 45 mph
D8 - Route 60 Eastbound AM (East Jct I-215 to Redlands Blvd)



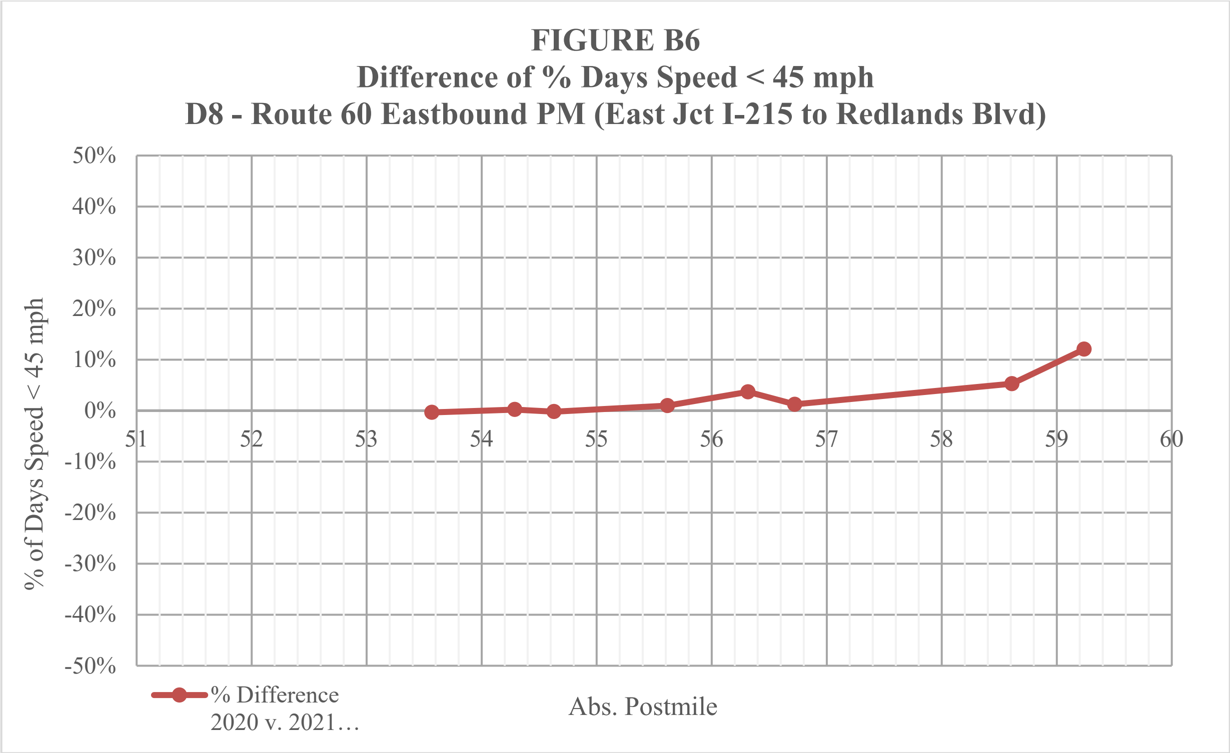


FIGURE B6
Difference of % Days Speed < 45 mph
D8 - Route 60 Eastbound PM (East Jct I-215 to Redlands Blvd)
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
% of Days Speed < 45 mph
51
52
53
54
55
56
57
58
59
60
% Difference 2020 v. 2021…
Abs. Postmile

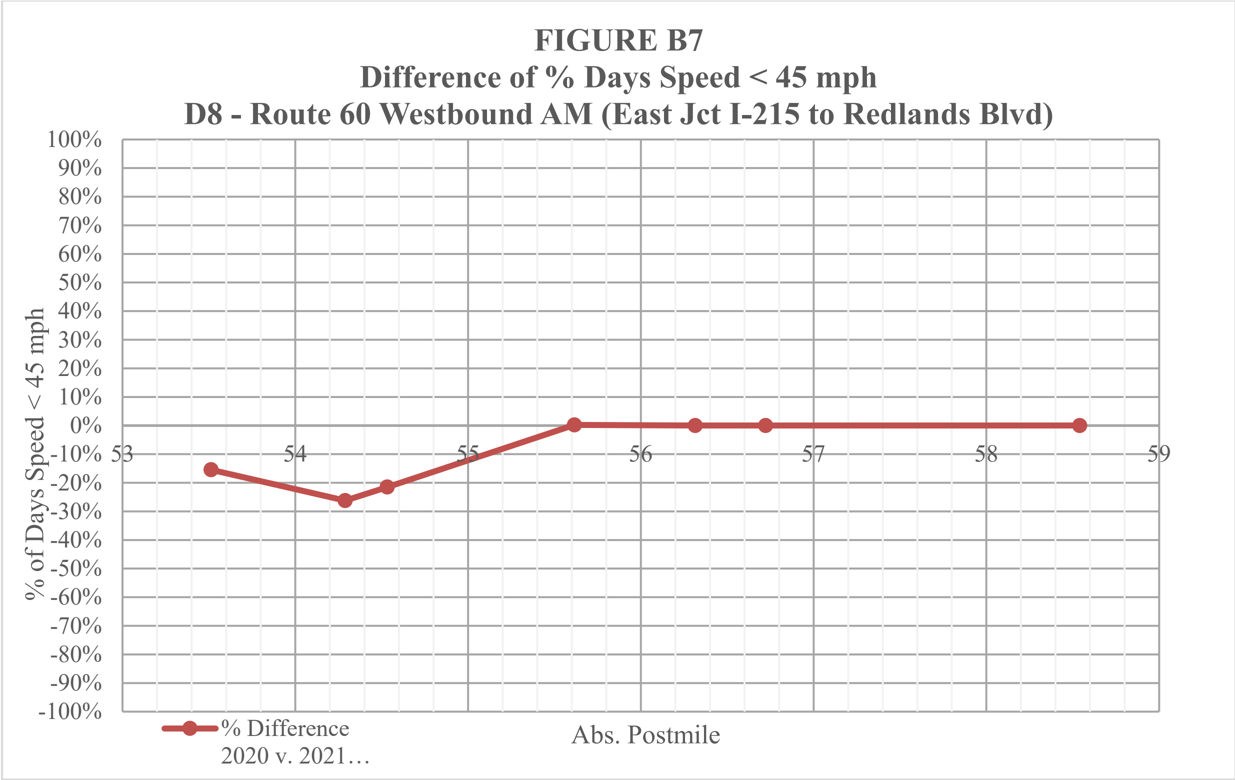
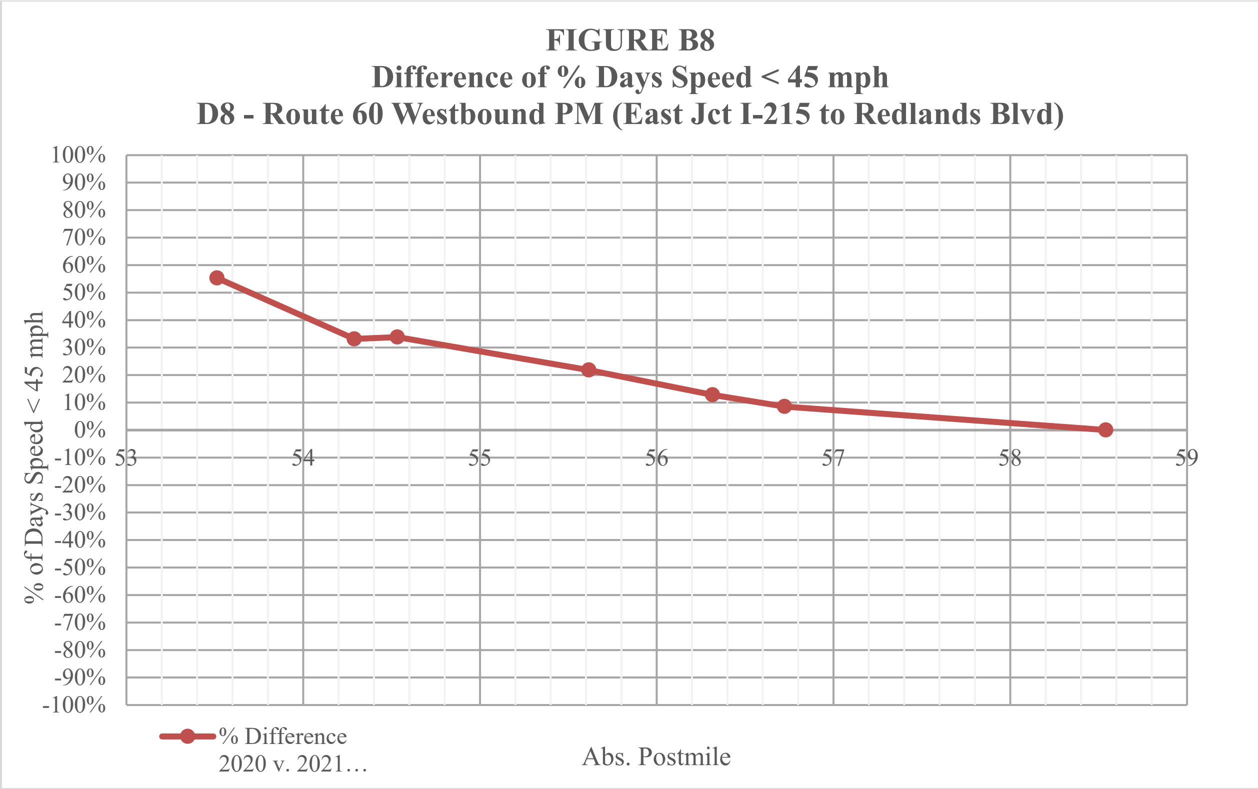


FIGURE B7
Difference of % Days Speed < 45 mph
D8 - Route 60 Westbound AM (East Jct I-215 to Redlands Blvd)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
-80%
-90%
-100%
% of Days Speed < 45 mph
53
54
55
56
57
58
59
% Difference 2020 v. 2021…
Abs. Postmile



By comparing the "2020- and 2021-% of Days Speed < 45 mph graph" along a segment, we could deduce the trend of the degradation along the segment itself in 2021.

Please refer to Figures B5, B6, B7 & B8. These graphs represent the difference between "2020- and 2021-% of Days Speed < 45 mph." Part of the graph above horizontal axis shows that the degradation is increased and the opposite shows that the degradation is decreased. Gaps on the graphs show that no data is available along the pertaining gaps either in 2020 or 2021.

For the eastbound direction in the morning peak hours, the degradation level on HOV lane was almost the same in 2021 as that in 2020. However, in the afternoon peak hours the degradation level was degraded as it approached Nason Street at about Abs. PM 59.0.

For the westbound direction in the morning peak hours, the degradation level on HOV lane was remained the same, and it was improved as it approached the Day Street IC at about Abs. PM 53.5 in 2021 compared to that in 2020. However, in the afternoon peak hours the degradation level was degraded as it approached the Day Street IC.

B. REMEDIATION STRATEGIES

<u>*Los Angeles County Line to Junction 60/91/215*</u>

- Project 08-1F260, SBD PM R7.8/R7.9 to widen Archibald Avenue interchange. The project is under construction from May 2021 to January 2023. Desired Outcome: Improving the traffic mobility on all lanes in the vicinity of Archibald Avenue Interchange.

- Project 08-0E33U, SBD R7.3/R10.0 to add westbound auxiliary lane and eastbound deceleration lane. Construction is scheduled to begin in May 2021 and end in March 2024. Current estimate is $43 million funded by SHOPP. Desired Outcome: Alleviating some weaving issues occurring in this segment and therefore enhancing traffic mobility on all lanes.

- Project 08-0C870 SBD PM R2.1/R2.6 to widen eastbound & westbound on- ramps & Central Avenue Construction was started in the April 2021 and will be completed in April 2023. Desired Outcome: Improving traffic operation at the interchange.

- D8 Traffic Ops initiated a project, SHOPP ID 23288, and to install appropriate short distance markings on HOV lanes on this Route. This SHOPP project have a provision of CHP enforcement on this Route to the locations with high rate of HOV violations of more than 20% during construction of the project. Overall, this project will have a positive impact to alleviate degradation on this Route. Desired Outcome: Reduced volumes in the HOV lanes due to fewer violators.

- District 8 Traffic Operations is in the process of installing Route Shield Pavement Markings near major interchanges on this Route to assist confused drivers to stay on their desired lanes and Routes. This approach will have some impact to alleviate degradation on HOV lane near major interchanges. Desired Outcome: It improves safety and reduces weaving conflict.

<u>*Junction 60/215 to Redlands Boulevard*</u>

- D8 Traffic Ops initiated a project, SHOPP ID 23288, and to install appropriate short distance markings on HOV lanes on this Route. This SHOPP project have a provision of CHP enforcement on this Route to the locations with high rate of HOV violations of more than 20% during construction of the project. Overall, this project will have a positive impact to alleviate degradation on this Route. Desired Outcome:

Reduced volumes in the HOV lanes due to fewer violators.

- District 8 Traffic Operations is in the process of installing Route Shield Pavement Markings near major interchanges on this Route to assist confused drivers to stay on their desired lanes and Routes. This approach will have some impact to alleviate degradation on HOV lane near major interchanges. Desired Outcome: It improves safety and reduces weaving conflict.

4.5.5 ACTION PLAN FOR HOV FACILITIES ON ROUTE 71

The HOV lane on Route 71 spans between Riverside County Line and Los Angeles County Line with the length of approximately 7 (seven) miles. This segment of HOV lane is the last and only Buffer-Separated HOV lane in District 8. The postmiles of the route is decreasing instead of increasing as it goes northward.

A. ANALYSIS

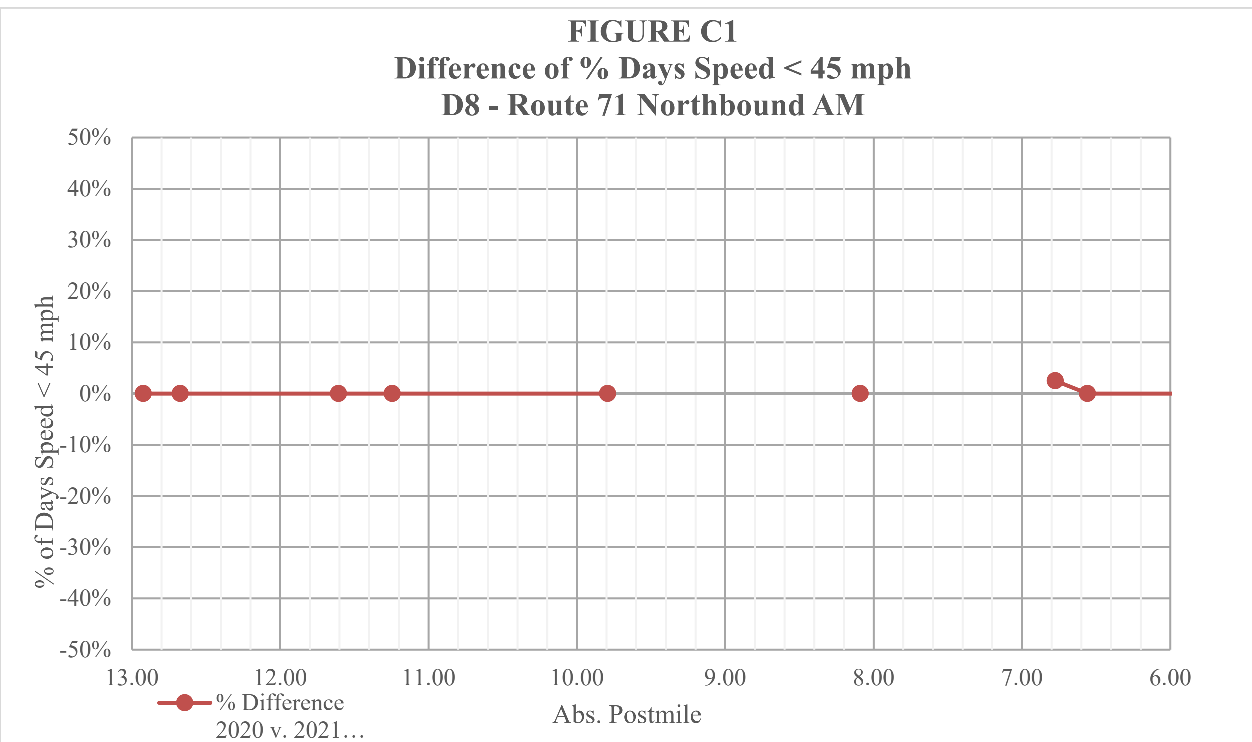


FIGURE C2
Difference of % Days Speed < 45 mph
D8 - Route 71 Northbound PM

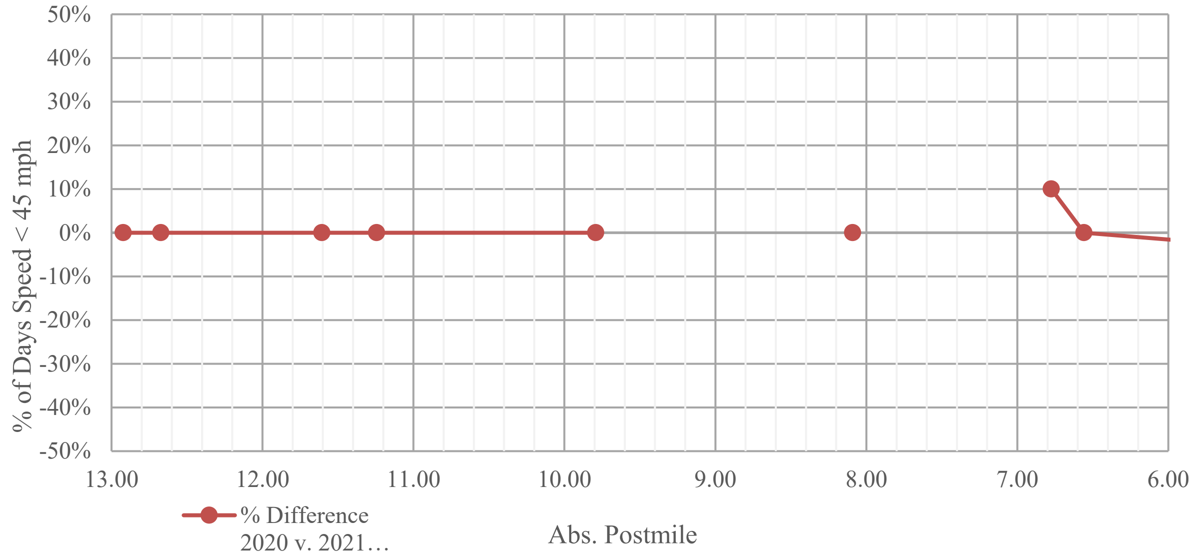
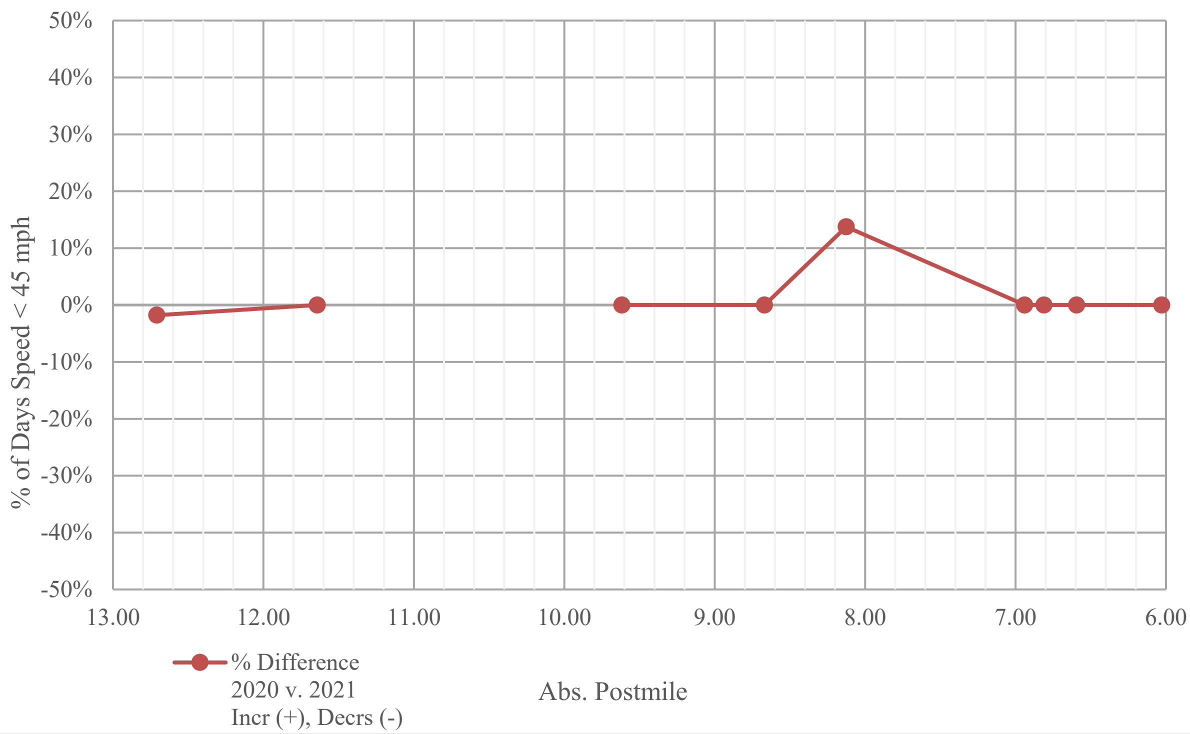
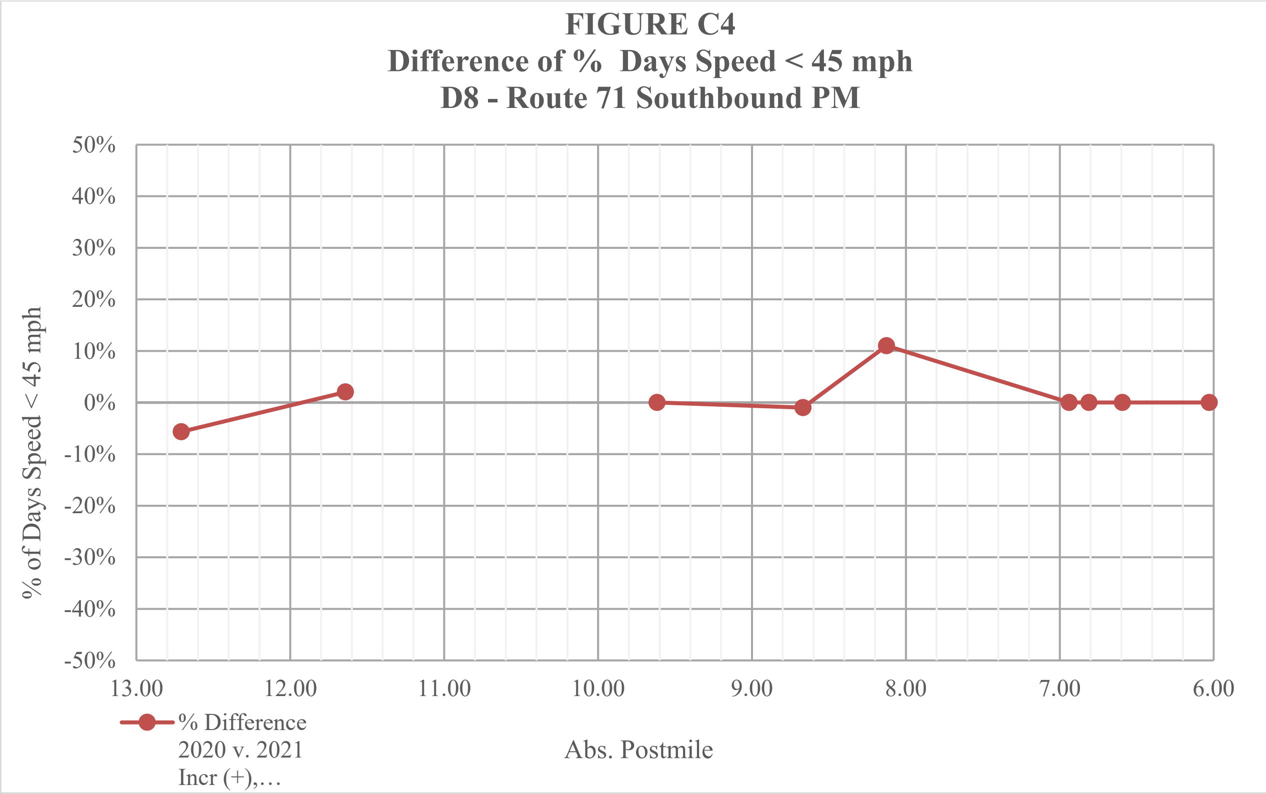


FIGURE C3
Difference of % Days Speed < 45 mph
D8 - Route 71 Southbound AM





By comparing the "2020- and 2021-% of Days Speed < 45 mph graph" along a segment, we could deduce the trend of the degradation along the segment itself in 2021.

Please refer to Figures C1, C2, C3, & C4 "Difference of % Days Speed < 45 mph for D8 – Route 71". These graphs represent the difference between "2020- and 2021-% of Days Speed < 45 mph." Part of the graph above horizontal axis shows that the degradation is increased and the opposite shows that the degradation is decreased. Gaps on the graphs show that no data is available along the pertaining gaps either in 2020 or 2021.

The degradation level on HOV lane on this route in northbound and southbound directions during morning and afternoon peak hours in 2020 compared to 2021 were almost the same, except in four occasions. Two of these occasions occurred at the same location, Chino Hills parkway Interchange (at about Abs. PM 8.1) with deviations of up to +14% in southbound direction during morning and afternoon peak hours.

Southbound during morning & afternoon peak hours: Recurrent congestion due to commuter traffic at the south end of the HOV lane–by Euclid Avenue IC -causes by dropping the HOV lane at the location. The end of lane-dropped is less than 1,500 feet up stream from gore of the westbound Euclid

Ave on-ramp. The Euclid Ave Interchange is a successive freeway entrance type. The eastbound Euclid Ave on-ramp is located down stream not too far from the westbound on-ramp. The traffic turbulences created by these three successive traffic merging (lane dropped and two on-ramps) cause congestion more than one mile up-stream in the PM peak hours.

B. REMEDIATION STRATEGIES

- District 8 Traffic Operations is in the process of installing Route Shield Pavement Markings near major interchanges on this Route to assist confused drivers to stay on their desired lanes and Routes. This approach will have some impact to alleviate degradation on HOV lane near major interchanges. Desired Outcome: It improves safety and reduces weaving conflict.

- 08-0G790, SBD. PM R.0.00-R8.50 will install Traffic Management Systems (TMS) field elements to include RMS (Ramp Meter System), CCTV, Changeable Message Sign (CMS), Vehicle Detection System (VDS), and Fiber Optic Communication System. Project cost estimate is $13.7 million. Construction to begin in November 2020 until October 2023. Desired Outcome: TMS will empower commuters with information about travel options and information to avoid delay. Thereby improving the traffic flow on the facility when the traffic is at full capacity or beyond. Improving traffic in GPLs will also improving traffic in HOV lanes.

4.5.6 ACTION PLAN FOR HOV FACILITIES ON ROUTE 91

A. ANALYSIS

FIGURE D1
Difference of % Days Speed < 45 mph
D8 - Route 91 Eastbound AM (I-15 to I-215)

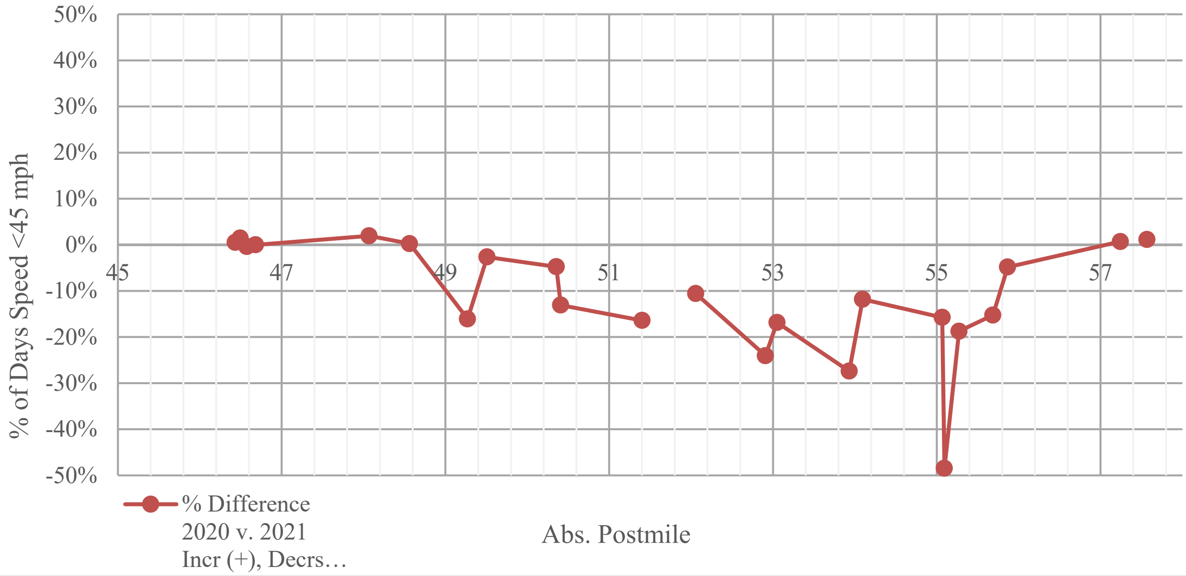
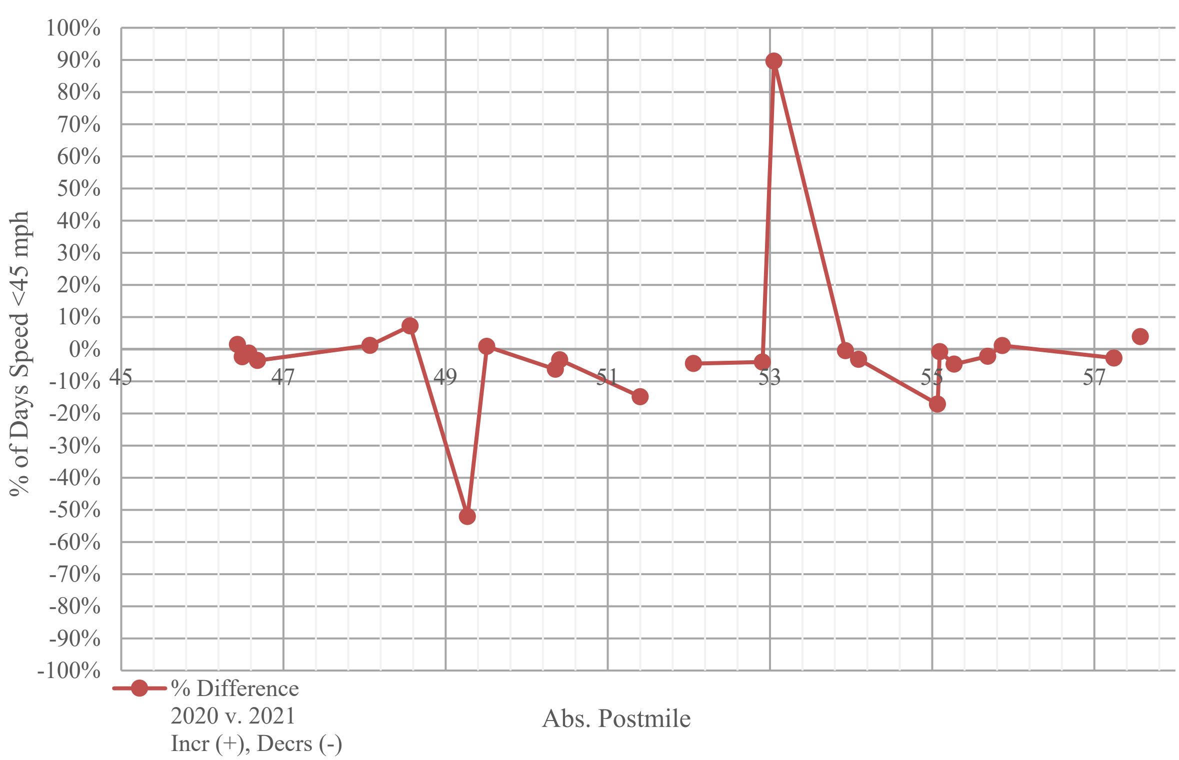


FIGURE D2
Difference of % Days Speed < 45 mph
D8 - Route 91 Eastbound PM (I-15 to I-215)



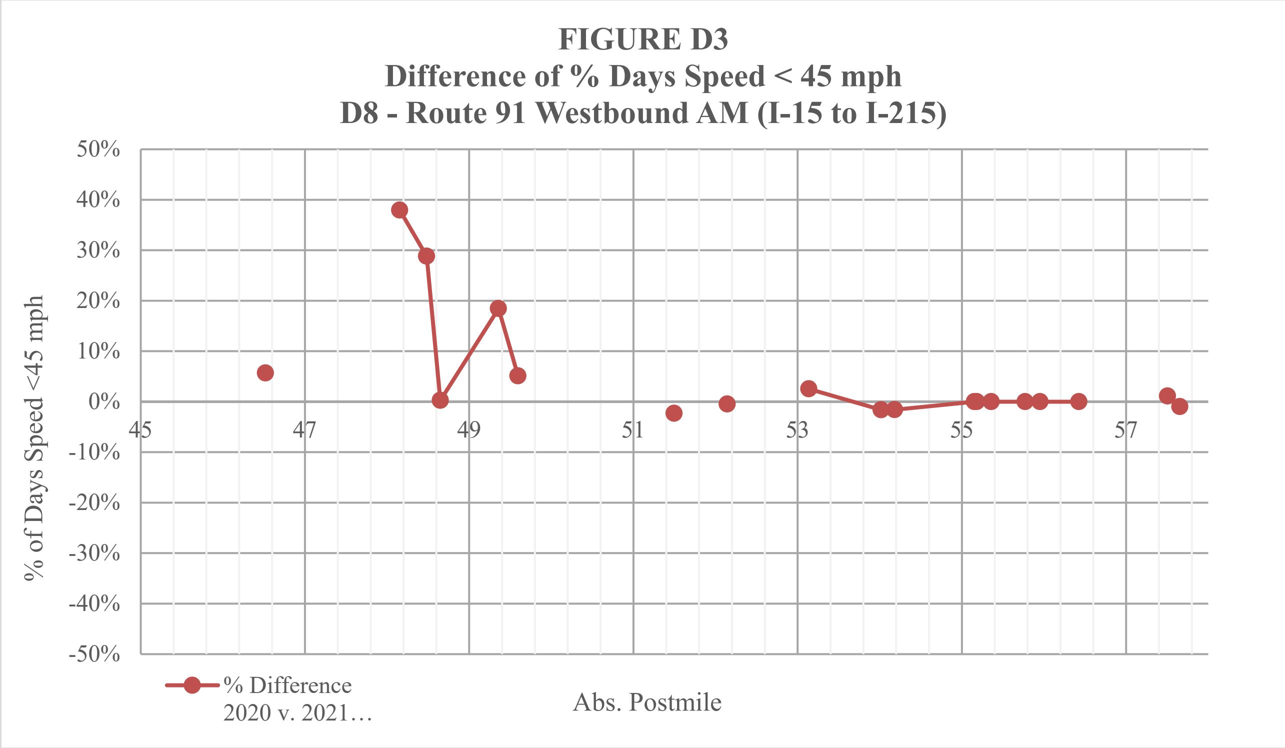


FIGURE D3
Difference of % Days Speed < 45 mph
D8 - Route 91 Westbound AM (I-15 to I-215)
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
45
47
49
51
53
55
57
% of Days Speed <45 mph
% Difference 2020 v. 2021…
Abs. Postmile

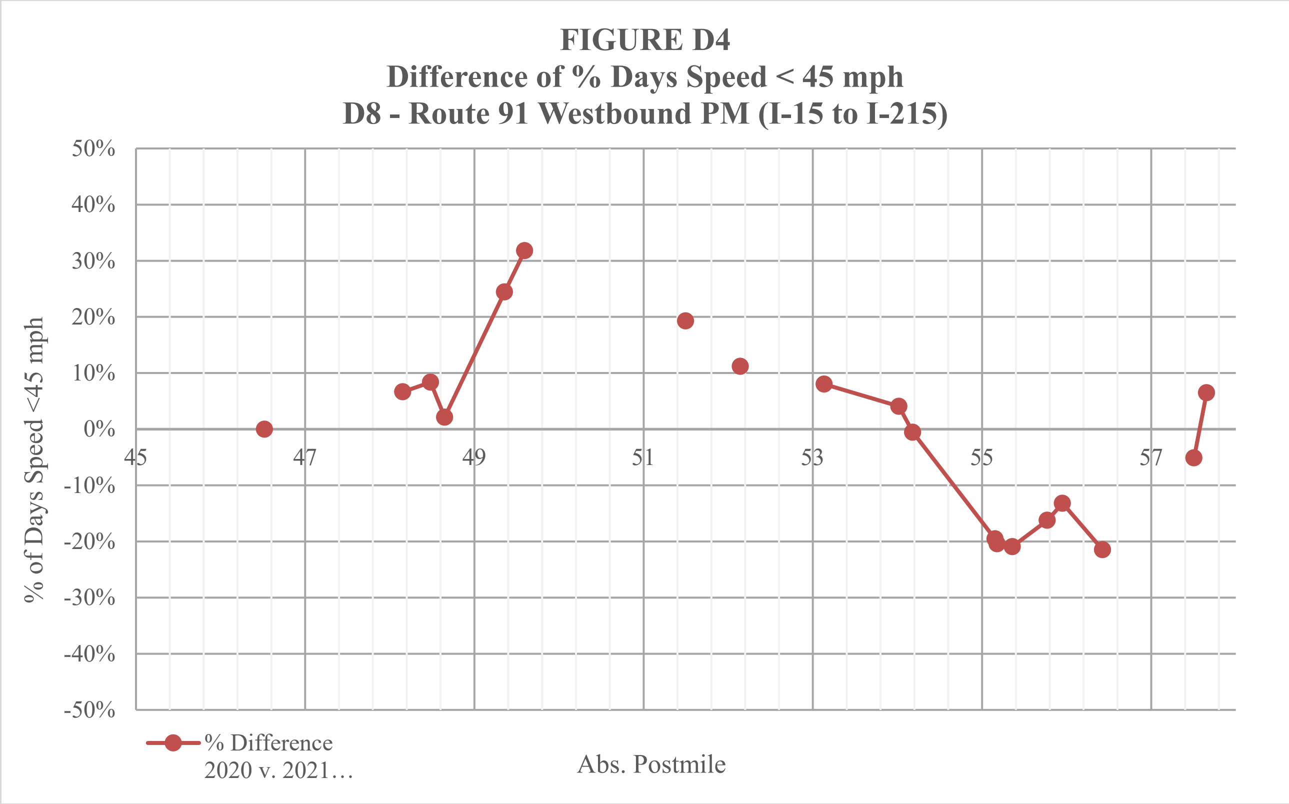


FIGURE D4
Difference of % Days Speed < 45 mph
D8 - Route 91 Westbound PM (I-15 to I-215)
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
45
47
49
51
53
55
57
% of Days Speed <45 mph
% Difference 2020 v. 2021…
Abs. Postmile

By comparing the "2020- and 2021-% of Days Speed < 45 mph graph" along a segment, we could deduce the trend of the degradation along the segment itself in 2021.

Please refer to Figures, D1, D2, D3 & D4. These graphs represent the difference between "2020- and 2021-% of Days Speed < 45 mph." Part of the graph above horizontal axis shows that the degradation is increased and the opposite shows that the degradation is decreased. Gaps on the graphs show that no data is available along the pertaining gaps either in 2020 or 2021.

For the eastbound direction in the morning and afternoon peak hours, the degradation level on HOV lane was improved in 2021 compared to that in 2020. However, in the eastbound afternoon peak hours the degradation level was degraded badly in the vicinity of Adams Street IC at about Abs. PM 53.0.

For the westbound direction in the afternoon peak hours, the degradation level on HOV lane as it approached the downtown of the City of Riverside in 2021 was higher compared to that in 2020.

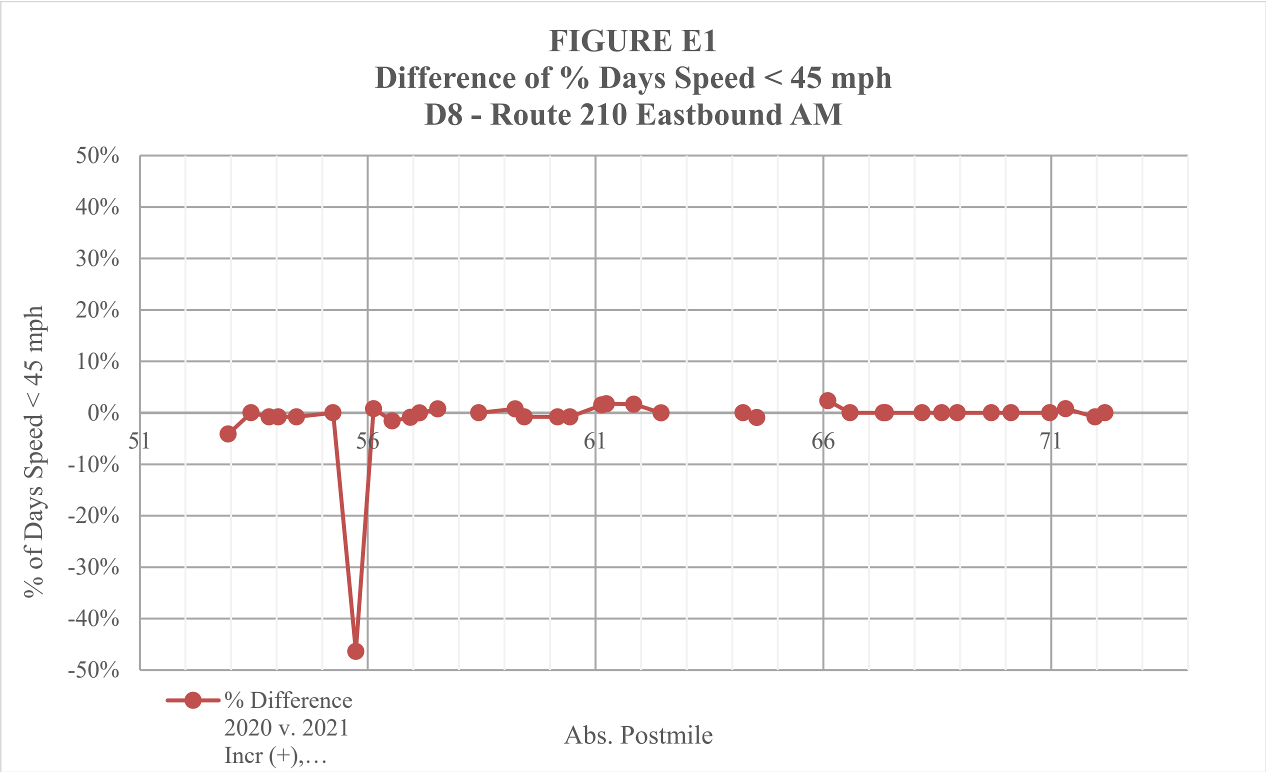
B. REMEDIATION STRATEGIES

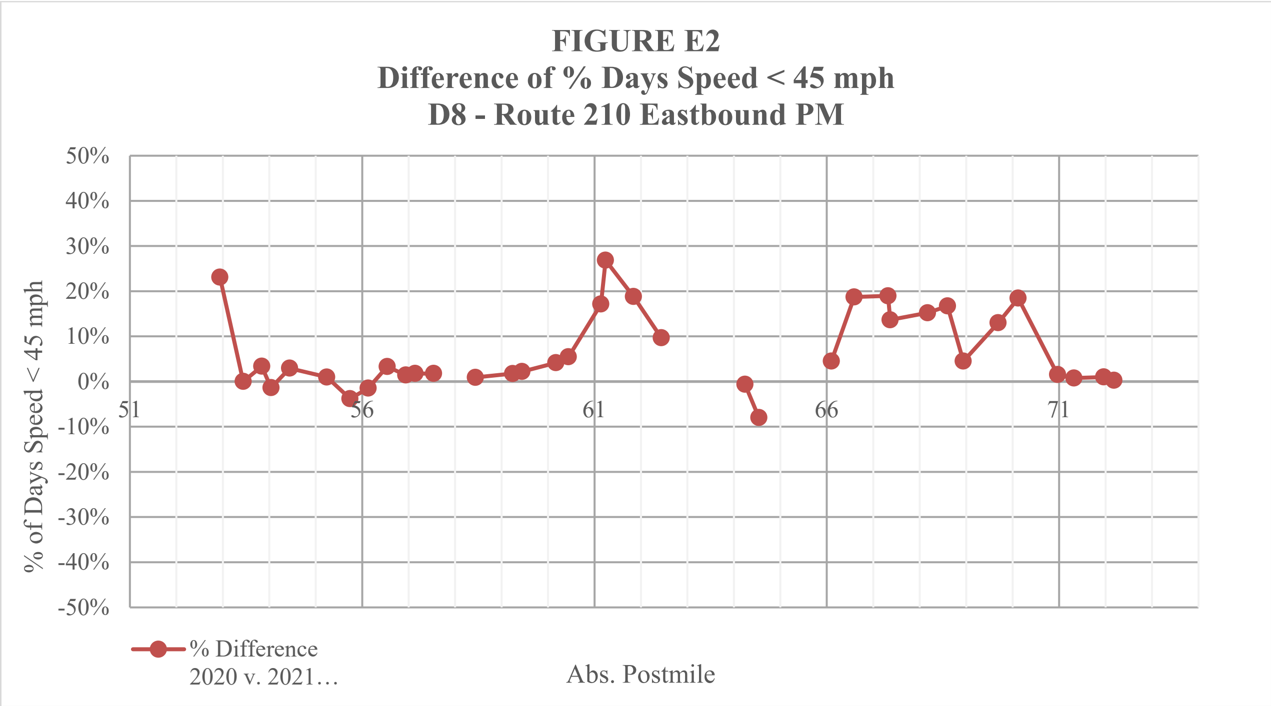
Route 15 to Junction Routes 60 and 215

- 08-0F543, RIV. PM 6.600-8.100 will construct Express Lanes North Direct Connector. The cost estimate is $180,000,000 million. Construction was to begin in April 2020 and will be completed in April 2027. Desired Outcome: Improving traffic operation at this segment.
- District 8 Traffic Operations is in the process of installing Route Shield Pavement Markings near major interchanges on this Route to assist confused drivers to stay on their desired lanes and Routes. This approach will have some impact to alleviate degradation on HOV lane near major interchanges.
- D8 Traffic Ops initiated a project, SHOPP ID 23288, and to install appropriate short distance markings on HOV lanes on this Route. This SHOPP project have a provision of CHP enforcement on this Route to the locations with high rate of HOV violations of more than 20%. Overall, this project will have a positive impact to alleviate degradation on this Route. Desired Outcome: Reduced volumes in the HOV lanes due to fewer violators.

4.5.7 ACTION PLAN FOR HOV FACILITIES ON ROUTE 210

A. ANALYSIS





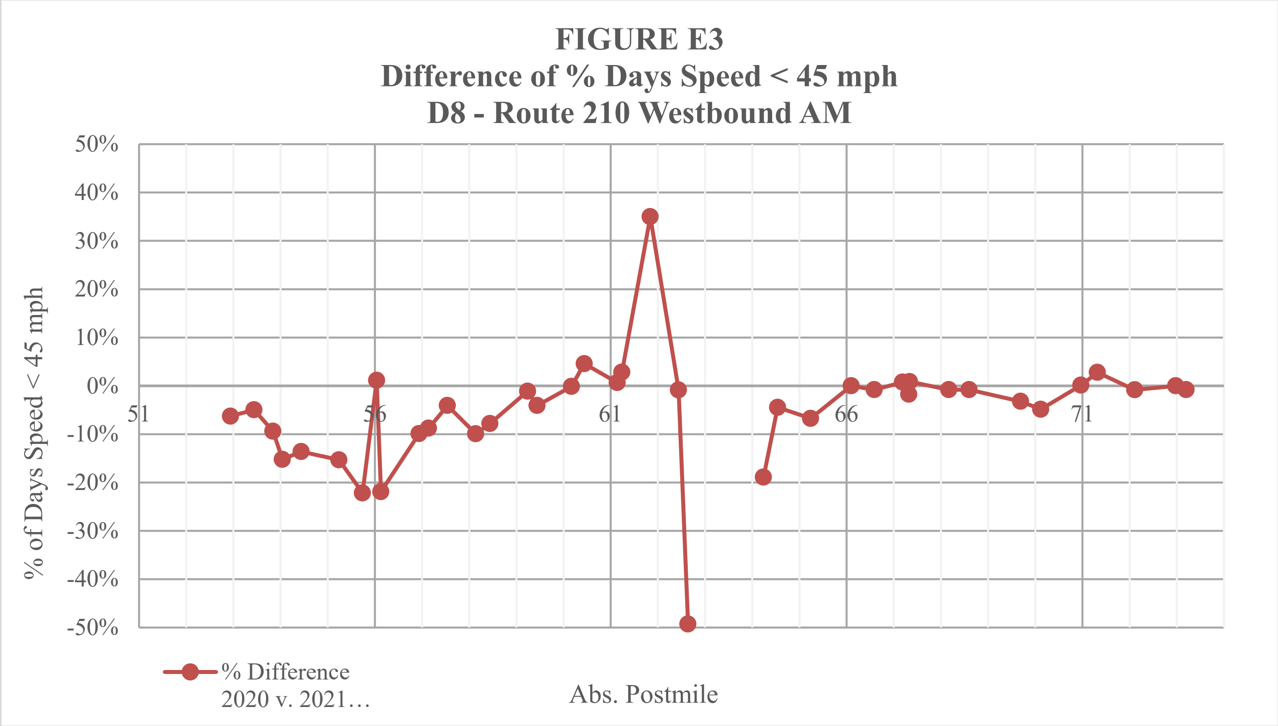


FIGURE E3
Difference of % Days Speed < 45 mph
D8 - Route 210 Westbound AM
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
% of Days Speed < 45 mph
51
56
61
66
71
% Difference 2020 v. 2021…
Abs. Postmile

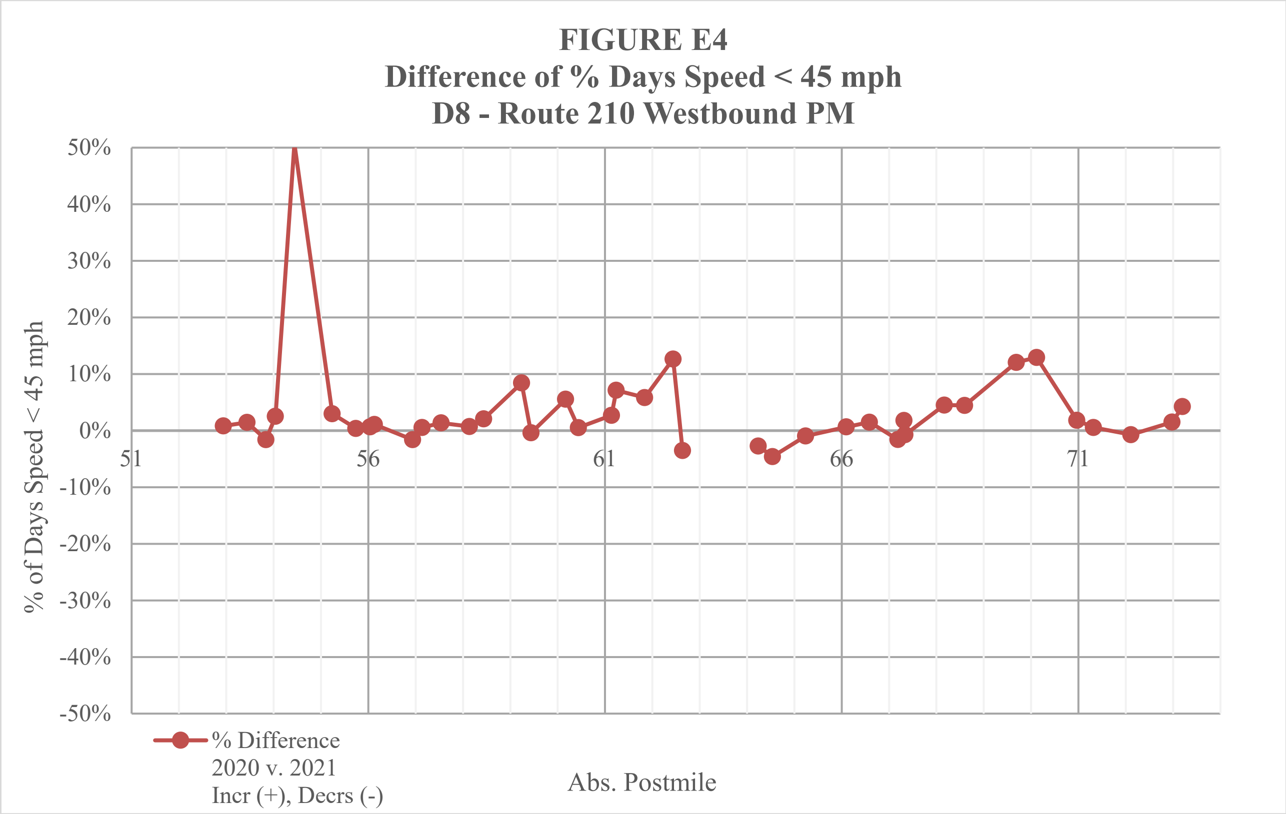


FIGURE E4
Difference of % Days Speed < 45 mph
D8 - Route 210 Westbound PM
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
% of Days Speed < 45 mph
51
56
61
66
71
% Difference 2020 v. 2021 Incr (+), Decrs (-)
Abs. Postmile

By comparing the "2020- and 2021-% of Days Speed < 45 mph graph" along a segment, we could deduce the trend of the degradation along the segment itself in 2021.

Please refer to Figures E1, E2, E3, & E4 of "Difference of % Days Speed < 45 mph for D8 – Route 210." These graphs represent the difference between "2020- and 2021-% of Days Speed < 45 mph." Part of the graph above horizontal axis shows that the degradation is increased and the opposite shows that the degradation is decreased. Gaps on the graphs show that no data is available along the pertaining gaps either in 2020 or 2021.

For the eastbound direction in the morning peak hours, the degradation level on HOV lane in general was at the same level in 2021 as that in 2020. There is one outlier at Campus Street at about Abs. PM 56.0. However, in the eastbound afternoon peak hours the degradation level was increased starting from Milliken Av. (about Abs. PM 60.0) to Alder Av. (about Abs. PM 68.0) in 2021 compared to that in 2020.

For the westbound direction in the morning peak hours, the degradation level on HOV lane was improving in 2021 compared to that in 2020. However, there is two outliers at WO 210/15 JCT (about Abs. 63.0) and Day Creek Bl. (about Abs. PM 62.0). For the westbound direction afternoon peak hours, the degradation was worsened slightly - between 0% to 13% at Ayala Dr. (about Abs. PM 70.0) and EO Day Creek Bl. (about Abs. PM 62.0) in 2021 compared to that in 2020. However, there is one outlier at Mountain Av. (about Abs. 64.40).

For the westbound direction in the afternoon peak hours, the degradation level on HOV lane as it approached the downtown of the City of Riverside in 2021 was higher compared to that in 2020.

B. REMEDIATION STRATEGIES

- District 8 Traffic Operations is in the process of installing Route Shield Pavement Markings near major interchanges on this Route to assist confused drivers to stay on their desired lanes and Routes. This approach will have some impact to alleviate degradation on HOV lane near major interchanges. Desired Outcome: It improves safety and reduces weaving conflict.

4.5.8 ACTION PLAN FOR HOV FACILITIES ON ROUTE 215

A. ANALYSIS

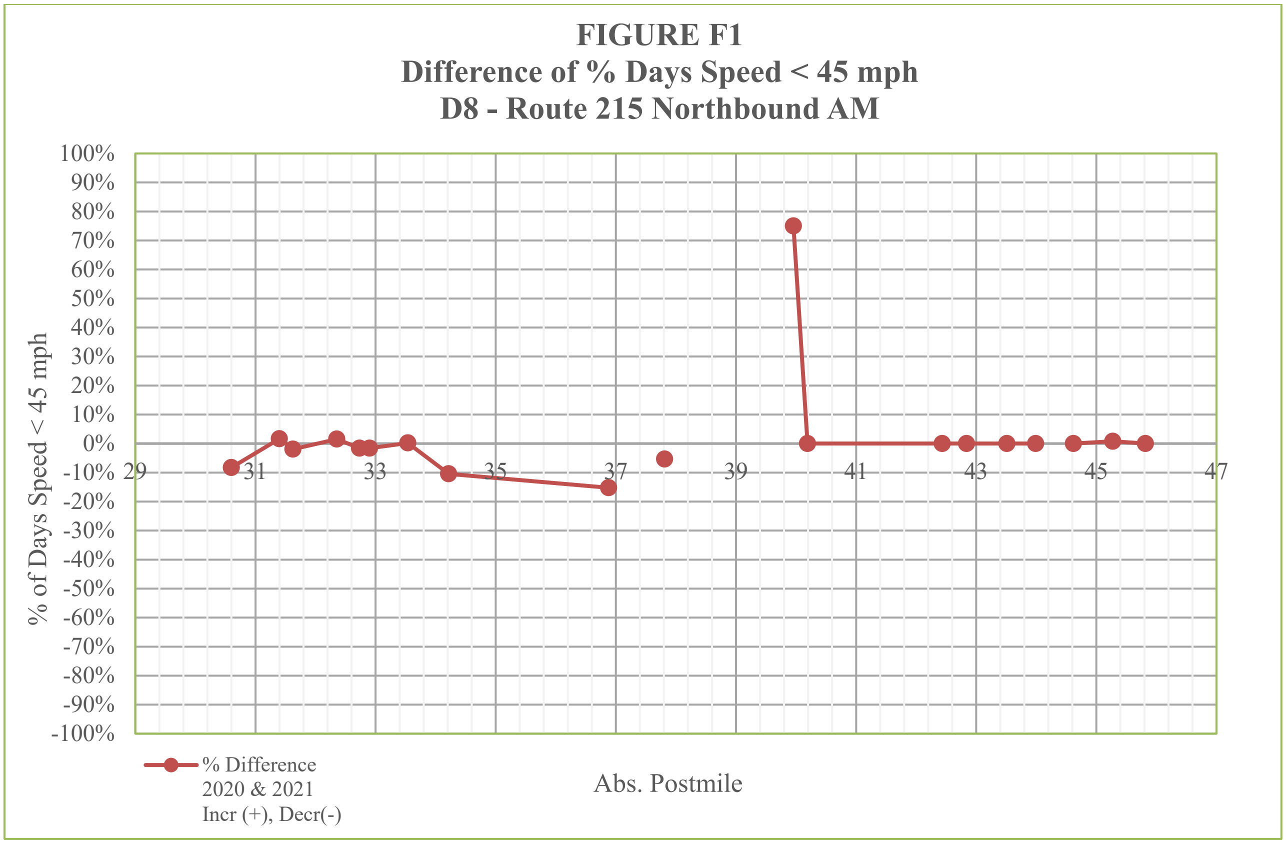


FIGURE F1
Difference of % Days Speed < 45 mph
D8 - Route 215 Northbound AM
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
-80%
-90%
-100%
% of Days Speed < 45 mph
29
31
33
35
37
39
41
43
45
47
% Difference 2020 & 2021 Incr (+), Decr(-)
Abs. Postmile

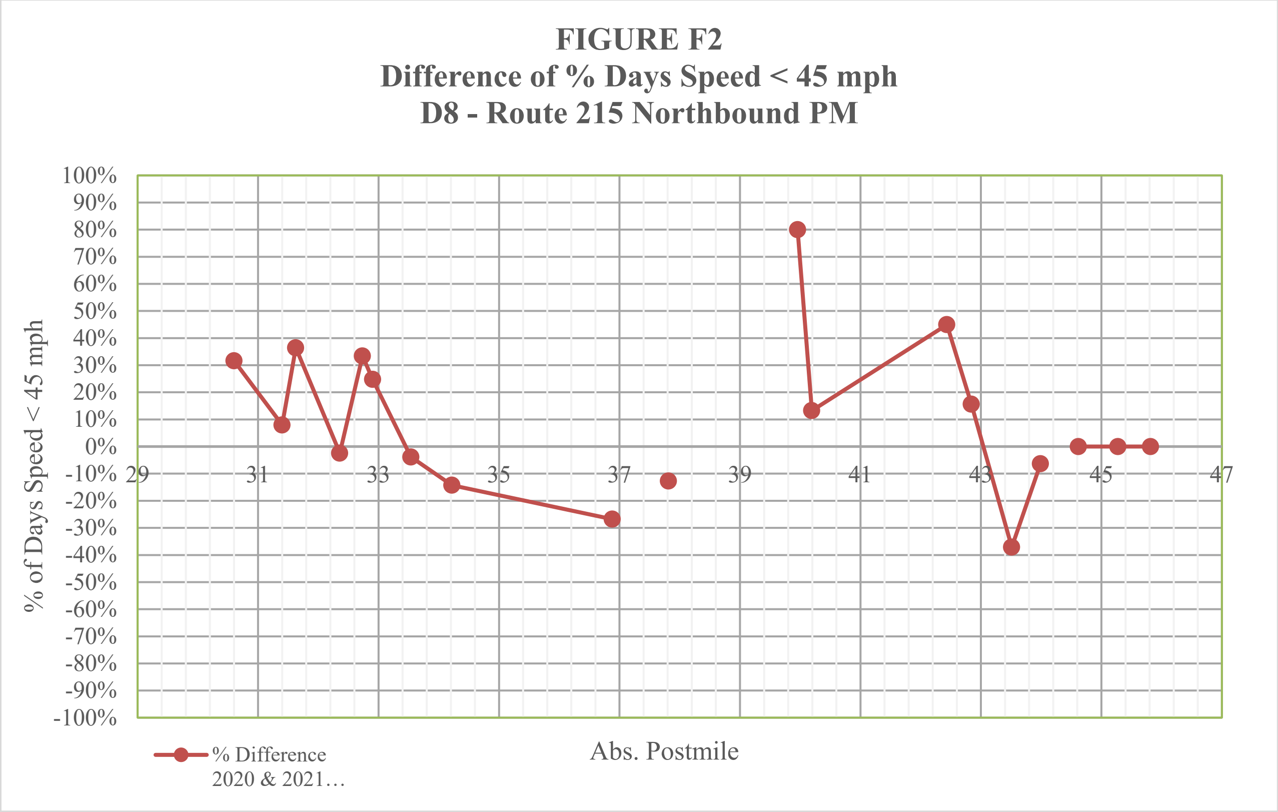


FIGURE F2
Difference of % Days Speed < 45 mph
D8 - Route 215 Northbound PM
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
-80%
-90%
-100%
% of Days Speed < 45 mph
29
31
33
35
37
39
41
43
45
47
% Difference 2020 & 2021…
Abs. Postmile

FIGURE F3
Difference of % days Speed < 45 mph
D8 - Route 215 Southbound AM

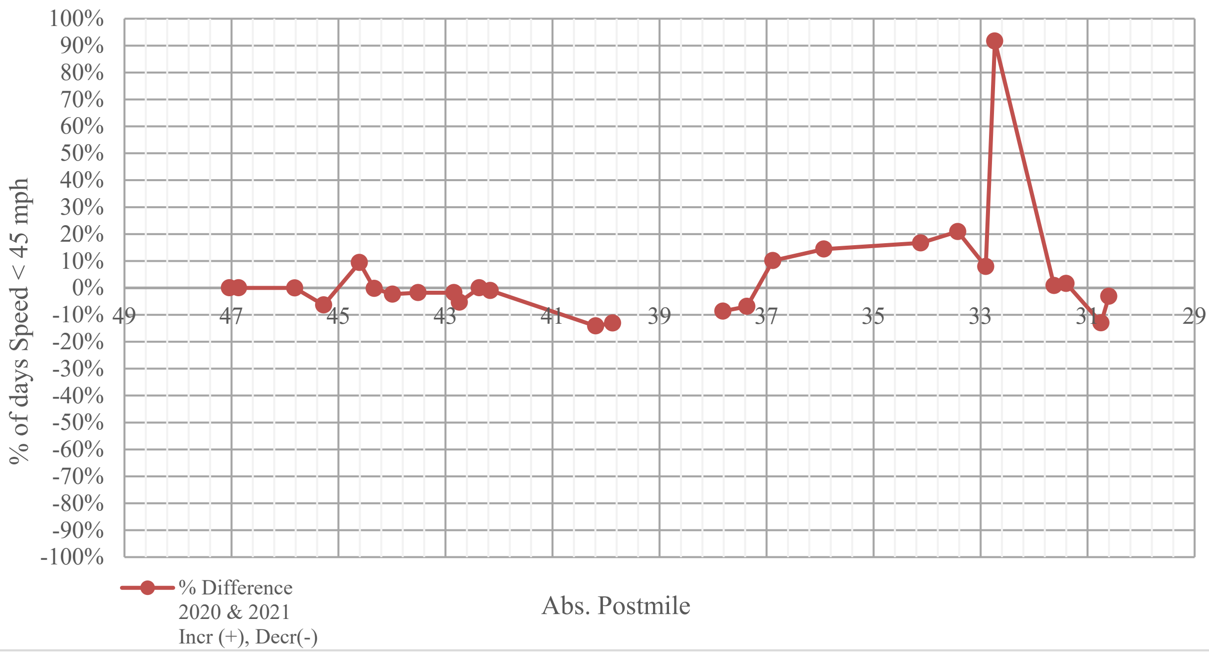
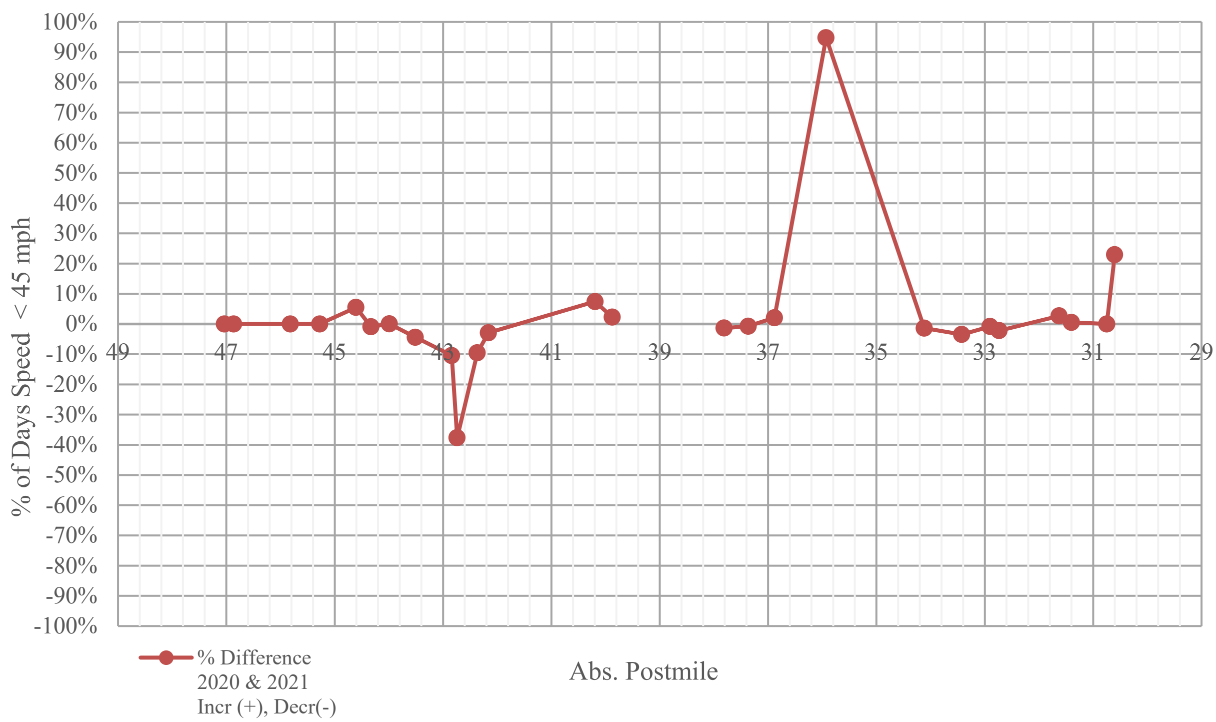


FIGURE F4
Difference of % days Speed < 45 mph
D8 - Route 215 Southbound PM



By comparing the "2020- and 2021-% of Days Speed < 45 mph graph" along a segment, we could deduce the trend of the degradation along the segment itself in 2021.

Please refer to Figures F1, F2, F3 & F4. These graphs represent the difference between "2020- and 2021-% of Days Speed < 45 mph." Part of the graph above horizontal axis shows that the degradation is increased and the opposite shows that the degradation is decreased. Gaps on the graphs show that no data is available along the pertaining gaps either in 2020 or 2021.

<u>Route 215 between 60/215 JCT in Moreno Valley and 60/91/215 JCT in the City of Riverside (Abs. PM + 31,0 & + 37.0):</u> Above graphs show that the degradation is increased at 44% of the detector locations within this segment during AM & PM peak hours in both directions. This increased most likely due to recurrent high peak hour volumes and high truck traffic volumes travelling on an up and down grade facility that caused congestion on GP lanes. The congestion is exacerbated by weaving caused by closely spaced interchanges within this 6-mile-long segment. The congestion on the GP lanes adversely effects the traffic flow on the adjacent continuous access HOV lane due to "friction."

<u>Route 215 between 60/91/215 JCT in the City of Riverside and Route 210 in the City of San Bernardino (Abs. PM + 37.0 & + 47.0):</u> Above graphs show that the degradation is increased at 17% of the detector locations within this segment during AM & PM peak hours in both directions. This increased most likely due to "friction" caused by recurrent high peak hour volumes on GP lanes, especially within the vicinity of interchanges.

The violation rate on HOV lane on above segments exceeds 27 percent (based on data collected in fall 2019 in both directions) which contributed to increase the traffic volumes on the HOV facility.

B. REMEDIATION STRATEGIES

- Project 08-0J070, SBD. PM 0.58-SBD. PM 1.66 will reconstruct Barton Road IC. Project cost estimate is $118.9 million. Construction to begin in November 2016 until July 2021. Desired Outcome: This project is anticipated to improve freeway traffic movement by the new improved IC and thereby minimizing recurrent local congestion on the GP lanes and due to "Friction," it will affect HOV lane as well.

- 08-1F730, SBD. PM 2.40-SBD. PM 3.00 will replace Mt. Vernon/Washington

Street OC. Project cost estimate is $34.4 million. Construction to begin in March 2021 until July 2023. *Desired Outcome*: This project is anticipated to improve freeway traffic movement by the new improved IC and thereby minimizing recurrent local congestion on the GP lanes and due to "Friction," it will affect HOV lane as well.

- Project 08-1H770, SBD. PM 4.50-SBD. PM 5.80 is a Lane reconfiguration and pavement widening project. Project cost estimate is $11.12 million. Construction to begin in June 2020 until May 2022. *Desired Outcome*: This project is anticipated to improve freeway traffic movement and thereby minimizing congestion on the GP lanes and due to "Friction," it will affect HOV lane as well.

- District 8 Traffic Operations is in the process of installing Route Shield Pavement Markings near major interchanges on this Route to assist confused drivers to stay on their desired lanes and Routes. This approach will have some impact to alleviate degradation on HOV lane near major interchanges. Desired Outcome: It improves safety and reduces weaving conflict.

4.6. DISTRICT 11 2021 DEGRADATION ACTION PLANS

4.6.1 SUMMARY OF DEGRADATION ON HOV FACILITIES IN DISTRICT 11

APPENDIX B provides the list of degraded facilities in District 11 that were identified in the 2021 California High Occupancy Vehicle Facilities Degradation Report. The speed and degradation profiles for each degraded facility are provided in APPENDIX B.

4.6.2 ACTION PLAN FOR HOV FACILITIES ON ROUTE 5

A. ANALYSIS

Route 5 is a major north-south artery serving the San Diego metropolitan area and numerous surrounding cities. In the past, northbound Route 5 would only experience degradation in the afternoon peak period. No degradation was observed on southbound Route 5 during either peak period.

Before February of 2022, the northbound Route 5 HOV lane was an open access HOV lane from Route 56 to Via De La Valle where it converts to a limited access HOV lane ending at Manchester Avenue. Due to the congestion at the end of the northbound HOV lane during the afternoon peak period, the experienced degradation ranged from slightly degraded to extremely degraded. The degradation occurred approximately 7 miles from Carmel Mountain Road to Manchester Avenue.

The North Coast Corridor (NCC) project is a $6.5 billion project which involves numerous rail and highway improvements stretching between the cities of La Jolla and Oceanside. Construction activities for the NCC greatly contributed to congestion in the GP lanes and this congestion would extend into the HOV lane at the terminus. As a part of the NCC Project, the HOV lanes were extended an additional nine miles to the north (opened to traffic in February 2022) to the major interchange at Palomar Airport Road, eliminating the terminus of the HOV lane at Manchester Avenue and is expected to reduce or eliminate degradation in this segment. The sensors in the new NCC segment are currently being configured.

B. REMEDIATION STRATEGIES

The NCC's new northbound and southbound HOV lanes from Manchester Avenue to Palomar Airport Road (9 miles) were opened to traffic in February 2022 ; it is expected to alleviate congestion.

District 11 will collect speed data from July 2022 to December 2022 and compare degradation data with data collected in 2020. We expect to verify that degradation was reduced or eliminated in the northbound HOV lane from Carmel Mountain Road to Manchester Avenue during the afternoon peak period.

4.6.3 ACTION PLAN FOR HOV FACILITIES ON ROUTE 15

A. ANALYSIS

Route 15 is the primary inland north-south transportation connector serving interregional travelers between Riverside County and downtown San Diego. It also is part of a major interregional goods movement corridor, connecting Mexico with Riverside, San Bernardino counties, and Las Vegas, Nevada. HOT lanes are operated by the San Diego Association of Governments (SANDAG) on Route 15 between Route 163 and Route 78.

Degradation was observed at the end of the HOT lanes in the northbound direction during the afternoon peak period. The experienced degradation is classified as slightly degraded. This slight degradation is caused by the speed reduction due to the friction between the general purpose lanes and HOV lanes.

The Route 15 HOT lanes have a regular recurring challenge affecting the facility. Surveys conducted by SANDAG over the past couple of years have indicated that 25-30 percent of users of the HOT lanes are violators, meaning single-occupant vehicles driving through the HOT lanes without a transponder.

B. REMEDIATION STRATEGIES

The slight degradation observed at the north end of the HOV lane is due to the unique circumstances at that terminus. District 11 will continue to monitor this location to evaluate if a project may be required in the future.

Caltrans District 11, San Diego Metropolitan Transit Service (MTS) and SANDAG have formed a multi-agency Corridor Management Team (CMT). The CMT meets quarterly to assess performance and develop strategies to remediate congestion.

In July 2020, SANDAG completed an operational study of the Route 15 HOT lanes. This study documented existing operations and performance, identified and analyzed strategies for improving the operations and performance of the HOT lanes. The three strategies examined were as follows:

- Transponder for All. This strategy requires all users of the EL to have a transponder, regardless of the number of occupants. The new transponder requirement would be accompanied by enhanced video enforcement.
- Change HOV Eligibility. This strategy increases the required number of occupants (for toll-free travel) from HOV2+ to HOV3+.
- Increase Maximum Toll. This strategy permits the toll rate to increase above the current maximum of $8 per trip. It maintains the current per-mile maximum of $1 but allows the per-mile rate to be applied to the full length of the trip. Since a full-length trip is 20 miles, this strategy essentially increases the maximum toll from $8 to $20.

The CMT is exploring these strategies further, with implementation occurring within the next one or two years as traffic returns to pre-pandemic levels.

Currently a new interchange project at I-15 and SR-78 is in the early design phase and is expected to start construction in 2026-2027 . This project along with the new sign and striping package will alleviate congestion during peak hours in the main lanes thus reducing the friction with the HOV lane users. This new interchange is expected to eliminate degradation in this segment.

4.6.4 ACTION PLAN FOR HOV FACILITIES ON ROUTE 805

A. ANALYSIS

Route 805 is a heavily traveled route serving the inland communities within the cities of San Diego, National City, and Chula Vista in San Diego County. The commuter freeway connects the Mexico border zone with the light industry of Sorrento Valley. There are two separate segments of Route 805 with HOV facilities; the south segment is from Palomar Street to Route 94 and the north segment is from Route 52 to the Route 5/Route 805 junction.

<u>Palomar Street to Route 94 (South segment)</u>

On the South segment, both the northbound and southbound HOV lanes are open access. The GP lanes in the northbound direction experience heavy congestion during the morning peak period, this congestion spills into the HOV lanes from Route 54 to Imperial Avenue. The degradation in this northbound segment is considered as slightly degraded and is due to the presence of the high percentage of HOV lane violators (35% - 40% based on HOV occupancy counts) plus the heavy traffic on the GP lanes (1,773 veh/lane/hr) causing friction to HOV users as vehicles from GP lanes weave in and out of the HOV lane using it as a passing lane.

Route 52 to Route 5 (North segment)

Both the northbound and southbound HOV lanes are open access on this segment. The southbound direction presents degradation considered extremely degraded during the morning peak period for approximately 0.8 miles and presents degradation ranging from slightly degraded to extremely degraded in the afternoon peak period for approximately 2.3 miles beginning at the southbound Sorrento Valley Road exit ramp for both periods. The cause of degradation is due to several factors, occupancy violation rates range from 20% - 25%, heavy traffic (1,813 veh/lane/hr) in the general-purpose lanes causing friction for HOV users, GP traffic weaving in and out of the HOV lane using it as a passing lane, this section of the HOV lane is on an incline grade and the merging of HOV traffic with DAR vehicles coming in form Carroll Canyon Road.

Northbound Route 805 does not experience degradation during either peak period.

B. REMEDIATION STRATEGIES

Palomar Street to Route 94 (South segment)

A Transit Only Lane (MTS bus on shoulder) project is a 3-year pilot project. It began operations in the south segment on June 21st, 2022, and will be operational during the commute hours from 6:00 am to 9:00 am. During these hours, the project provides enhanced CHP (2 patrol vehicles) to support the buses when traveling from the HOV lanes to the outside shoulder.

District 11 is currently collecting speed data along the northbound direction in this segment, from south of Plaza Blvd. to Imperial Ave. to evaluate how the presence of CHP will discourage GP vehicles using the HOV lane as a passing lane and violators on the HOV facility.

Route 52 to Route 5 (North segment)

The current DAR has queuing capacity for a ramp meter. District 11 is currently working with the Ramp Metering Unit to evaluate the SB DAR and include it in their ramp meter development plan to have a ramp meter installed in the near future. Depending on which program is used, it could take from one to two years to have it installed. We are also pursuing additional law enforcement presence in this segment to assist with violation rates and illegal GP traffic weaving into the HOV lane.

4.7. DISTRICT 12 2021 DEGRADATION ACTION PLANS

4.7.1 SUMMARY OF DEGRADATION ON HOV FACILITIES IN DISTRICT 12

APPENDIX B provides the list of degraded facilities in District 12 that were identified in the 2021 California High Occupancy Vehicle Facilities Degradation Report. The speed and degradation profiles for each degraded facility are provided in APPENDIX B.

4.7.2 DISTRICT-WIDE ACTIONS RELATED TO DEGRADATION

To manage congestion, resolve HOV speed degradation, improve travel reliability, and offer enhanced mobility options, Caltrans District 12 has increasingly turned to Priced Managed Lanes (PML) as a viable solution. PMLs maximize system efficiency, increase mobility choices, improve the environment, and contribute financially to freeway corridor maintenance, operations, and improvements.

Caltrans District 12 has conducted two Managed Lanes studies to implement Caltrans' mission, vision, goals, and values. These two studies and their goals are listed as follows:

- Orange County Managed Lanes Feasibility Study (MLFS) to replace the HOV lane network with the HOT lane network.
- Orange County Managed Lanes Network Study (MLNS) to analyze the operational benefits of PMLs with planning-level traffic analysis.

The 2014 District Systems Management Plan (DSMP) of District 12 also indicated in section 3.1D that managed lane pricing is one of the powerful policy tools that helps reduce congestion and improve finance to our declining infrastructure. Similar policies have effectively proven reducing traffic in highly congested areas at other states while generating revenue for transportation projects.

4.7.3 ACTION PLAN FOR I-5 HOV FACILITIES

A. ANALYSIS

According to AM summary and Speed Plot for I-5 northbound during AM peak hours (6 – 9 AM), HOV degradation occurred from Crown Valley (PM 86.128) to Oso (PM 87.649), from Jeffrey (PM 97.338) to south of SR-55 (PM 102.451), and from Stanton (PM 115.261) to Western (PM 116.151).

Project EA 12-0C8904 (completed 2020) added a second HOV lane from Grand (PM 103.851) to La Veta (PM 106.451). HOV degradation was subsequently eliminated from north of SR-55 (PM 102.651) to north of SR-57 (PM 106.651).

According to PM summary and Speed Plot for I-5 northbound during PM peak hours (3 – 6 PM), HOV degradation occurred from Alton (PM 94.358) to Ball (PM 109.51) and from Orangethorpe (PM 114.771) to Western (PM 116.151).

According to AM summary and Speed Plot for I-5 southbound during AM peak hours (6 – 9 AM), HOV degradation occurred from Magnolia (PM 114.088) to Lincoln (PM 111.188) and from Harbor (PM 109.668) to Yale (PM 97.995).

According to PM summary and Speed Plot for I-5 southbound during PM peak hours (3 – 6 PM), HOV degradation occurred at Seventeenth (PM 104.438), El Toro (PM 90.895), and Alicia (PM 89.455).

After extensive review of traffic data and field investigations, the causes of the degradation on I-5 are as follows:

- Demand exceeding capacity – Peak period recurrent congestion in all lanes reduces HOV lane performance and speed. These are locations that reach to more than a 1,700 veh/ln/hr threshold based on 2020 – 2021 PeMS data: I-5 northbound at Culver, Broadway, Yale, Santiago, El Toro, Harbor, and Main; I-5 southbound at Tustin Ranch Road, Ankerton, El Toro, and Santiago.
- Vehicle weaving conflict at ingress/egress locations due to congestion in the general purpose (GP) lanes.
- The violation rates at Main Street showed northbound AM is 1.63%, PM is 10.12% and southbound AM is 7.96%, PM is 8.03% according to Spring 2022 HOV count data.
- High volumes of low or zero emission vehicles in HOV lanes – 33.8% at Los Alisos (per Managed Lanes report).

B. REMEDIATION STRATEGIES

- Three projects (12-0K021, 12-0K022, and 12-0K023) are currently under construction to add one lane in both directions between El Toro Road (PM 18.9) and SR-73 (PM 12.4). The proposed projects will add GP lanes in each direction on I-5 between Avery Parkway and Alicia Parkway, extend the 2nd HOV lane from Alicia Parkway to El Toro Road, re-establish existing auxiliary lanes/construct new auxiliary lanes, and improve several existing on- and off-ramps. Additionally, the projects propose no HOV buffer, meaning the HOV lane will accommodate continuous access throughout the project limits. Construction began in October 2020 and will be completed in October 2024. Project costs for the three segments are funded by Measure M2, STBG, and STIP/SB-1, and are estimated at $306 million (per 0K0200 Project Report dated May 2014).

- Project 12-0P5500 proposes the addition of an HOV lane to reduce delay along I-5 between the San Diego/Orange County line and the I-5/Avenida Pico Avenue interchange. This project would extend the recently completed HOV lane between San Juan Creek Bridge and Avenida Pico Avenue to the Orange/San Diego County line. The project limits are from approximately 1.4 miles south of the San Diego/Orange County line interchange (PM R71.0) to 3.5 miles north at Avenida Pico in the City of San Clemente (PM 3.4). The project is in PA&ED phase now, PS&E will start in 2026 and anticipated to RTL in 2028.

- Project 12-0Q950 proposes to add and convert HOV lanes to HOT lanes along I-5 from Red Hill Avenue (PM 29.1) to the Orange/Los Angeles County line (PM 0.5). The project limit is currently designated as urban with mixed land uses (commercial, industrial, and residential). Alternative No. 4 will convert existing HOV lanes to PMLs and construct one additional PML between SR-57 and SR-91, one additional PML in each direction between Red Hill Avenue and SR-55, and two additional PMLs in each direction between SR-55 and SR-91. The estimated cost for this project will be $330 million. This project is in PA&ED phase now and anticipated to RTL in 2024.

- The Project Initiation Proposal (PIP) for an HOV 3+ Study and converting to HOT from the I-5/I-405 interchange to Red Hill Avenue is moving forward after receiving Planning PIR approval in June 2022.

4.7.4 ACTION PLAN FOR SR-22 HOV FACILITIES

A. ANALYSIS

According to AM summary and Speed Plot on SR-22 eastbound during AM peak hours (6 – 9 AM), HOV degradation occurred from Magnolia (PM 6.447) to City Drive (PM 11.261).

According to PM summary and Speed Plot on SR-22 eastbound during PM peak hours (3 – 6 PM), HOV degradation occurred from Magnolia (PM 6.447) to Hesperian (PM 11.461).

In 2020, degradation occurred from Brookhurst (PM 7.0) to Glassell/Grand (PM 13.2). The existing concrete barriers on the collector distributor roads were shortened, and eastbound SR-22 mainline was reconfigured by striping to add one auxiliary lane. This project improved weaving maneuvers between GP and HOV lanes, thus reducing HOV violations. The queue in the eastbound GP lane from Fairview Street to Bristol Street (1/2 mile) was reduced.

According to AM summary and Speed Plot on SR-22 westbound during AM peak hours (6 – 9 AM), HOV degradation did not occur.

According to PM summary and Speed Plot on SR-22 westbound during PM peak hours (3 – 6 PM), HOV degradation occurred from Bristol (PM 11.701) to Harbor (PM 9.4).

After extensive traffic data review and field investigations, the causes of the degradation on SR-22 are as follows:

- Peak period recurrent congestion in all lanes reducing HOV lane performance and speed.
- High HOV violation rates – approximately 30% at Pearce Street POC during Fall of 2019.

B. REMEDIATION STRATEGIES

- There are none of projects to add HOV lane or convert HOV to HOT lane from year 2022 to year 2028.
- According to Orange County Managed Lane Feasibility Study, there will be a plan for second HOV lane and convert to Dual HOT Lanes from I-405 to Grand Avenue. The project will be RTL in 2040/2041.

4.7.5 ACTION PLAN FOR SR-55 HOV FACILITIES

A. ANALYSIS

- According to AM summary and Speed Plot on SR-55 northbound during AM peak hours (6 – 9 AM), HOV degradation did not occur.
- According to PM summary and Speed Plot on SR-55 northbound during PM peak hours (3 – 6 PM), HOV degradation occurred from Paularino (PM 5.8) to Taft (PM 15.782).
- According to AM summary and Speed Plot on SR-55 southbound during AM peak hours (6 – 9 AM), HOV degradation occurred from Walnut (PM 14.382) to Chapman (PM 13.492) and from Santa Clara (PM 12.282) to McFadden (PM 10.00).
- According to PM summary and Speed Plot on SR-55 southbound during PM peak hours (3 – 6 PM), HOV degradation did not occur.
- After extensive traffic data review and field investigations, the causes of the degradation on SR-55 are as follows:
    - Demand exceeding capacity – Peak period recurrent congestion in all lanes reduces HOV lane performance and speed. These are locations that reach to more than a 1,700 veh/ln/hr threshold based on 2020 – 2021 PeMS data: SR-55 northbound at Mac Fadden, La Veta, Main, and MacArthur; SR-55 southbound at Main, MacArthur, Walnut, Mac Fadden, Dyer, and La Veta.
    - Bottlenecks at SR-55/I-405 HOV direct connector and I-5 HOV direct connector.
    - Mainline bottlenecks at SR-55/SR-22 interchange and SR-55/SR-91 interchange.
- Northbound HOV lane transitioning to a GP lane prior to joining the SR-91 express lane. At this location, several vehicles exit the HOV lane and merge to GP lanes to avoid the toll charge. This causes slowdowns on both the HOV and GP lanes. The weaving creates an extreme backlog at the SR-55/SR-91 interchange, especially during peak hours.

B. REMEDIATION STRATEGIES

- Project 12-0J340 proposes to add one HOV lane, one GP lane, and auxiliary lanes in both directions between the I-5/SR-55 separation and I-5 at Newport Avenue. Design was completed in April 2020 with RTL occurring 9/2/2021 and the award being granted in May 2022. Project cost is estimated at $477 million with funding by Measure M2, SHOPP, CMAQ, STBG, and STIP.

- Project 0K-720 PS&E has begun on SR-55 from I-5 to SR-91 to add additional GP lanes funded by OCTA/OCGO. Construction funding has not been identified before 2030.

- Project 0K-9701 PS&E is nearing completion to add an Express Connector between the SR-241and SR-91 express lanes. This connector may provide relief to SR-55 HOV lanes in both directions at the SR-91 interchanges as the Draft of Eastern Corridor Master Agreement among Foothill/Eastern Transportation Agency, Orange County Transportation Agency, Riverside County Transportation Commission, and Caltrans mentioned in Traffic Operation Metrics section dated on May 22, 2022.

4.7.6 ACTION PLAN FOR SR-57 HOV FACILITIES

A. ANALYSIS

- According to AM summary and Speed Plot on SR-57 northbound during AM peak hours (6 – 9 AM), HOV degradation did not occur.

- According to PM summary and Speed Plot on SR-57 northbound during PM peak hours (3 – 6 PM), HOV degradation occurred from Chapman (PM 0.466) to Tonner (PM 11.266).

- According to AM summary and Speed Plot on SR-57 southbound during AM peak hours (6 – 9 AM), HOV degradation occurred from Imperial (PM 9.291) to Ball (PM 2.621).

- According to PM summary and Speed Plot on SR-57 southbound during PM peak hours (3 – 6 PM), HOV degradation occurred from Imperial (PM 9.921) to Placentia (PM 6.351) and from Underhill (PM 4.451) to Orangewood (PM 0.901).

- After extensive traffic data review and field investigations, the causes of the degradation on SR-57 are as follows:

  - High-speed differences between GP and HOV lanes with no buffer separation – HOV traffic tends to reduce speed in preparation for the sudden emergence of traffic from a GP lane with low speeds due to continuous access striping.

- o Major bottlenecks at SR-91 interchange and I-5 interchange.

- o Termination of SR-57 at the I-5/SR-22 interchange – the HOV lane keeps connecting to I-5, but the number of GP lanes reduces from 4 to 2, resulting in major braking, slowing, and weaving.

- o Queuing of vehicles from the southbound SR-57 HOV lane onto southbound I-5 at the interchange.

B. REMEDIATION STRATEGIES

- o Project 12-0M970 proposes geometric improvements to increase capacity and improve congestion from Orangewood Avenue to Katella Avenue in the City of Anaheim. Construction will begin in January 2025 and is scheduled to be completed by March 2027. This is an OCTA project with a cost of approximately $30 million.

- o Project 12-0J420 is under construction to convert buffer-separated HOV lanes to continuous lanes to reduce friction, violations, and weaving problems. Project completion will be in July 2023. This project will be studied the effectiveness between buffer-separated and continuous striping.

4.7.7 ACTION PLAN FOR SR-91 HOV FACILITIES (from Los Angeles County Line to 91 Express Lanes at SR-55 Connector Only, PM 0.6 To PM 8.8)

A. ANALYSIS

- o According to AM summary and Speed Plot on SR-91 eastbound during AM peak hours (6 – 9AM), HOV degradation occurred from Holder (PM 16.059) to East/Raymond (PM 22.723).

- o According to PM summary and Speed Plot on SR-91 eastbound during PM peak hours (3 – 6 PM), HOV degradation occurred from Orangethorpe (PM 15.339) to Tustin (PM 26.23).

- o According to AM summary and Speed Plot on SR-91 westbound during AM peak hours (6 – 9 AM), a pocket of HOV degradation with lengths of less than one mile occurred at Orangethorpe (PM 15.139), east of Stanton (PM 17.739) and State College (PM 23.553).

- o According to PM summary and Speed Plot on SR-91westbound during PM peak hours (3 – 6 PM), HOV degradation occurred from Orangethorpe (PM 15.139) to Kraemer (PM 25.813).

- After extensive traffic data reviewing and field investigations, the causes of the degradation on SR-91 are as follows:

- Peak period recurrent congestion in all lanes reducing HOV lane performance and speed.

- Major bottlenecks at the I-5 and SR-57 interchanges contributing to congestion due to lane changing/merging problems when drivers compete for available gaps in the traffic stream.

- Weaving conflicts occurring where the eastbound SR-91 HOV lane transitions to an express lane near Tustin Avenue in the City of Anaheim. A primary cause of the congestion is the existing demand to access the Express Toll Lane facility, which exceeds capacity during afternoon peak periods.

- High HOV violation rate – AM violation was 26.6% and PM violation was 31.66% on westbound SR-91 at Kraemer Boulevard (PM 25.813).

B. REMEDIATION STRATEGIES

Based on the analysis in the previous section, the following remediation strategies for SR-91 in both directions will be implemented for the studied facilities:

- According to OC Managed Lanes Feasibility Study, it suggested adding a second HOV lane and converting to Dual HOT lanes from Los Angeles County line to SR-55 to ensure traffic flow for all SR-91 express lanes. This project will reduce traffic jams and weaving at the current express lane entrances. In the Plan Analysis section of OC Managed Lanes Feasibility Study, the single HOV lane per direction from I-5 to SR- 55 would be converted to single HOT lanes in Phase 1 and it is the most likely plan now.

- Foothill/Eastern Transportation Agency, Orange County Transportation Agency, Riverside County Transportation Commission, and Caltrans are currently drafting a Master Agreement to ensure average peak period travel speeds of greater than 60 miles per hour on the SR-91 express lanes in the vicinity of the SR-241/91 EC connection. The proposal will have a positive impact on HOV lanes from the Los Angeles County line to SR-55. The operational speed during peak periods will be increased and the HOV violations at Kraemer Street to the eastbound SR-91 express lanes will be decreased.

4.7.8 ACTION PLAN FOR I-405 HOV FACILITIES

A. ANALYSIS

According to AM summary and Speed Plot on I-405 northbound during AM peak hours (6 – 9 AM), HOV degradation occurred from TMS 2542 (PM 23.699) to TMS 2218 (PM 23.411). This is a transitional area between I-605 and SR-22 to I-405.

According to PM summary and Speed Plot on the I-405 northbound during PM peak hours (3 – 6 PM), HOV degradation occurred from south of SR-133 (PM. 1.34) to TMS 2542 (PM 23.699).

According to AM summary and Speed Plot on the I-405 southbound during PM peak hours (3 – 6 PM), HOV degradation occurred from TMS 2240 (PM 20.106) to TMS 5014 (PM. 14.309).

According to PM summary and Speed Plot on the I-405 southbound during PM peak hours (3 – 6 PM), HOV degradation occurred from Jamboree (PM 6.78) to Sand Canyon (PM 2.65).

After extensive traffic data review and field investigations, the causes of the degradation on I-405 are as follows:

- Peak period recurrent congestion in all lanes reducing HOV lane performance and speed.
- Vehicle weaving conflicts at ingress/egress locations.
- Congestion in the GP lanes at the SR-55 interchange and SR-22 interchange, and through Irvine.
- High traffic volume and demand from John Wayne Airport and South Coast Metro Center.
- Bottleneck at I-405/SR-55 HOV direct connector (PM. 8.12).
- High volumes of low or zero emission vehicles in HOV lanes- at Jeffrey Road, northbound AM, the low emission vehicle percentage is 23.4% in October 2019 (per 2019 HOV report data).
- High HOV violation rate – AM violation was 23.77% and PM violation was 12.58% on southbound I-405 at Jeffrey Road POC (per Fall 2021 HOV report data).

B. REMEDIATION STRATEGIES

Based on the analysis in the previous section, the following remediation strategies for I-405 in both directions will be implemented for the studied facilities:

- Design-Build Widening Project 0H-100 on I-405 between SR-73 and I-605 is currently in construction to convert the existing HOV lane to an express lane and add another HOT lane to create dual HOT lanes in each direction. The project also adds one GP lane in each direction to increase freeway capacity. The project is scheduled for completion February 28, 2024.
- CCTV cameras to monitor the express lanes and toll equipment will be installed for I-405 from SR-73 to I-605. The cameras will have pan, tilt, and zoom (PTZ) capabilities to allow the TOP and Caltrans to monitor freeway incidents and the toll facilities.
- Project 0Q-970 will convert the buffered/separated HOV lane to Continuous Access from I-5 to Jamboree Boulevard. This facility will be converted to a HOT facility after the HOT lane project 0H-100 is completed. Project reached RTL in June 2022.

5. ATTACHMENT A

A. ADDITIONAL INFORMATION FROM DISTRICT 5 (4)

6. APPENDIX A

LIST OF 2021 DEGRADED HOV FACILITIES

District	Route	Direction	Limits	Facility Length	Time Period	Lane Miles Monitored	Not Degraded	Slightly Degraded	Very Degraded	Extremely Degraded
3	80	EB	West El Camino Ave	21.55	AM	16.39	16.39	0.00	0.00	0.00
	80		to SR-65		PM	16.39	14.83	1.55	0.00	0.00
	80	WB	SR-65	21.46	AM	14.81	14.81	0.00	0.00	0.00
	80		to West El Camino Ave		PM	14.81	12.54	0.22	0.72	1.34
	99/51	NB	Elk Grove Blvd	13.10	AM	12.57	8.01	4.56	0.00	0.00
	99/51		to N Street		PM	12.57	8.67	3.90	0.00	0.00
	99/51	SB	B Street	13.63	AM	11.14	11.14	0.00	0.00	0.00
	99/51		to Elk Grove Blvd		PM	11.14	3.78	5.78	0.77	0.81
4	4	WB	Hillcrest Ave	12.32	AM	8.13	3.29	1.45	2.05	1.34
	4		to Port Chicago Hwy		PM	N/A	N/A	N/A	N/A	N/A
	80	EB	I-880	18.62	AM	15.11	15.11	0.00	0.00	0.00
	80		to Cummings Skyway		PM	15.11	4.27	1.35	2.00	7.50
	80	WB	SR-29	19.00	AM	14.40	6.45	3.76	3.65	0.55
	80		to Powell Street		PM	14.71	14.33	0.00	0.00	0.39
	80	EB	Red Top Road	8.12	AM	3.82	3.82	0.00	0.00	0.00
	80		to Air Base Pkwy		PM	3.82	1.73	1.49	0.61	0.00

District	Route	Direction	Limits	Facility Length	Time Period	Lane Miles Monitored	Not Degraded	Slightly Degraded	Very Degraded	Extremely Degraded
	85	NB	US-101 (South San Jose)	25.60	AM	15.03	10.44	4.59	0.00	0.00
	85		to US-101 (Mountain View)		PM	14.52	14.52	0.00	0.00	0.00
	85	SB	US-101 (Mountain View)	25.58	AM	15.01	15.01	0.00	0.00	0.00
	85		to US-101 (South San Jose)		PM	15.60	7.27	5.95	1.01	1.37
	87	NB	SR-85	9.70	AM	5.34	4.06	1.28	0.00	0.00
	87		to US-101		PM	5.59	5.12	0.47	0.00	0.00
	87	SB	US-101	9.12	AM	4.34	4.34	0.00	0.00	0.00
	87		to SR-85		PM	4.34	3.89	0.45	0.00	0.00
	101	NB	Cochrane Rd	44.72	AM	20.13	18.35	1.03	0.75	0.00
	87	NB	SR-85	9.70	AM	5.34	4.06	1.28	0.00	0.00
	101		to Whipple Ave		PM	18.71	18.71	0.00	0.00	0.00
	101	SB	Whipple Ave	43.99	AM	20.49	20.22	0.27	0.00	0.00
	101		to Cochrane Rd		PM	18.95	13.17	1.67	1.30	2.82
	101	NB	Richardson Bay Bridge	18.67	AM	N/A	N/A	N/A	N/A	N/A
	101		to Atherton Ave		PM	7.99	6.30	0.00	0.99	0.70
4	101	SB	De Long	16.18	AM	4.46	1.79	2.67	0.00	0.00
	101		to Richardson Bay Bridge		PM	N/A	N/A	N/A	N/A	N/A
	101	NB	0.4 mil. S of the Marin Co. line	28.98	AM	16.78	16.46	0.33	0.00	0.00
	101		to Windsor River Rd		PM	15.94	14.18	1.76	0.00	0.00

District	Route	Direction	Limits	Facility Length	Time Period	Lane Miles Monitored	Not Degraded	Slightly Degraded	Very Degraded	Extremely Degraded
4	101	SB	Windsor River Rd	21.29	AM	14.25	14.25	0.00	0.00	0.00
	101		to Old Redwood Hwy		PM	14.25	10.22	3.02	1.01	0.00
	280	NB	Leland Ave	10.69	AM	6.37	4.50	1.87	0.00	0.00
	280		to Magdalena Ave		PM	6.37	6.37	0.00	0.00	0.00
	280	SB	Magdalena Ave	10.59	AM	3.69	3.69	0.00	0.00	0.00
	280		to Leland Ave		PM	3.69	1.08	2.61	0.00	0.00
	580	EB	Hacienda Rd	17.00	AM	7.49	7.49	0.00	0.00	0.00
	580		to Greenville Rd		PM	7.56	5.83	1.74	0.00	0.00
	680	NB	South Grimer	7.65	AM	0.18	0.18	0.00	0.00	0.00
	680		to SR-84		PM	0.18	0.00	0.18	0.00	0.00
	680	SB	SR-84	13.70	AM	7.85	7.85	0.00	0.00	0.00
	680		to SR-237		PM	7.85	7.85	0.00	0.00	0.00
	680	NB	Alcosta Blvd	12.02	AM	8.32	8.32	0.00	0.00	0.00
	680		to Livorna Road		PM	7.72	4.44	3.28	0.00	0.00
	680	SB	Marina Vista	23.50	AM	11.21	10.57	0.35	0.30	0.00
	680		to Alcosta Blvd		PM	11.60	11.60	0.00	0.00	0.00
	880	SB	Dixon Landing Rd	6.32	AM	3.18	3.18	0.00	0.00	0.00
	880		to US-101		PM	3.18	1.71	0.92	0.56	0.00
	880	NB	Dixon Landing Rd	17.91	AM	8.84	8.84	0.00	0.00	0.00

District	Route	Direction	Limits	Facility Length	Time Period	Lane Miles Monitored	Not Degraded	Slightly Degraded	Very Degraded	Extremely Degraded
	880		to SR-238		PM	7.84	4.88	2.41	0.00	0.56
	880	SB	Hegenberger Rd	25.04	AM	15.71	13.36	2.35	0.00	0.00
	880		to Dixon Landing Rd		PM	14.73	14.73	0.00	0.00	0.00
5	101	NB	Ventura County Line	1.13	AM	1.13	0.00	1.13	0.00	0.00
	101		to Bailard Avenue		PM	1.13	1.13	0.00	0.00	0.00
7	5	NB	Magnolia Ave	15.01	AM	4.56	3.88	0.67	0.00	0.00
	5		to SR-14		PM	4.56	0.00	3.00	0.00	1.56
	5	SB	SR-14	14.97	AM	4.71	3.56	0.27	0.88	0.00
	5		to Magnolia Ave		PM	4.71	3.83	0.00	0.00	0.88
	10	EB	Alameda St	21.90	AM	16.42	16.42	0.00	0.00	0.00
	10		to I-605		PM	16.42	8.29	3.33	0.00	4.81
	10	WB	Garvey Ave	21.27	AM	19.42	16.63	1.53	1.26	0.00
	10		to Alameda St		PM	19.42	18.58	0.84	0.00	0.00
	10	EB	I-605	17.27	AM	4.96	4.10	0.60	0.00	0.27
	10		to San Bernardino County Line		PM	4.96	0.00	0.00	0.00	4.96
	10	WB	San Bernardino County Line	16.97	AM	5.89	3.61	1.24	0.00	1.04
	10		to I-605		PM	5.89	5.50	0.00	0.00	0.40
	14	NB	I-5	35.83	AM	N/A	N/A	N/A	N/A	N/A

District	Route	Direction	Limits	Facility Length	Time Period	Lane Miles Monitored	Not Degraded	Slightly Degraded	Very Degraded	Extremely Degraded
	14	NB	to Palmdale Blvd		PM	15.03	4.25	5.70	0.00	5.08
	14	SB	Avenue P-8	36.44	AM	14.57	0.00	9.07	0.00	5.50
	14		to I-5		PM	N/A	N/A	N/A	N/A	N/A
	57	NB	Orange County Line	5.42	AM	1.47	0.89	0.57	0.00	0.00
	57		to SR-60		PM	1.47	0.00	0.00	0.00	1.47
	60	EB	I-605	18.66	AM	10.71	9.47	0.81	0.43	0.00
	60		to San Bernardino County Line		PM	10.71	2.06	3.91	1.90	2.84
	60	WB	San Bernardino County Line	16.64	AM	9.12	2.22	0.48	4.70	1.72
	60		to 7th Ave		PM	9.12	5.02	3.48	0.00	0.62
	91	EB	I-110	14.18	AM	8.83	8.11	0.72	0.00	0.00
	91		to Orange County Line		PM	8.83	1.75	1.32	2.09	3.67
	91	WB	Orange County Line	12.21	AM	10.69	2.22	3.86	4.61	0.00
	91		to Central Avenue		PM	10.69	6.04	2.56	0.00	2.09
	105	EB	I-405	16.33	AM	2.80	2.80	0.00	0.00	0.00
	105		to Studebaker Rd		PM	2.80	1.25	0.00	0.00	1.55
	105	WB	Studebaker Rd	15.73	AM	3.41	0.46	0.90	0.85	1.20
	105		to I-405		PM	3.41	2.61	0.50	0.00	0.30
	110	NB	Harbor Gateway Transit Center	18.07	AM	2.83	0.51	0.00	0.00	2.32
	110		to Adams Blvd		PM	2.83	0.00	0.51	0.00	2.32

District	Route	Direction	Limits	Facility Length	Time Period	Lane Miles Monitored	Not Degraded	Slightly Degraded	Very Degraded	Extremely Degraded
7	118	EB	Ventura County Line	10.40	AM	10.35	9.60	0.75	0.00	0.00
	118		to I-5		PM	10.35	4.50	2.92	2.33	0.60
	134	EB	US-101/SR-170	5.03	AM	4.82	4.82	0.00	0.00	0.00
	134		to I-5		PM	4.82	2.00	0.47	0.18	2.18
	134	EB	I-5	7.67	AM	5.54	4.89	0.66	0.00	0.00
	134		to I-210		PM	5.54	1.73	2.42	0.66	0.74
	134	WB	I-210	7.20	AM	3.64	3.64	0.00	0.00	0.00
	134		to I-5		PM	3.64	2.79	0.86	0.00	0.00
	210	EB	SR-134	27.50	AM	25.91	24.80	0.65	0.46	0.00
	210		to San Bernardino County Line		PM	25.91	2.26	7.08	0.93	15.65
	210	WB	San Bernardino County Line	27.50	AM	23.64	6.08	6.24	1.94	9.39
	210		to SR-134		PM	23.64	17.16	4.96	1.53	0.00
	405	NB	Orange County Line	48.42	AM	31.16	16.16	6.85	2.40	5.75
	405		to I-5		PM	31.16	10.40	8.09	1.21	11.46
	405	SB	I-5	47.68	AM	32.49	21.90	3.53	1.46	5.61
7	405		to Orange County Line		PM	32.49	10.44	3.22	2.51	16.32
	605	NB	Orange County Line	19.84	AM	11.27	10.09	1.17	0.00	0.00
	605		to I-10		PM	11.27	4.17	1.35	1.41	4.34
	605	SB	I-10	20.71	AM	12.00	8.15	2.00	0.96	0.88

District	Route	Direction	Limits	Facility Length	Time Period	Lane Miles Monitored	Not Degraded	Slightly Degraded	Very Degraded	Extremely Degraded
	605		to Orange County Line		PM	12.00	7.09	1.06	0.00	3.85
8	10	EB	Los Angeles County Line	8.27	AM	7.82	4.86	2.11	0.85	0.00
8	10	EB	to Haven Ave	8.27	PM	7.82	0.00	1.70	3.01	3.12
8	10	WB	Haven Ave	8.52	AM	7.81	1.60	1.51	4.19	0.51
8	10	WB	to Los Angeles County Line	8.52	PM	7.81	2.21	3.88	0.50	1.22
8	15	NB	Cajalco Road	25.39	AM	19.35	16.35	0.52	2.48	0.00
8	15	NB	to Route 60	25.39	PM	19.35	16.87	1.98	0.50	0.00
8	15	SB	Route 60	24.24	AM	18.78	18.78	0.00	0.00	0.00
8	15	SB	to Cajalco Road	24.24	PM	18.41	12.54	2.77	0.22	2.89
8	60	EB	Los Angeles County Line	22.37	AM	8.94	8.44	0.00	0.00	0.50
8	60	EB	to West Jct I-215	22.37	PM	8.94	2.62	2.82	0.00	3.50
8	60	WB	West Jct I-215	22.11	AM	11.96	8.82	3.14	0.00	0.00
8	60	WB	to Los Angeles County Line	22.11	PM	11.96	10.26	0.82	0.00	0.88
8	60	EB	East Jct I-215	7.26	AM	6.31	6.31	0.00	0.00	0.00
8	60	EB	to Redlands Blvd	7.26	PM	6.31	2.86	0.31	0.00	3.13
8	60	WB	Redlands Blvd	8.08	AM	4.39	1.67	1.52	1.20	0.00
8	60	WB	to East Jct I-215	8.08	PM	4.39	1.11	2.08	1.20	0.00
8	71	NB	Riverside County Line	7.31	AM	6.49	6.49	0.00	0.00	0.00
8	71	NB	to Los Angeles County Line	7.31	PM	6.49	6.32	0.17	0.00	0.00

District	Route	Direction	Limits	Facility Length	Time Period	Lane Miles Monitored	Not Degraded	Slightly Degraded	Very Degraded	Extremely Degraded
8	71	SB	Los Angeles County Line	7.06	AM	6.31	4.01	1.49	0.81	0.00
	71	SB	to Riverside County Line		PM	6.31	4.01	0.86	0.00	1.44
	91	EB	Orange County Line	16.52	AM	11.45	9.63	1.82	0.00	0.00
	91		to I-15		PM	11.45	5.60	5.67	0.00	0.18
	91	WB	I-15	16.43	AM	12.00	4.81	6.11	0.17	0.91
	91		to Orange County Line		PM	12.00	12.00	0.00	0.00	0.00
	91	EB	I-15	13.42	AM	11.44	7.86	3.58	0.00	0.00
	91		to I-215		PM	11.44	3.06	1.24	3.36	3.79
	91	WB	I-215	13.97	AM	10.45	7.41	2.19	0.86	0.00
	91		to I-15		PM	10.45	0.77	4.99	2.25	2.44
	210	EB	Los Angeles County Line	21.29	AM	19.28	19.28	0.00	0.00	0.00
	210		to I-215		PM	19.28	5.13	5.07	0.50	8.59
	210	WB	I-215	21.48	AM	21.45	11.41	4.20	5.84	0.00
	210		to Los Angeles County Line		PM	21.45	11.49	9.36	0.60	0.00
	215	NB	South Jct SR-60	16.32	AM	12.92	8.46	1.20	0.47	2.79
	215		to SR-210		PM	12.92	3.54	3.62	0.99	4.78
	215	SB	SR-210	16.30	AM	16.20	5.15	5.91	2.00	3.13
	215		to South Jct SR-60		PM	16.20	5.56	0.00	0.47	10.17

District	Route	Direction	Limits	Facility Length	Time Period	Lane Miles Monitored	Not Degraded	Slightly Degraded	Very Degraded	Extremely Degraded
11	5	NB	I-805	7.10	AM	6.75	6.75	0.00	0.00	0.00
	5		to Manchester Avenue		PM	6.75	0.78	1.66	4.32	0.00
	15	NB	SR-163	39.68	AM	36.81	36.81	0.00	0.00	0.00
	15		to SR-78		PM	36.81	33.15	3.65	0.00	0.00
	15	SB	SR-78	39.03	AM	37.52	37.52	0.00	0.00	0.00
	15		to SR-163		PM	37.52	35.02	2.50	0.00	0.00
	805	NB	Telegraph Canyon Rd	7.89	AM	7.36	4.67	2.69	0.00	0.00
	805		to Market Street		PM	7.36	7.36	0.00	0.00	0.00
	805	SB	I-5	4.33	AM	4.33	3.54	0.00	0.00	0.79
	805		to SR-52		PM	4.33	1.55	1.13	0.85	0.79
12	5	NB	Ave Pico	42.04	AM	33.50	26.22	5.52	1.06	0.70
	5		to Beach Blvd		PM	33.50	16.61	6.60	2.05	8.25
	5	SB	Artesia Blvd	43.33	AM	32.25	18.95	8.49	3.45	1.36
	5		to Ave Pico		PM	32.25	27.73	3.16	0.45	0.92
	22	EB	I-405	11.65	AM	11.43	6.56	4.29	0.57	0.00
	22		to Grand Ave		PM	11.43	6.26	1.47	1.56	2.13
	22	WB	SR-55	12.39	AM	11.64	11.33	0.32	0.00	0.00
	22		to I-405		PM	11.64	7.82	1.92	0.28	1.62
	55	NB	I-405	10.67	AM	9.52	9.42	0.10	0.00	0.00

District	Route	Direction	Limits	Facility Length	Time Period	Lane Miles Monitored	Not Degraded	Slightly Degraded	Very Degraded	Extremely Degraded
12	55		to Lincoln Ave		PM	9.52	1.88	1.52	0.96	5.17
	55	SB	Lincoln Ave	10.29	AM	10.20	6.08	0.56	2.29	1.27
	55		to I-405		PM	10.20	10.20	0.00	0.00	0.00
	57	NB	I-5	11.78	AM	10.65	9.80	0.20	0.65	0.00
	57		to Los Angeles County Line		PM	10.65	2.46	2.90	3.40	1.90
	57	SB	Los Angeles County Line	11.85	AM	10.94	4.37	1.47	2.08	3.03
	57		to I-5		PM	10.94	3.48	4.67	1.12	1.68
	91	EB	Los Angeles County Line	11.78	AM	11.72	5.14	5.22	1.36	0.00
	91		to Tustin Avenue		PM	11.72	1.25	2.77	4.43	3.27
	91	WB	Tustin Ave	11.76	AM	11.63	10.24	1.39	0.00	0.00
	91		to Los Angeles County Line		PM	11.63	2.87	5.77	2.35	0.64
	405	NB	I-5	26.54	AM	14.65	13.81	0.84	0.00	0.00
	405		to Los Angeles County Line		PM	14.65	4.56	7.04	1.39	1.67
	405	SB	Los Angeles County Line	26.35	AM	12.10	10.48	0.52	0.64	0.45
	405		to I-5		PM	12.10	8.21	2.05	1.85	0.00
	605	NB	I-405	2.36	AM	2.10	2.10	0.00	0.00	0.00
	605		to Los Angeles County Line		PM	2.10	1.81	0.29	0.00	0.00

EB = Eastbound, WB = Westbound, NB = Northbound, SB = Southbound Lane-miles may not add up exactly due to rounding

7. APPENDIX B

SPEED AND DEGRADATION PROFILES

FIGURE 3.1 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 80, PM

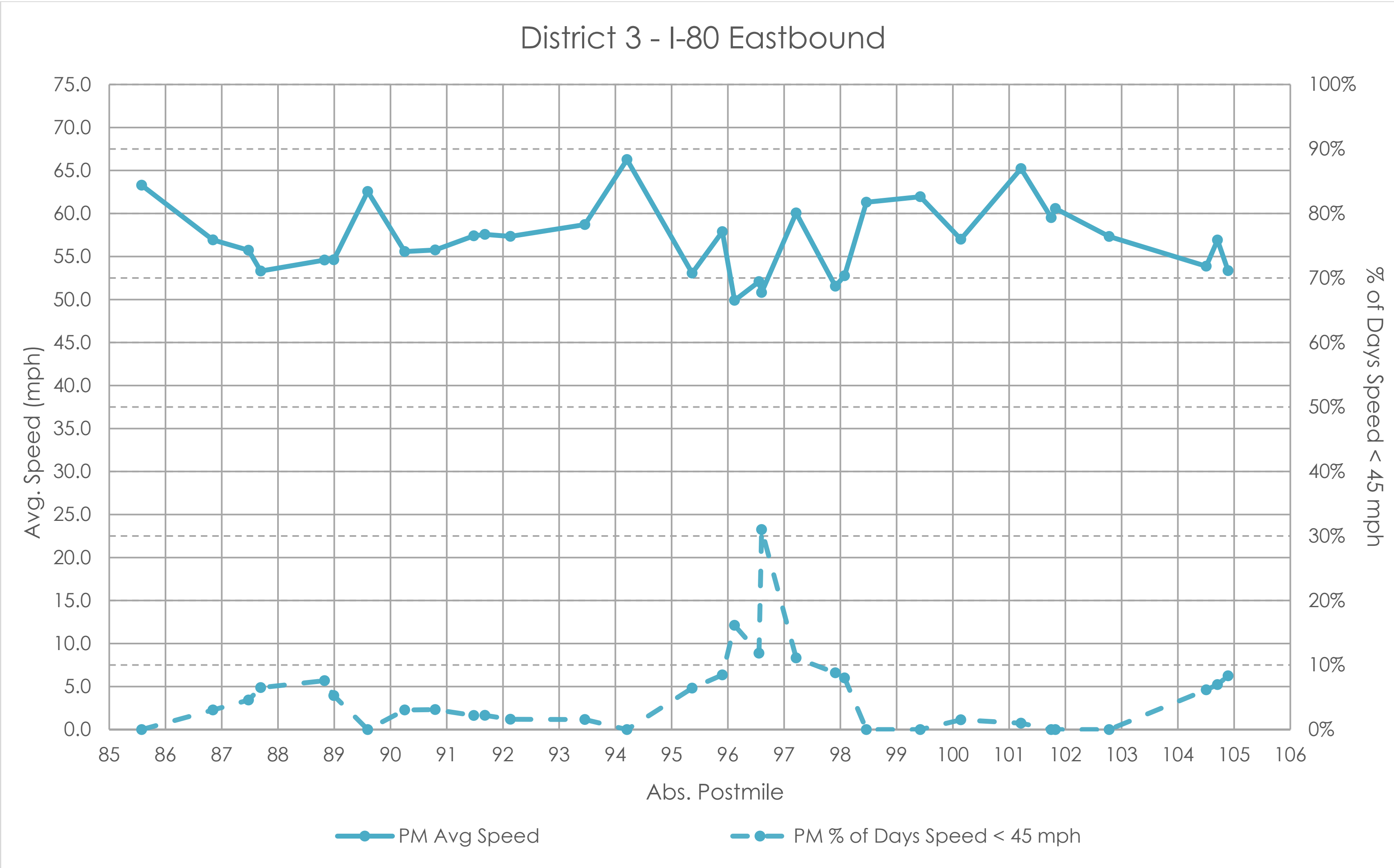


FIGURE 3.2 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 80, PM

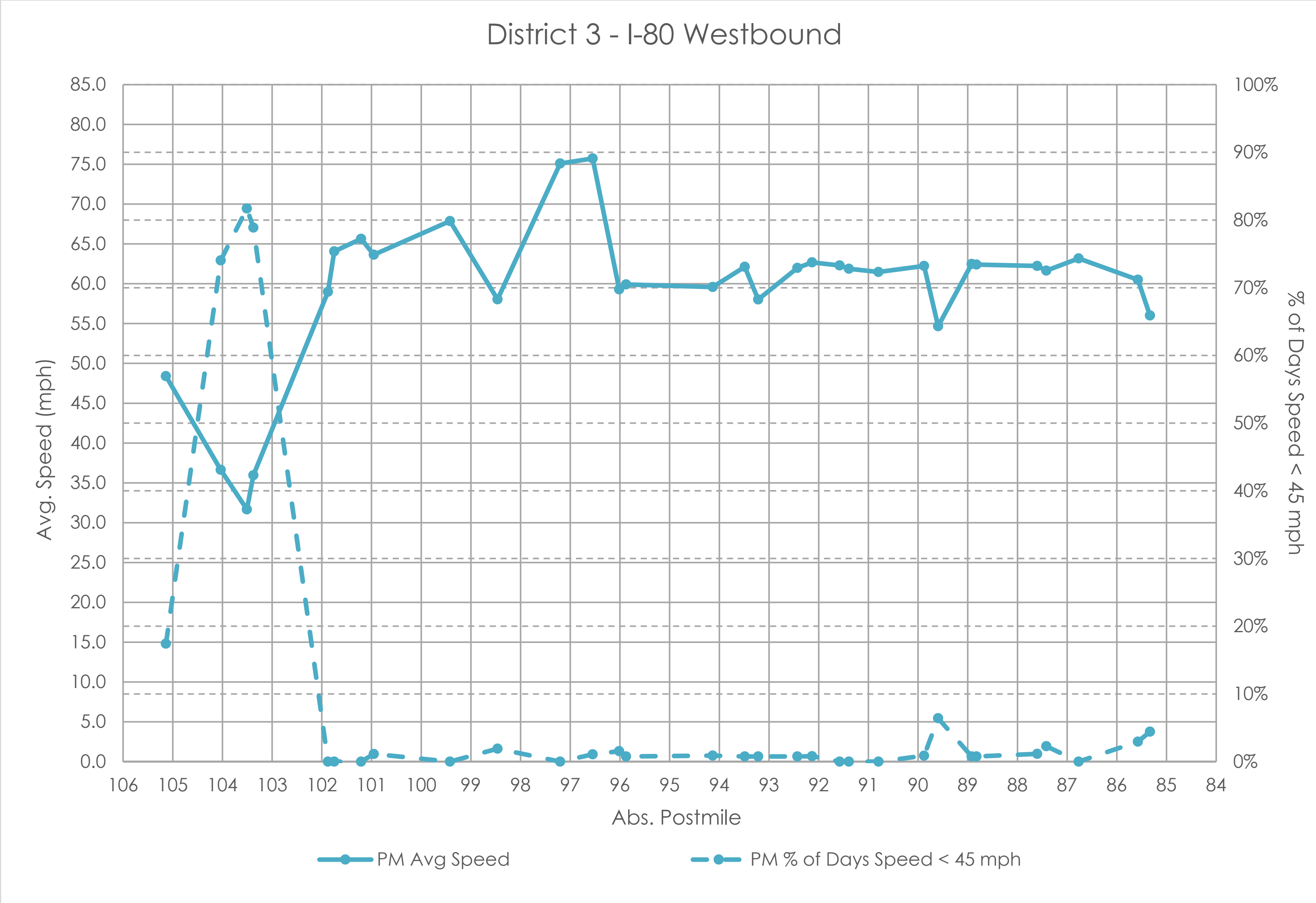


FIGURE 3.3 SPEED AND DEGRADATION PROFILE – NORTHBOUND ROUTE 99/51, AM

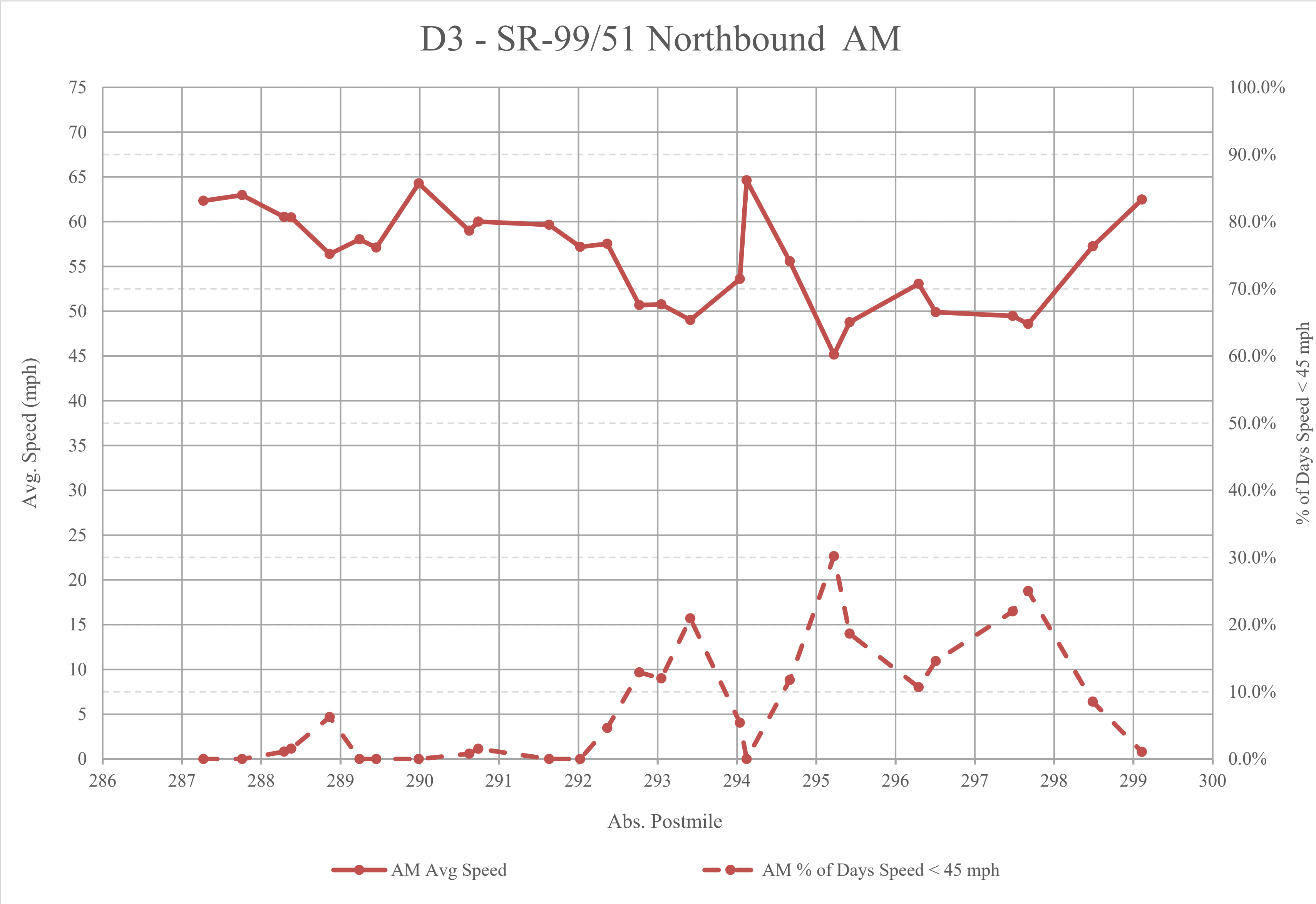


FIGURE 3.4 SPEED AND DEGRADATION PROFILE – NORTHBOUND ROUTE 99/51, PM

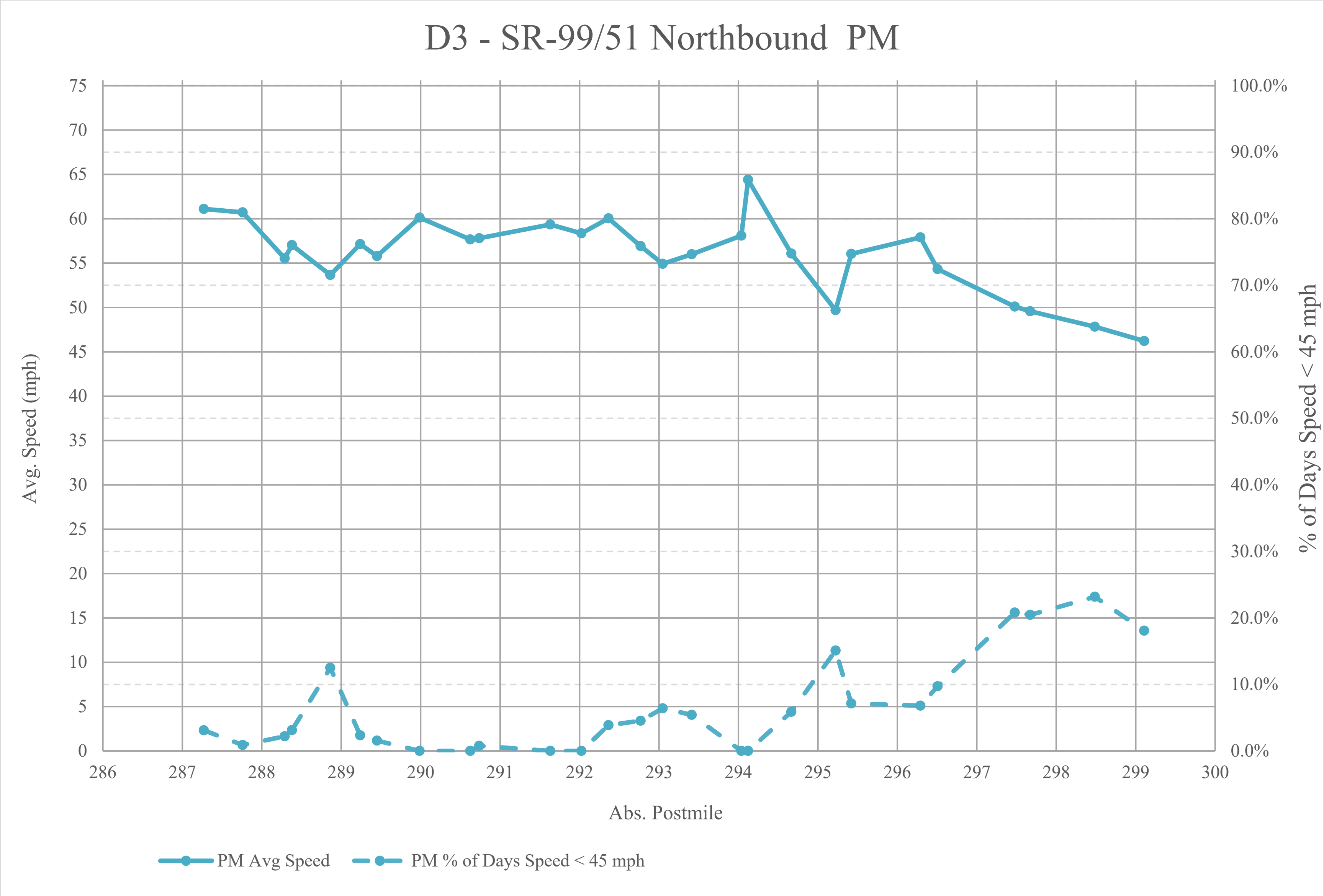


FIGURE 3.5 SPEED AND DEGRADATION PROFILE – SOUTHBOUND ROUTE 99/51, PM

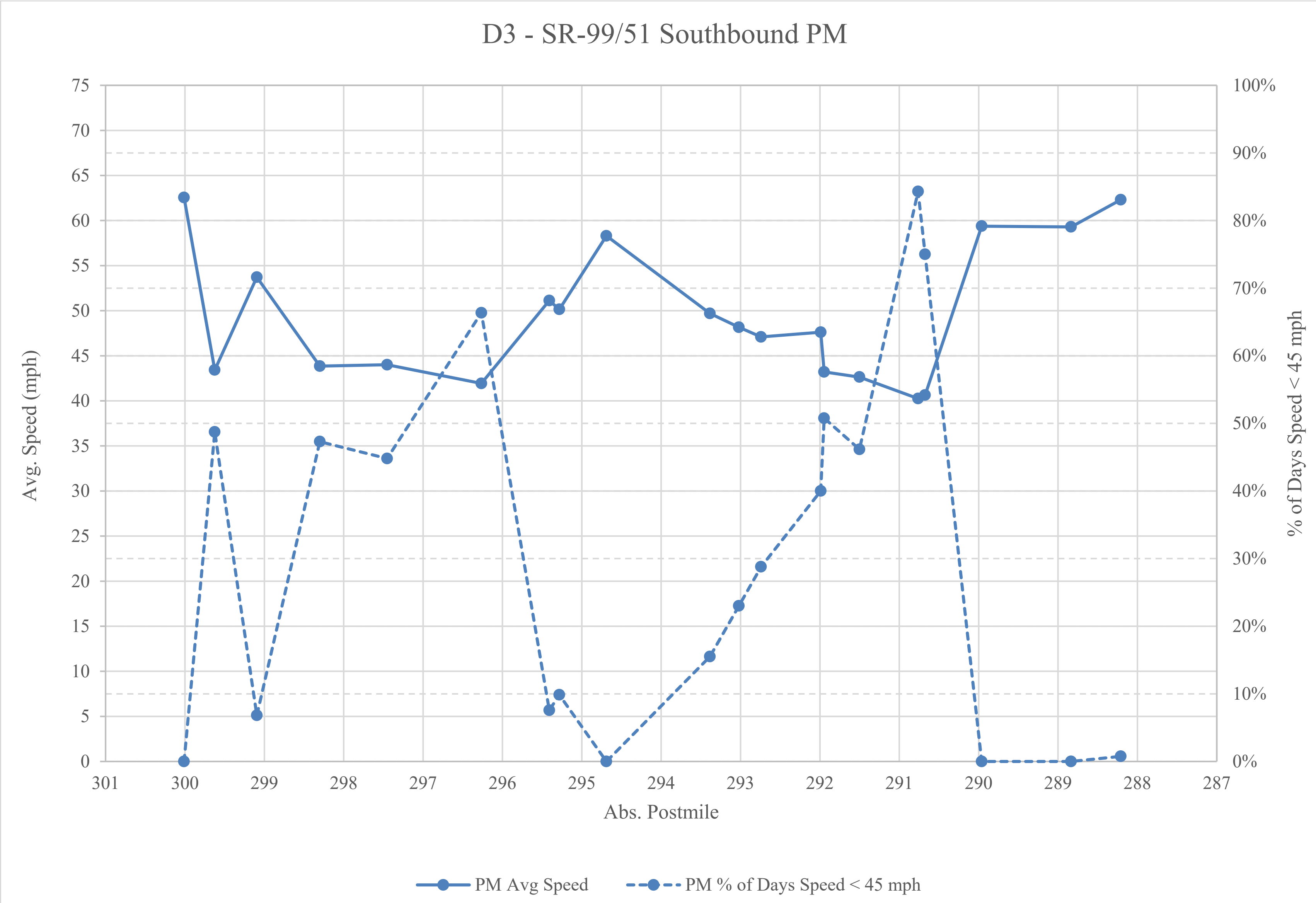


FIGURE 4.1 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 4, AM

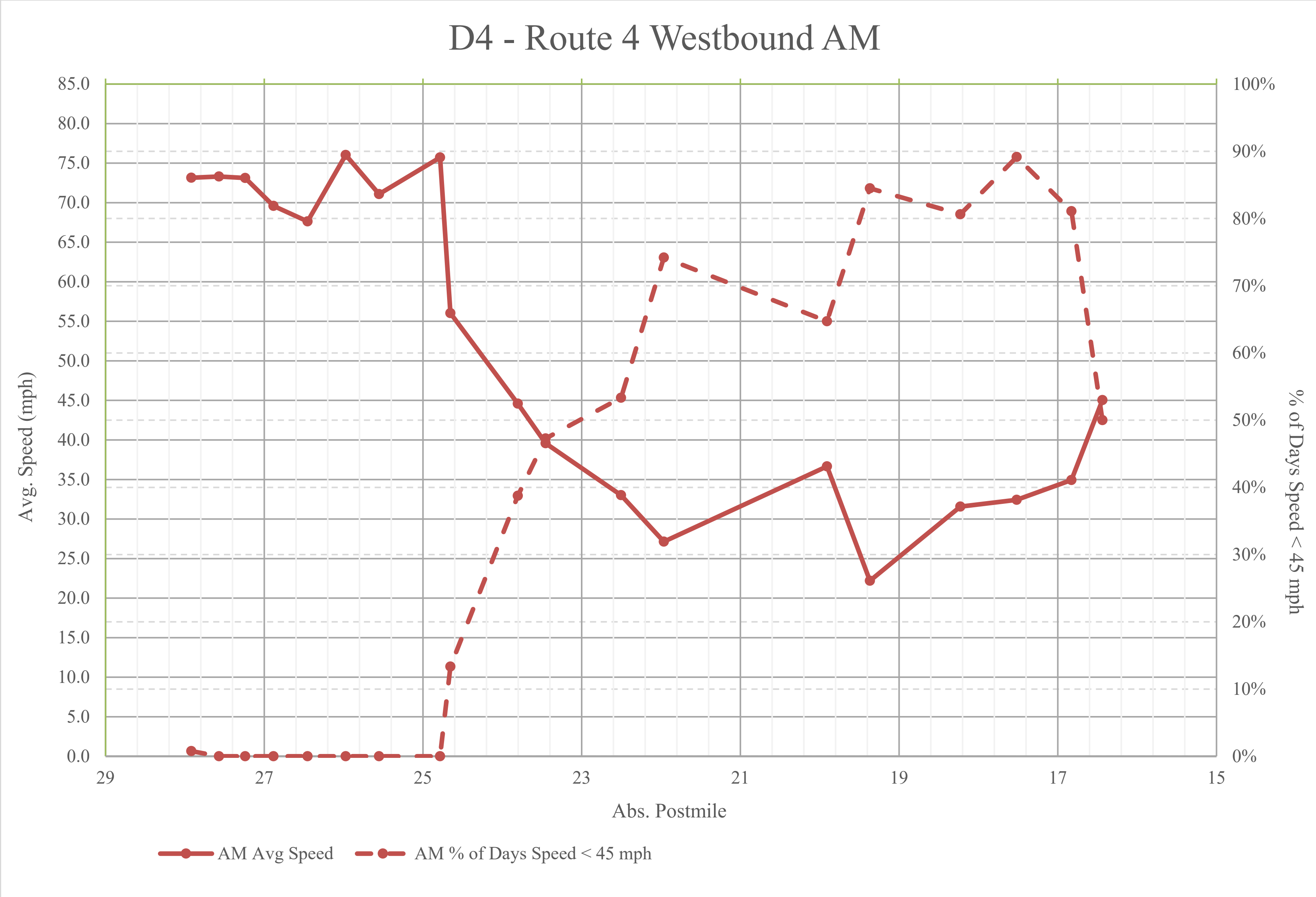


FIGURE 4.2 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 80, PM

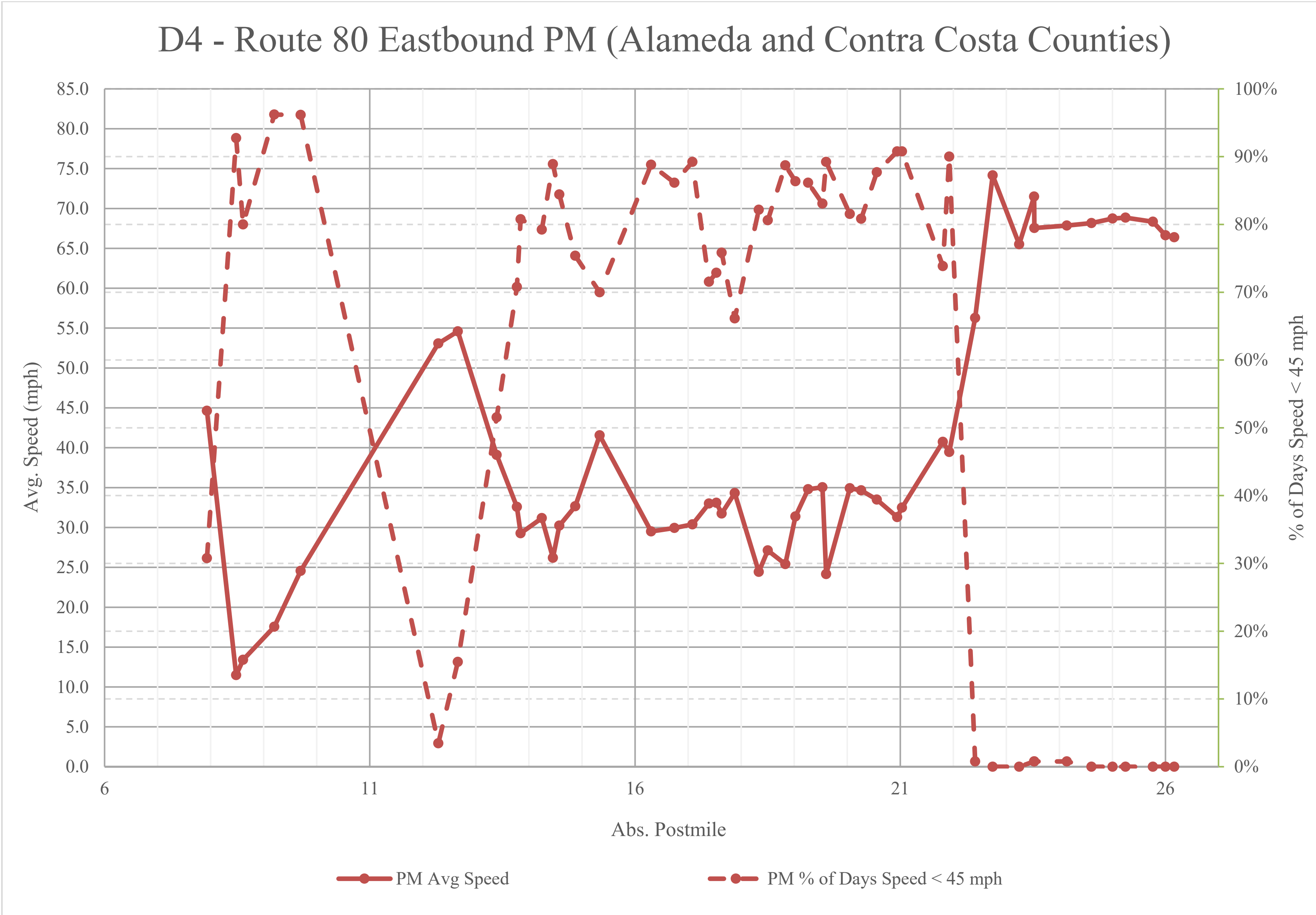


FIGURE 4.3 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 80, AM

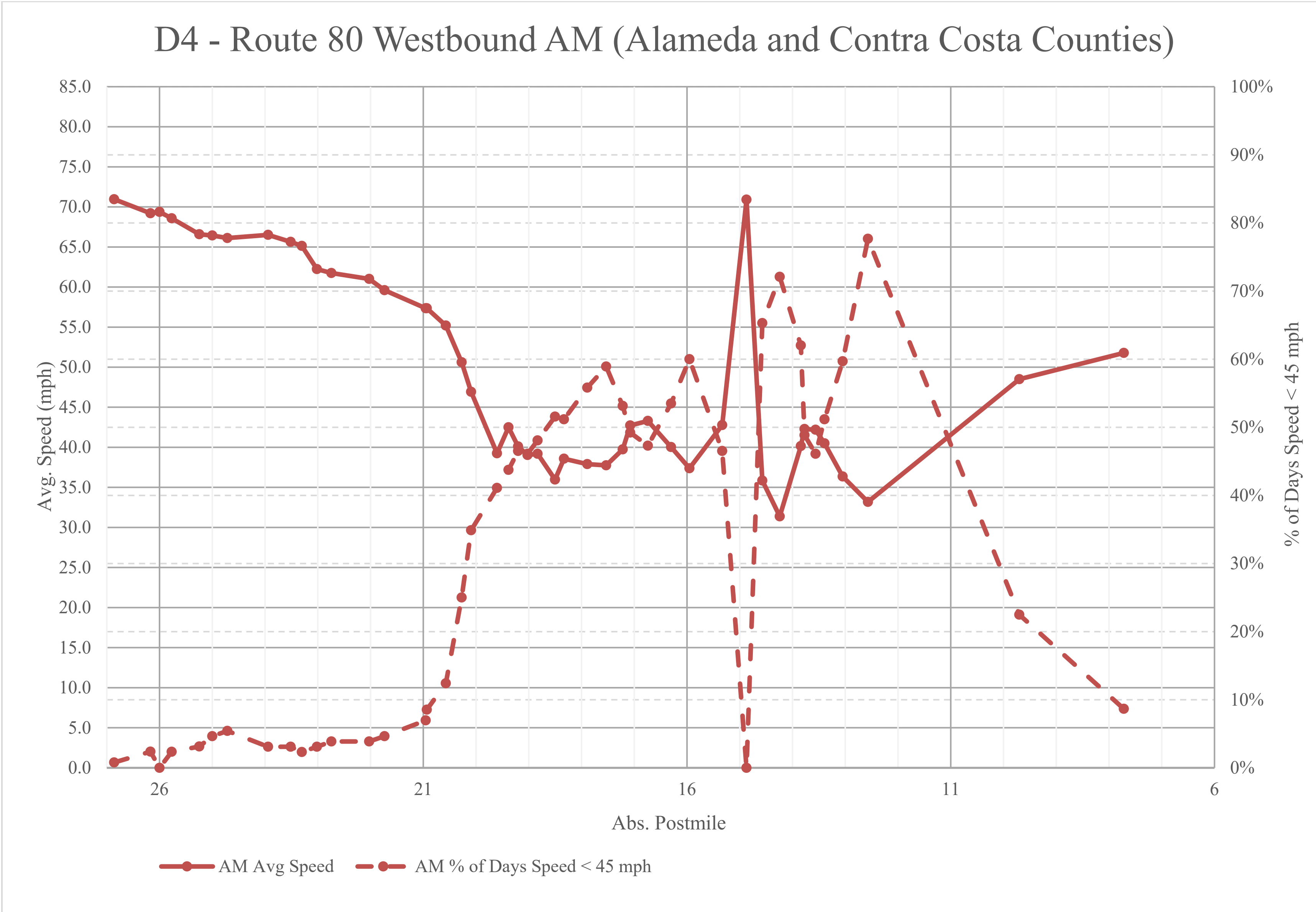


FIGURE 4.4 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 80, PM

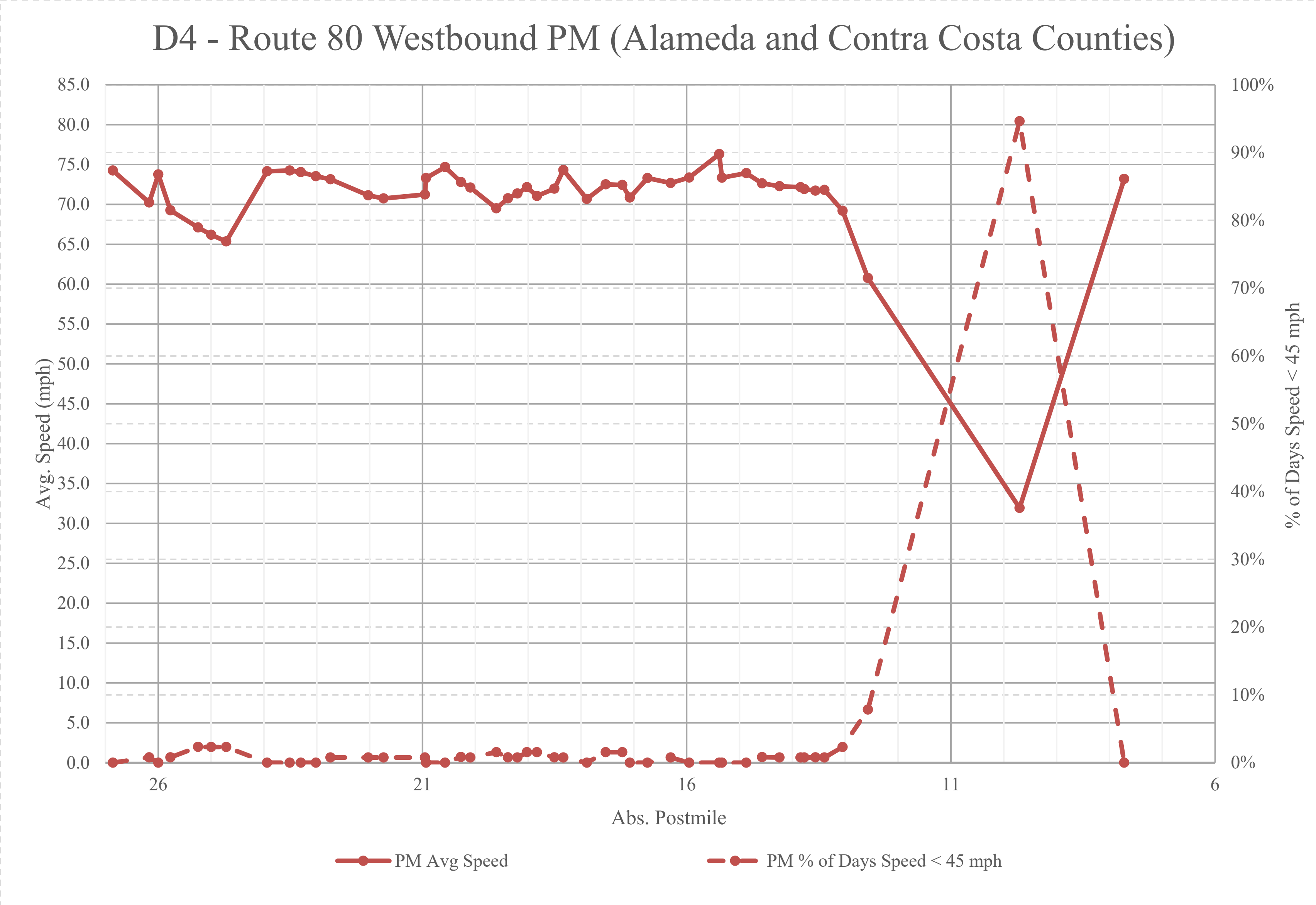


FIGURE 4.5 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 80, PM

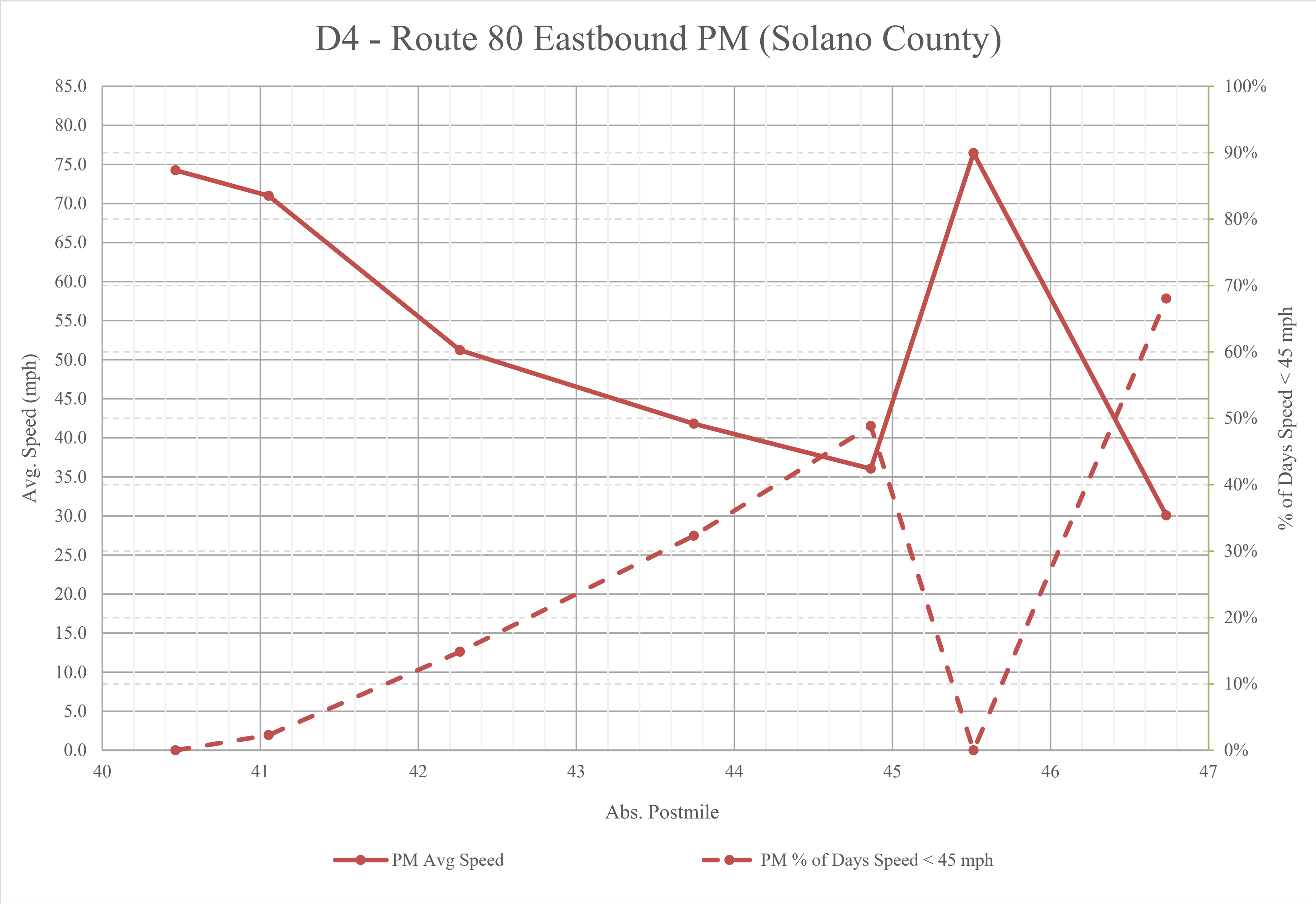


FIGURE 4.6 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 85, AM

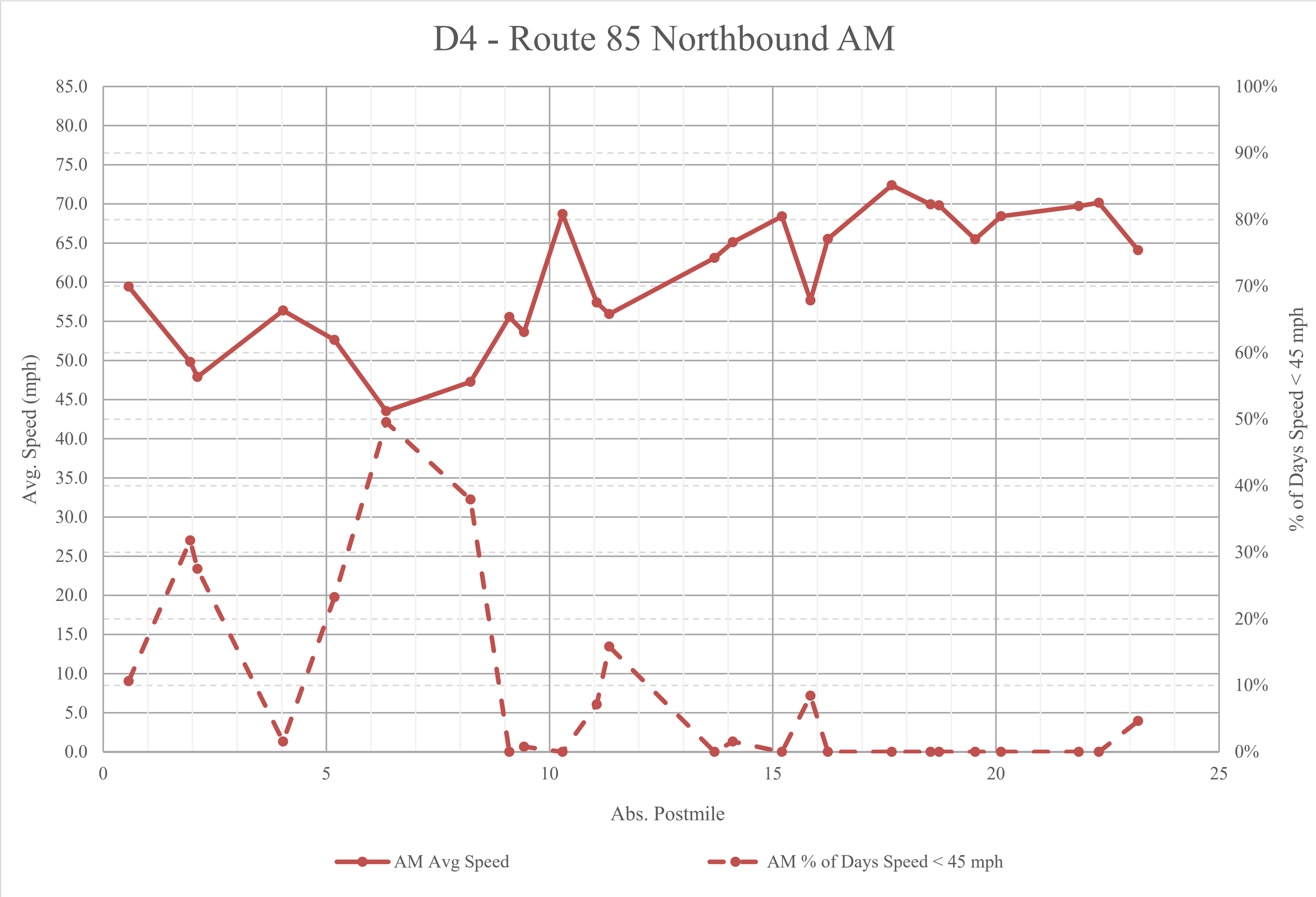


FIGURE 4.7 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 85, PM

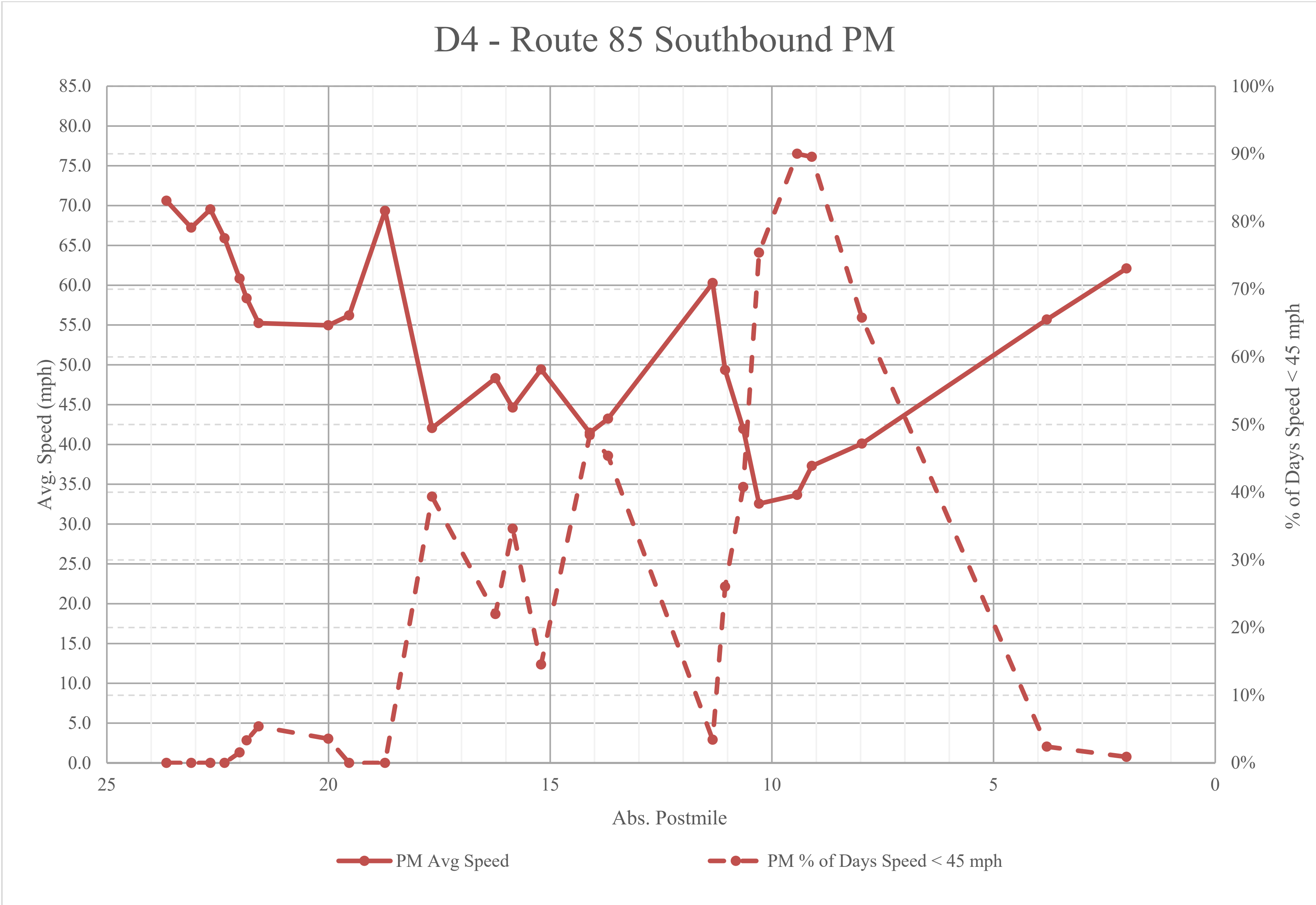


FIGURE 4.8 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 87, AM

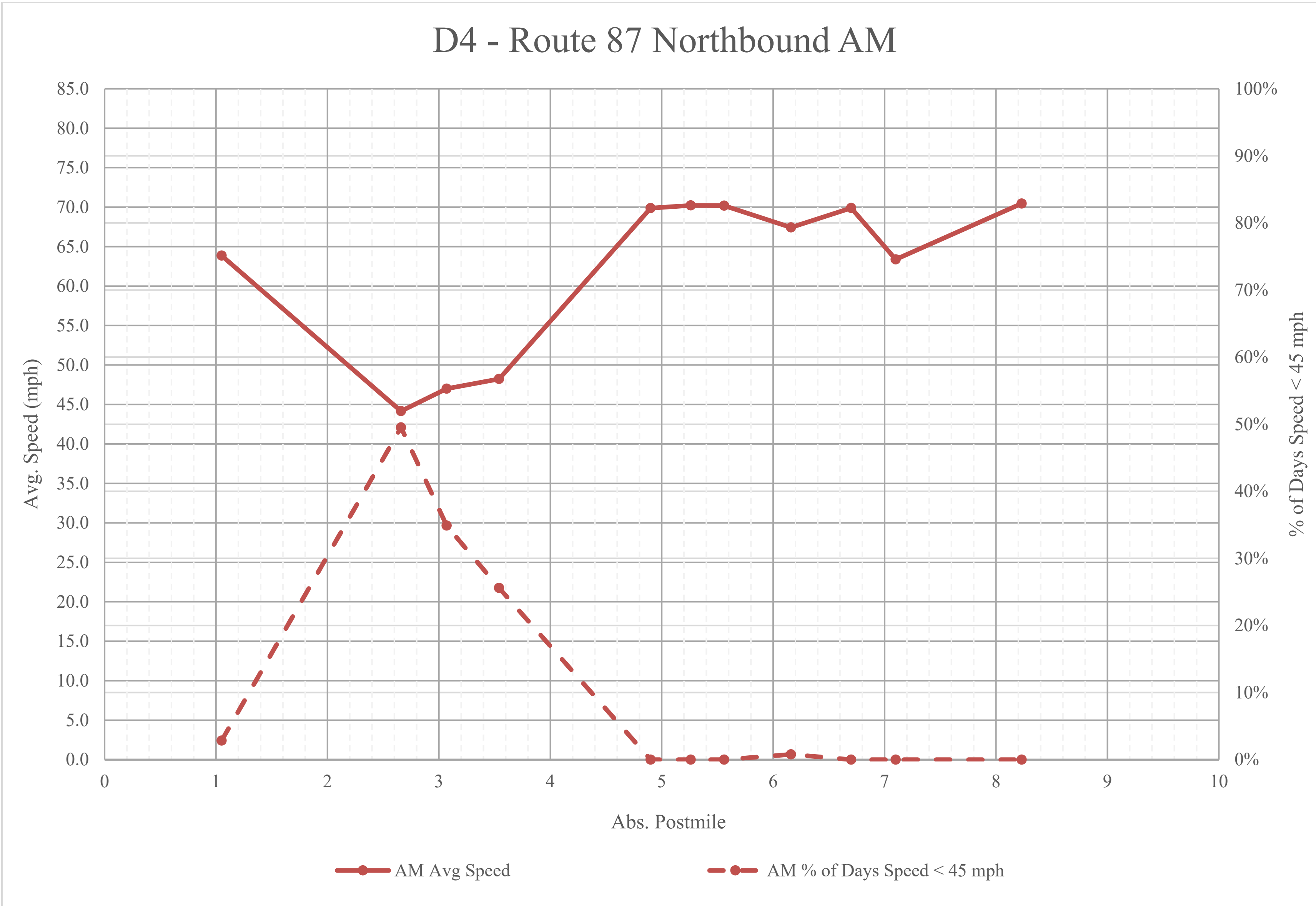


FIGURE 4.9 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 87, PM

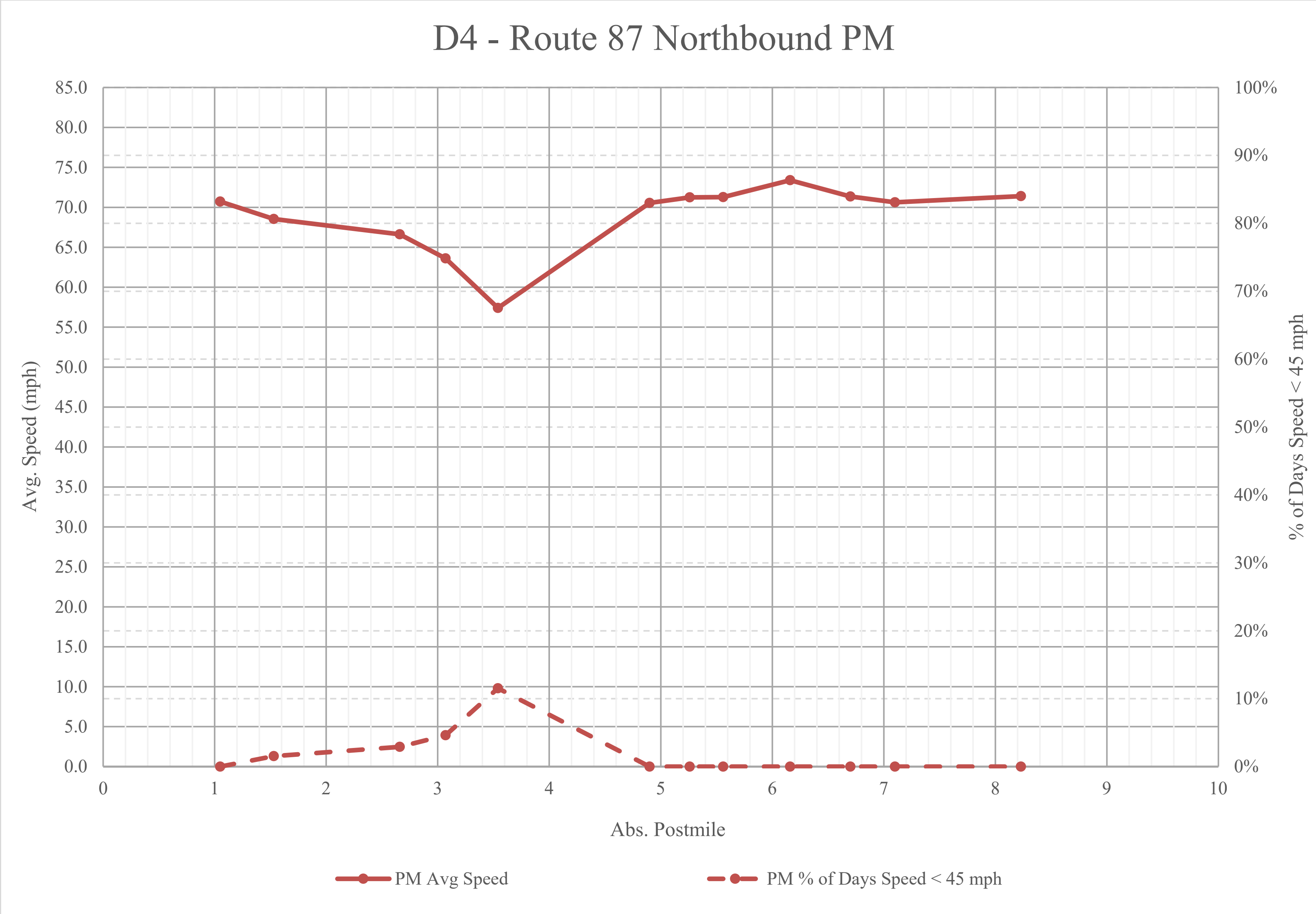


FIGURE 4.10 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 87, PM

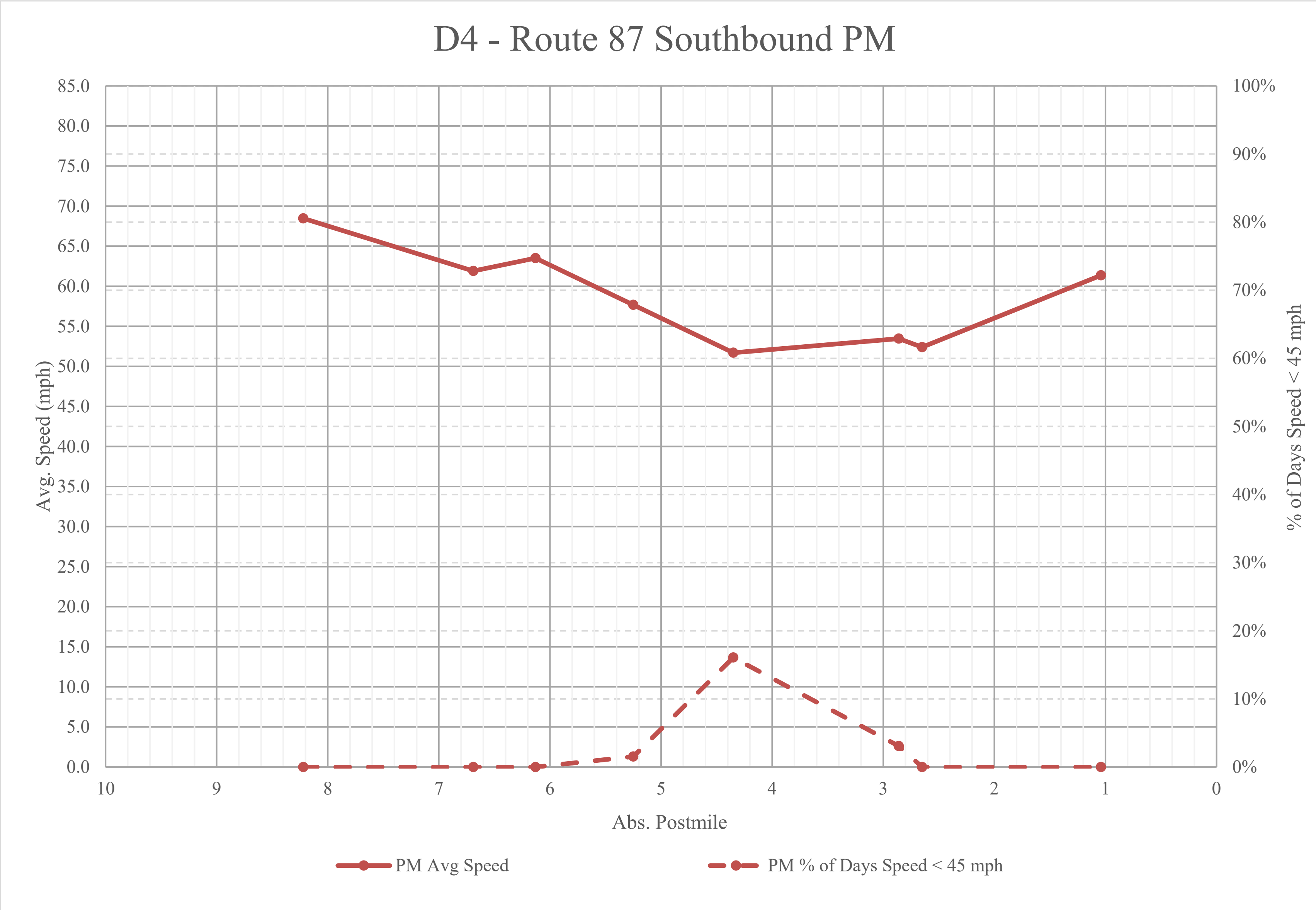


FIGURE 4.11 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 101, AM

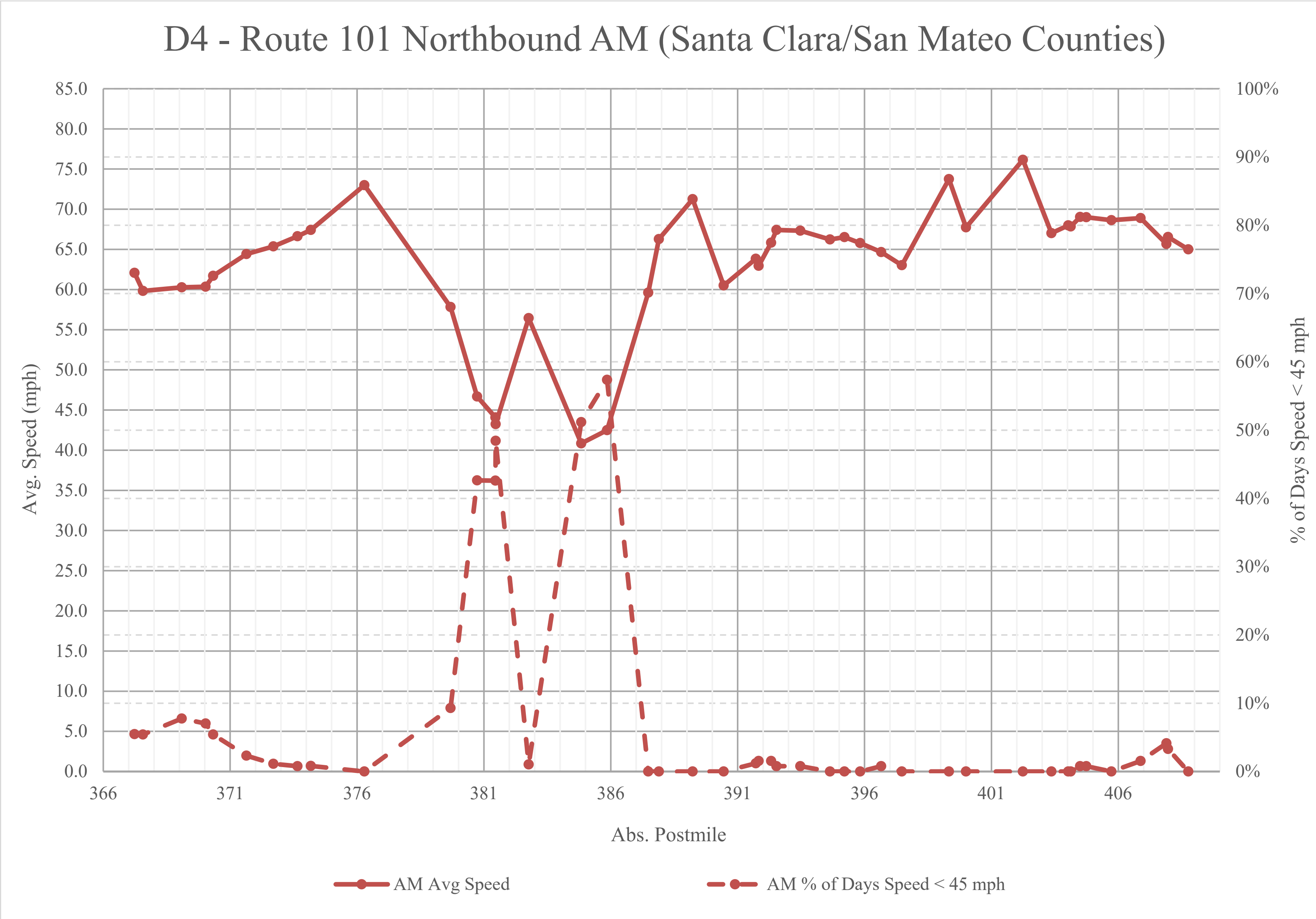


FIGURE 4.12 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 101, AM

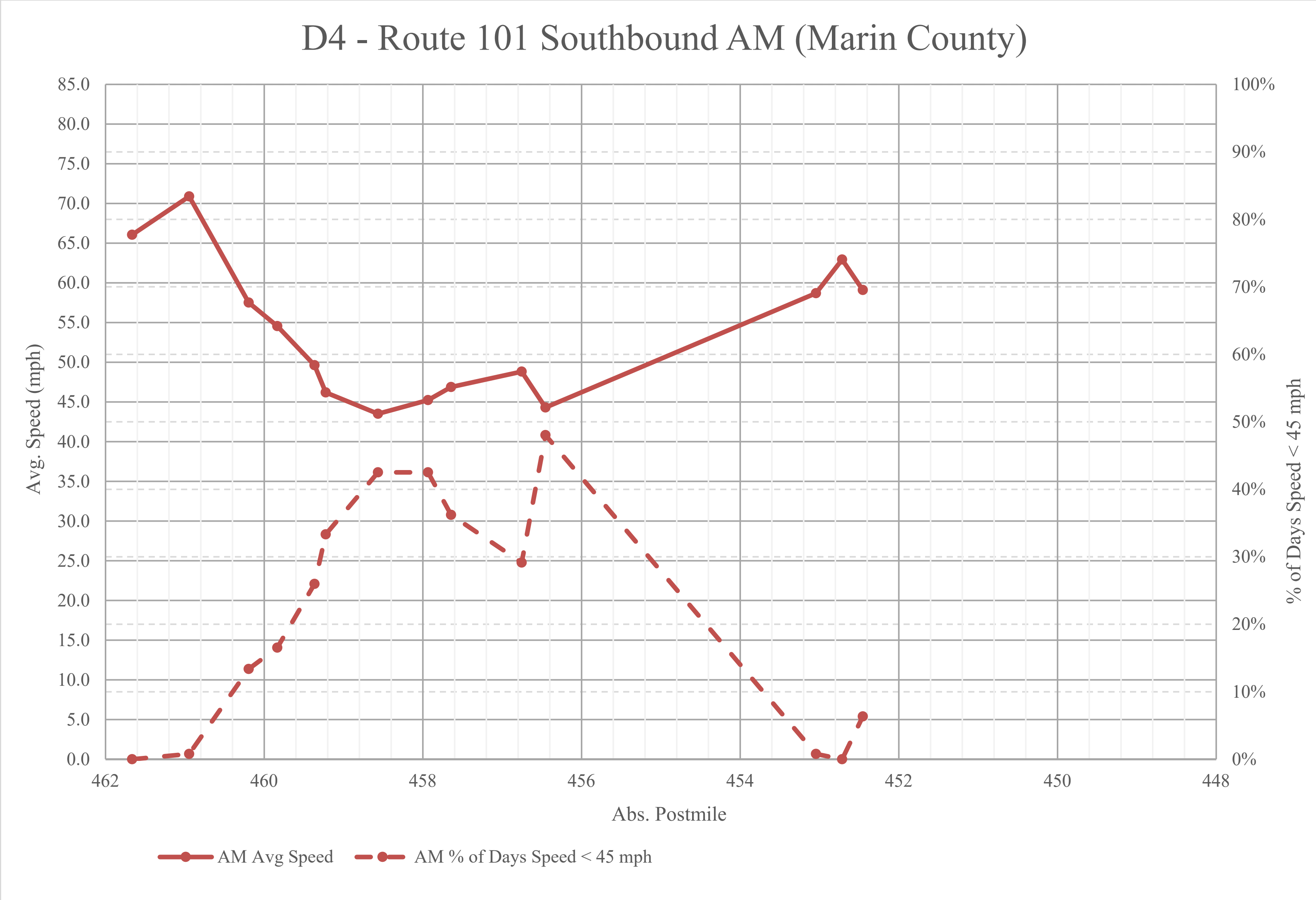


FIGURE 4.13 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 101, PM

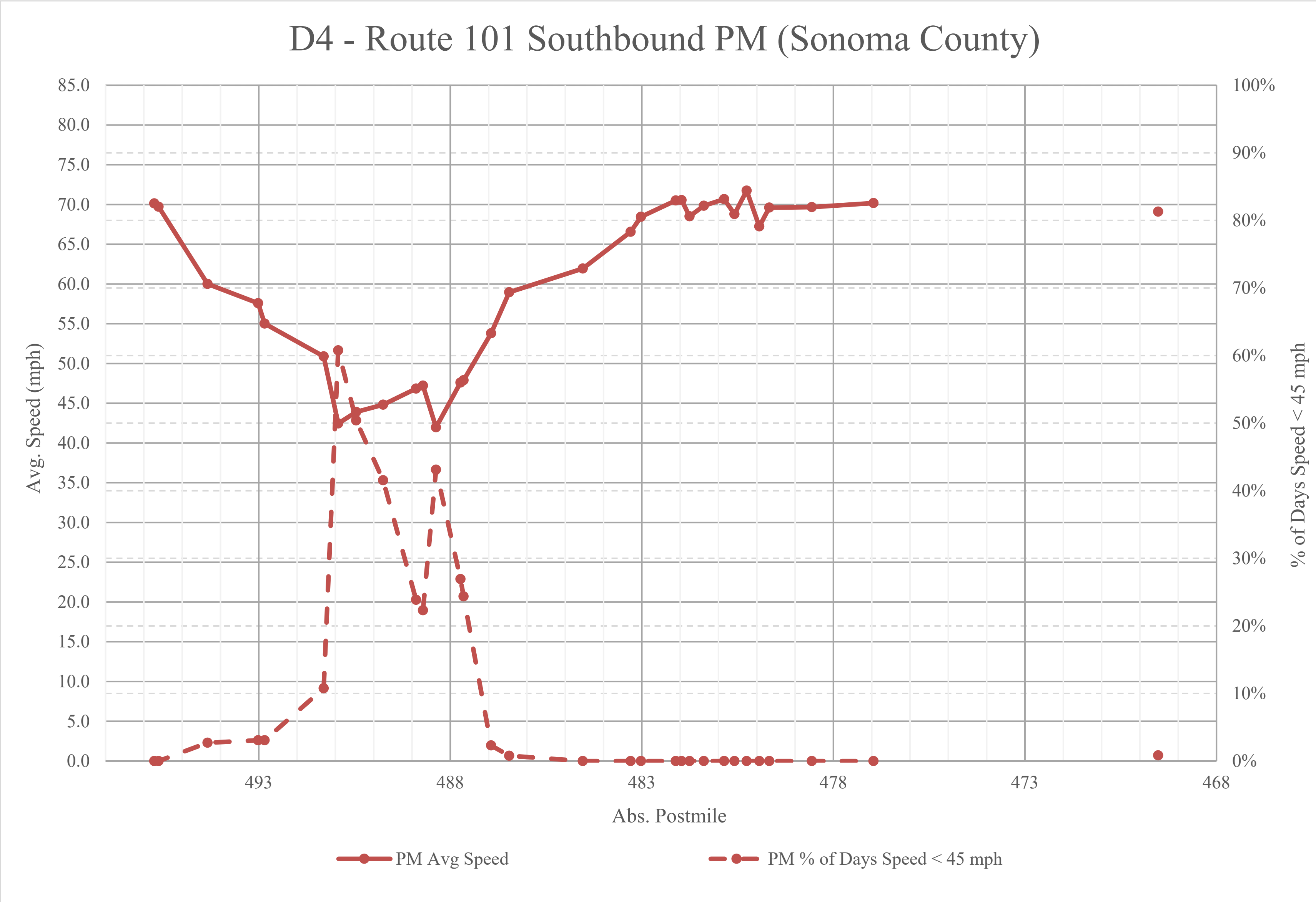


FIGURE 4.14 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 101, PM

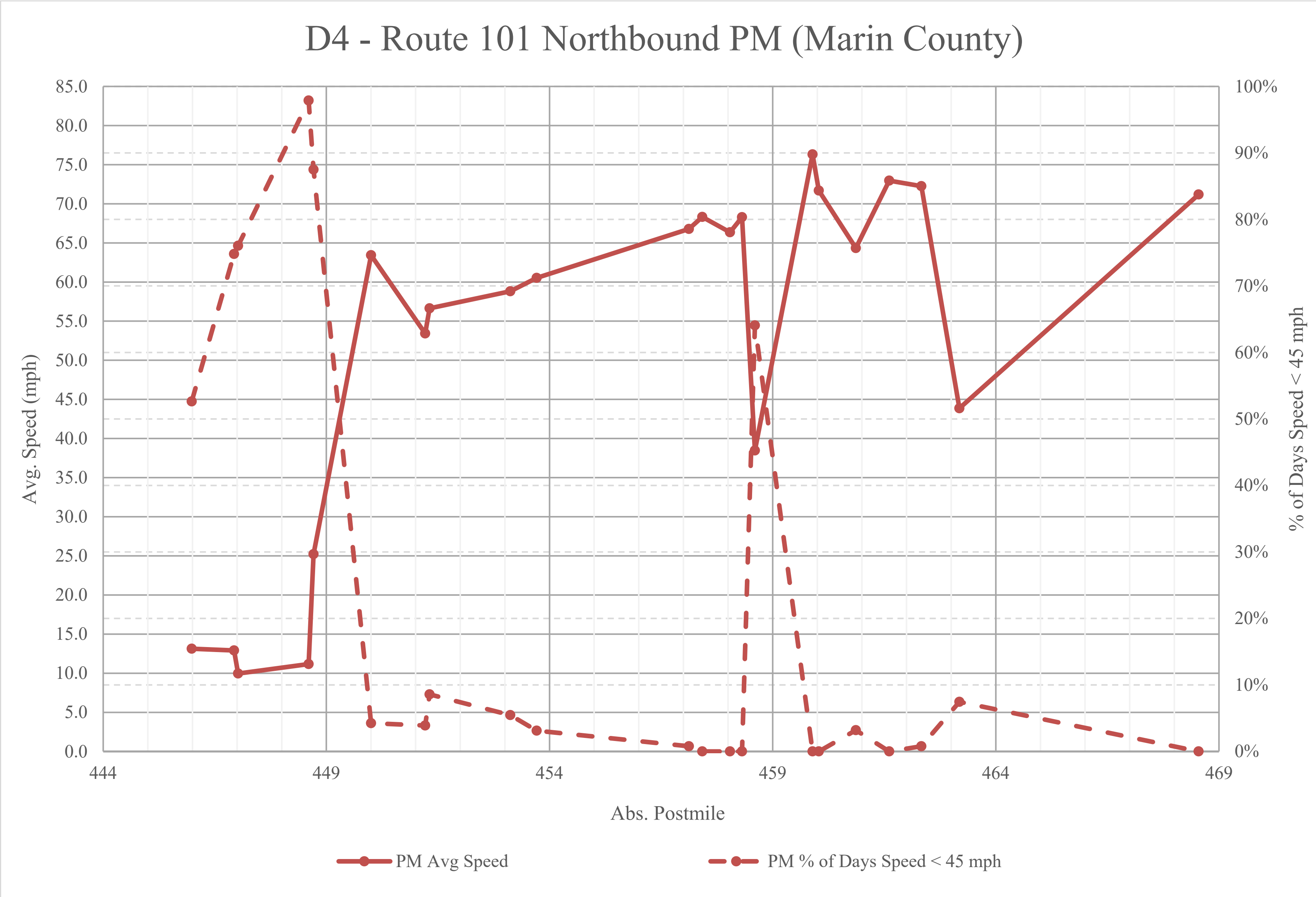


FIGURE 4.15 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 101, AM

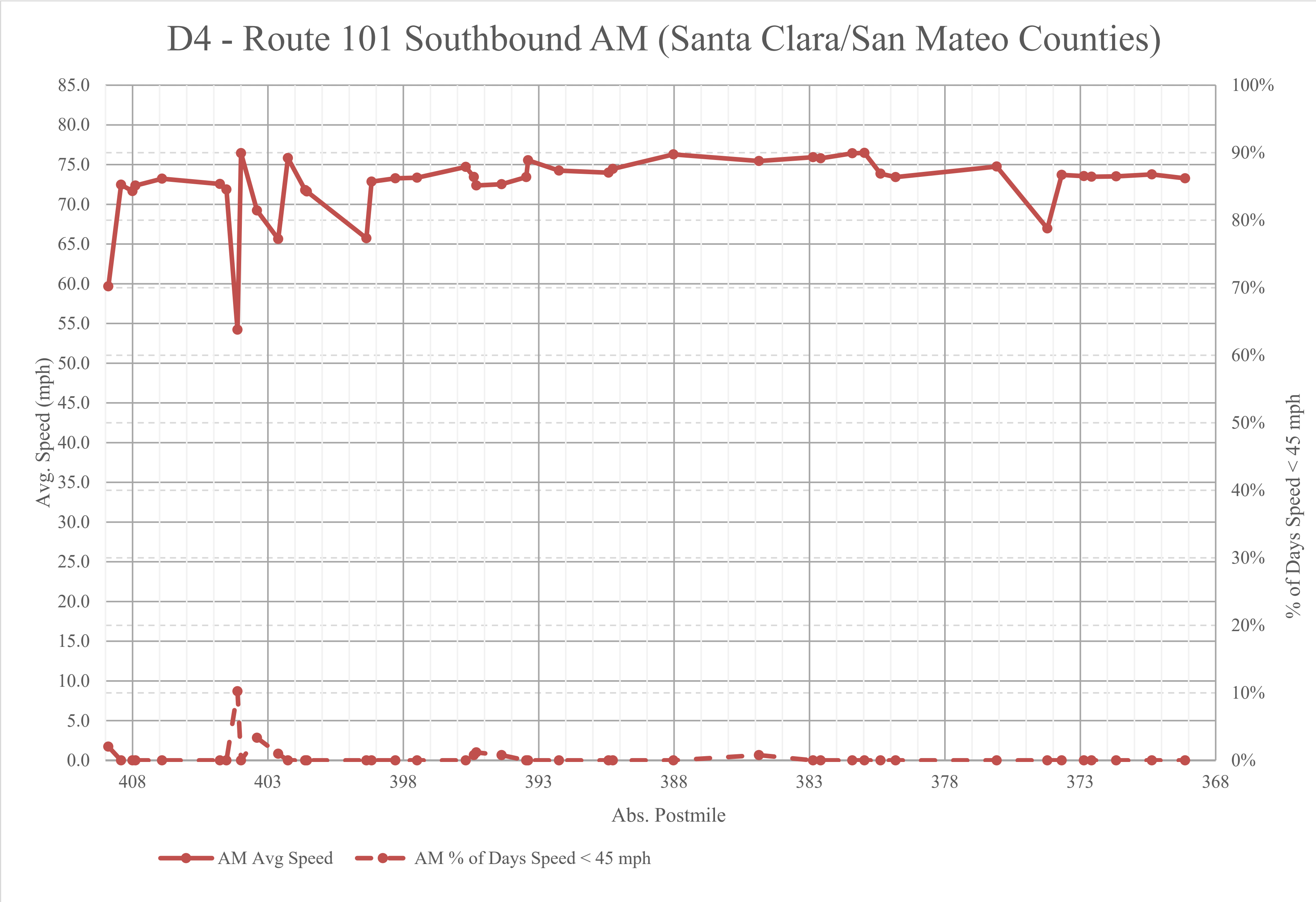


FIGURE 4.16 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 101, AM

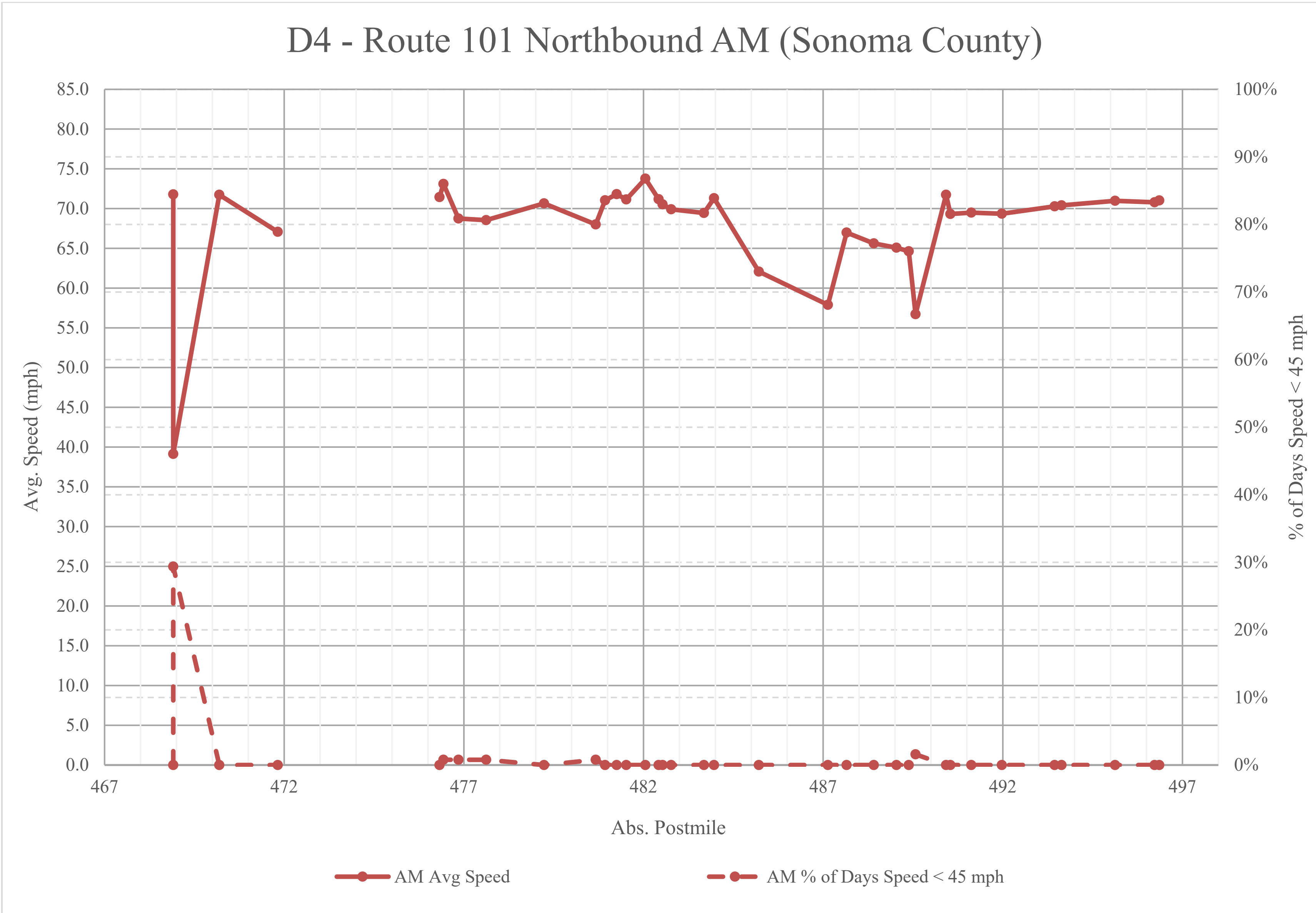


FIGURE 4.17 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 101, PM

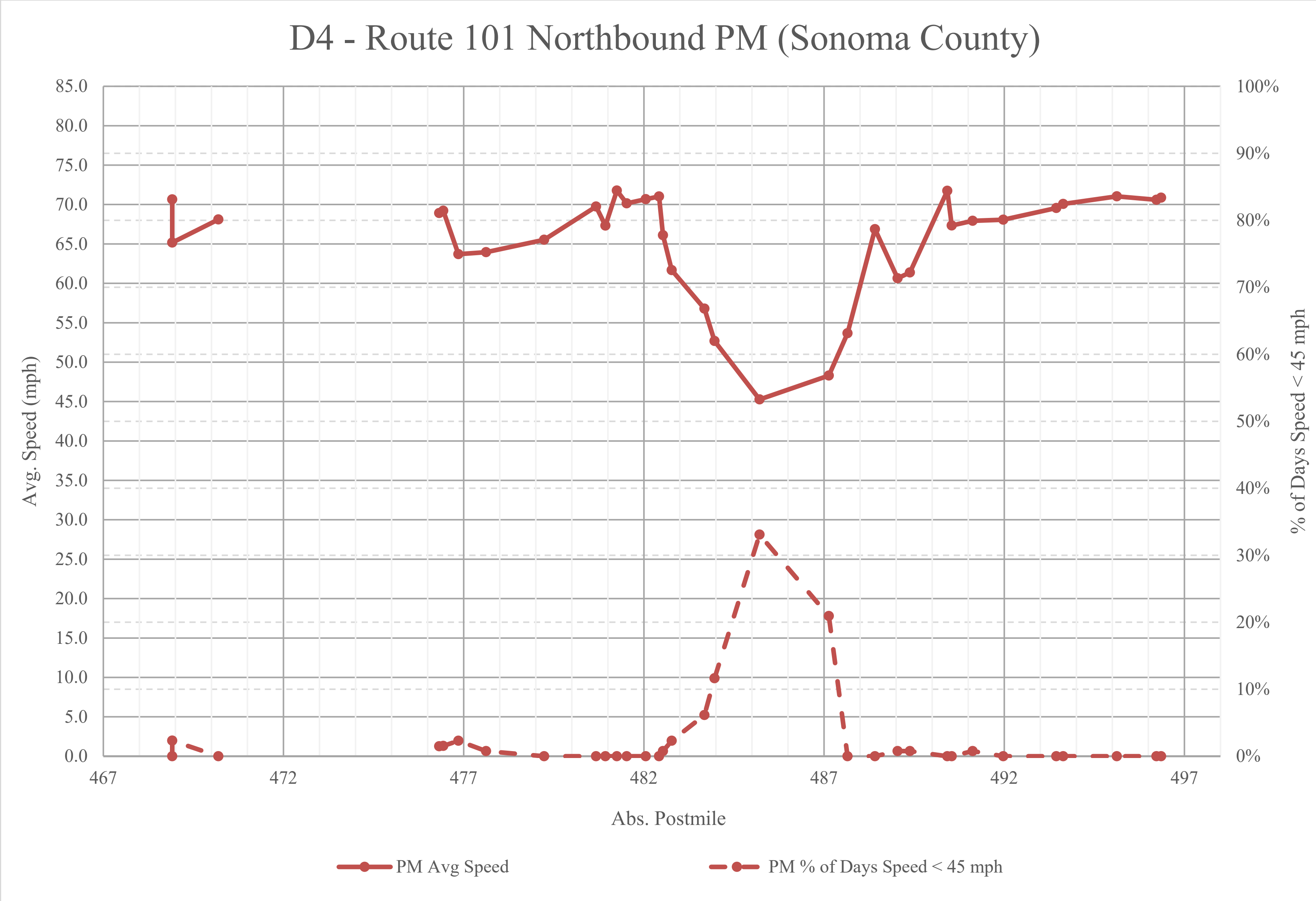


FIGURE 4.18 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 101, PM

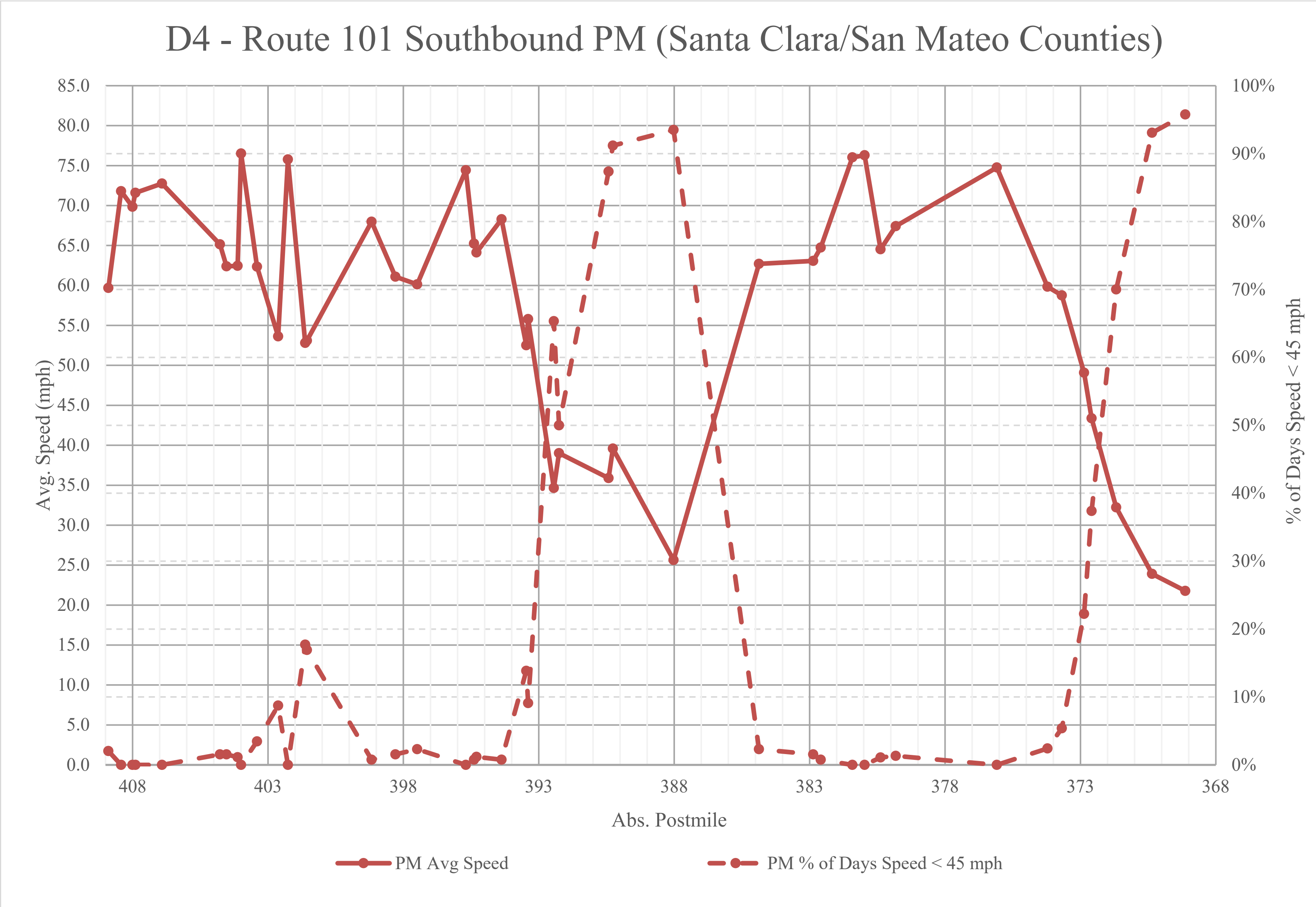


FIGURE 4.19 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 280, AM

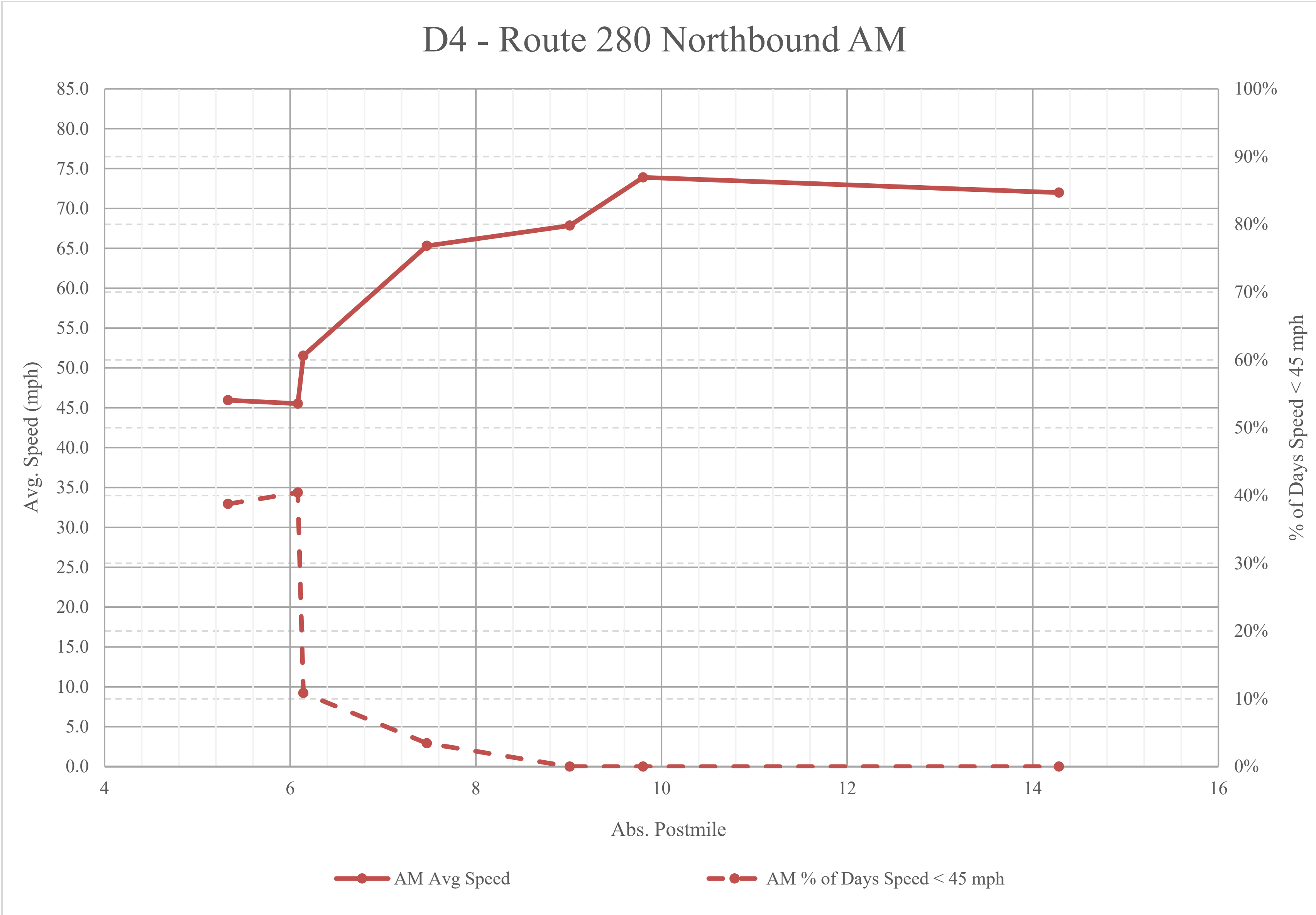


FIGURE 4.20 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 280, PM

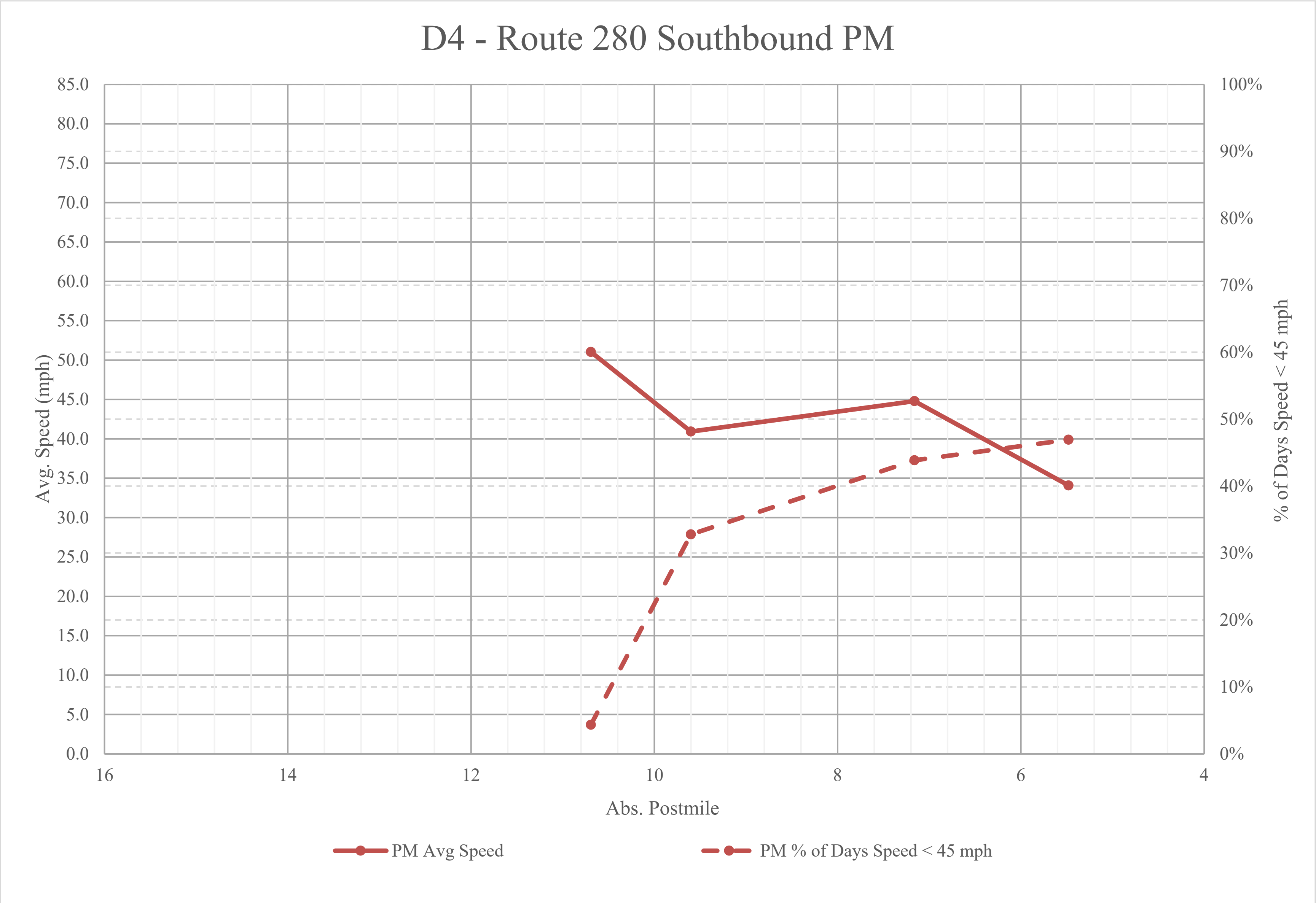


FIGURE 4.21 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 580, PM

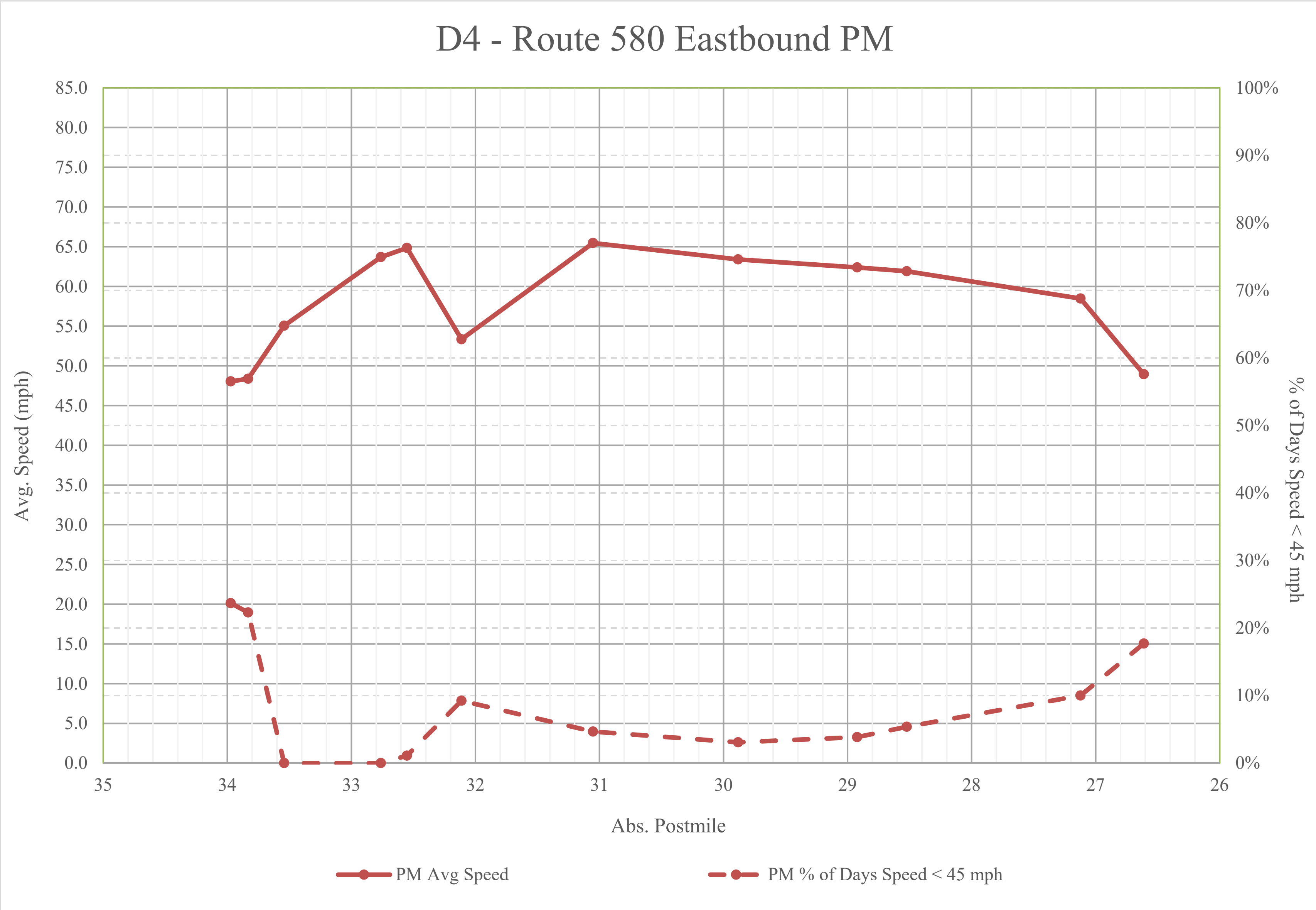


FIGURE 4.22 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 680, PM

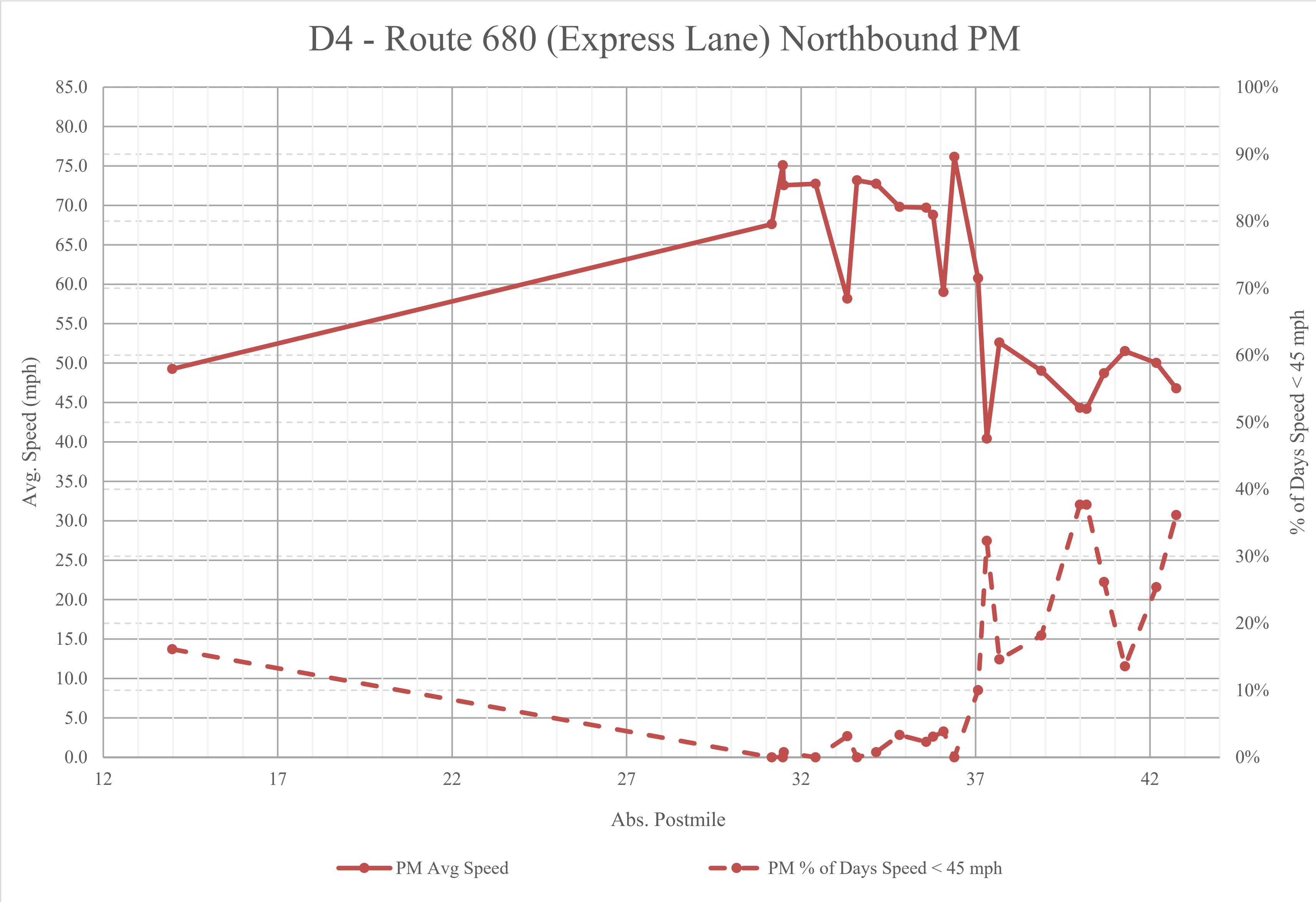


FIGURE 4.23 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 680, AM

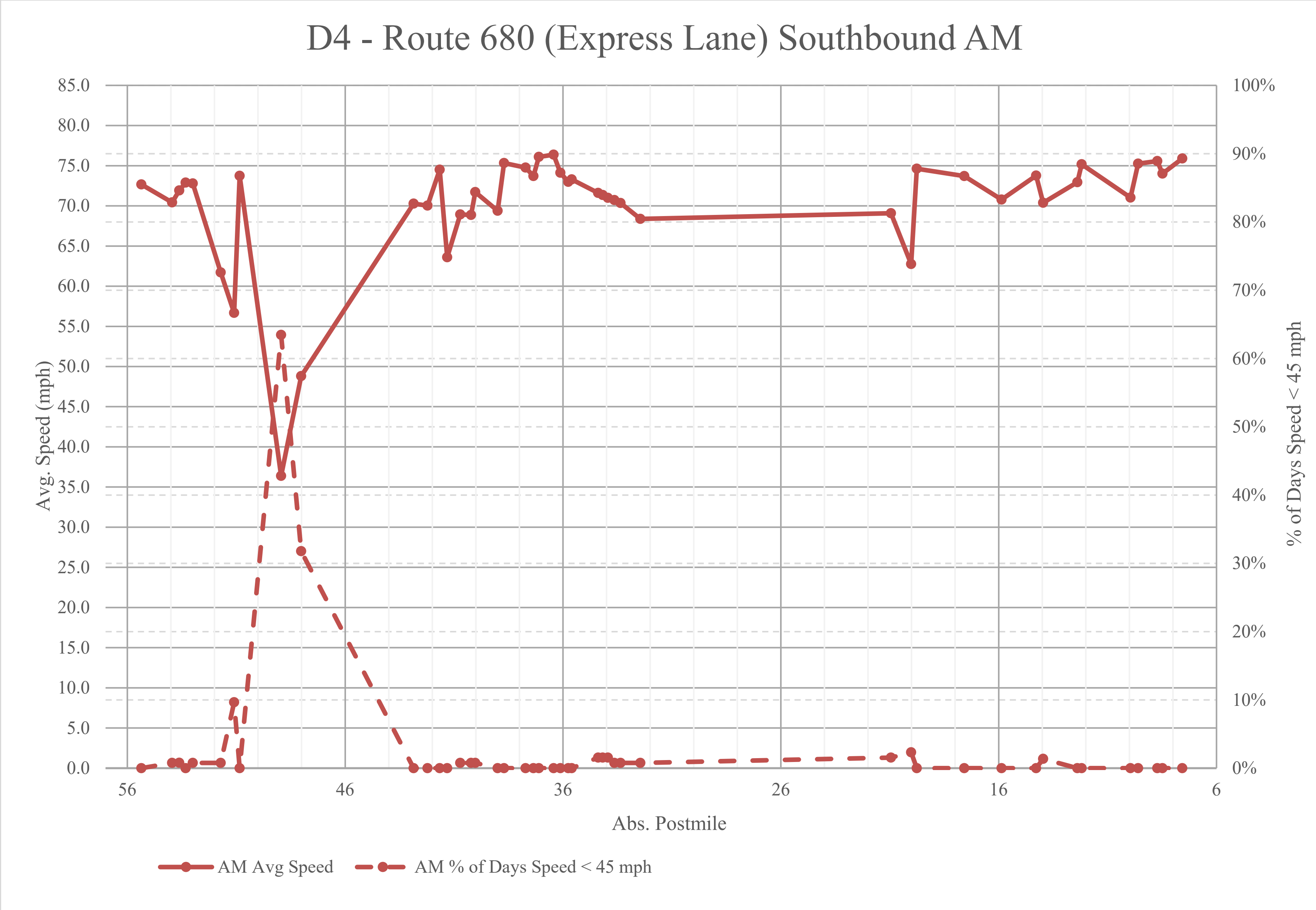


FIGURE 4.24 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 880, PM

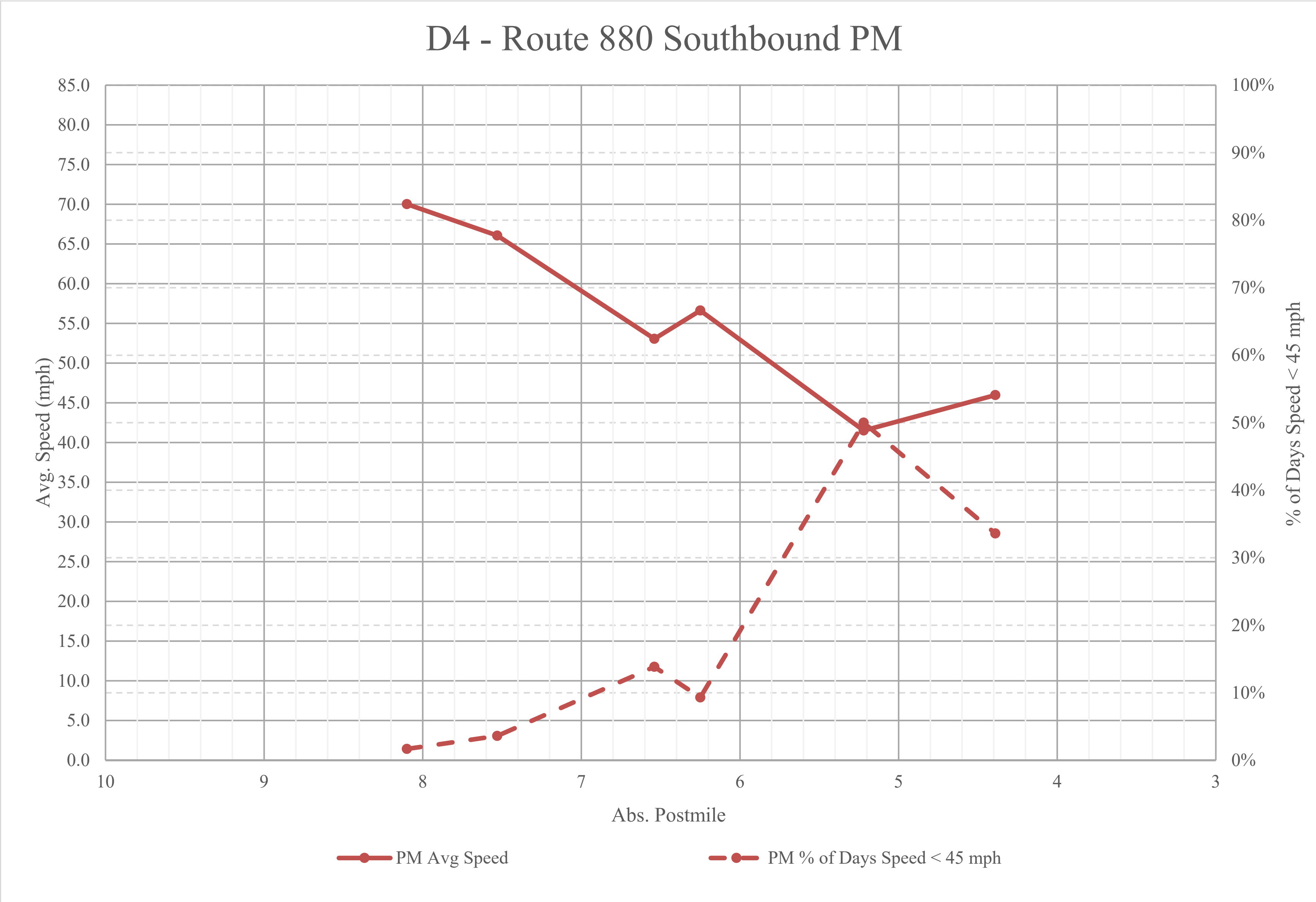


FIGURE 4.25 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 880, PM

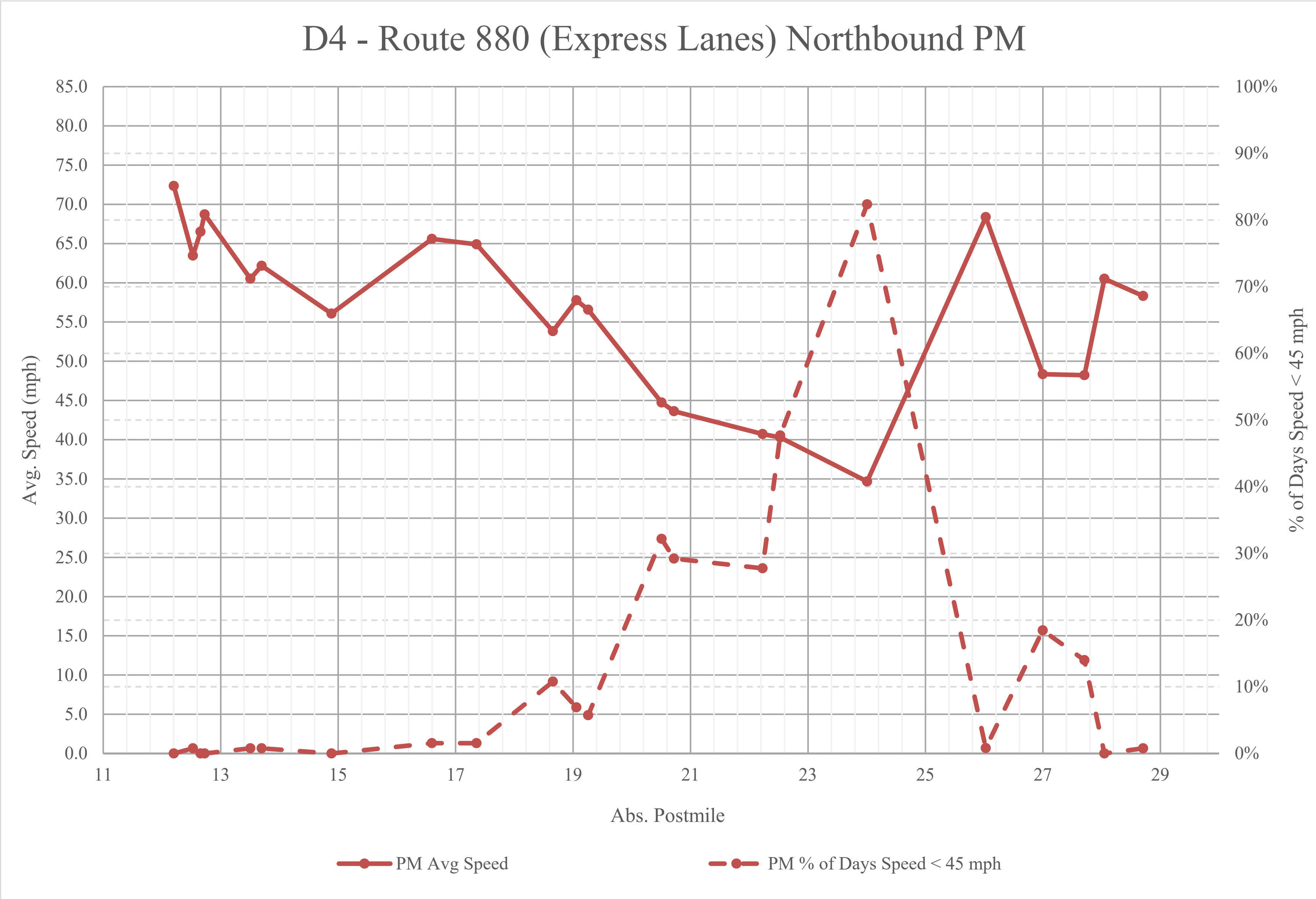


FIGURE 4.26 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 880, AM

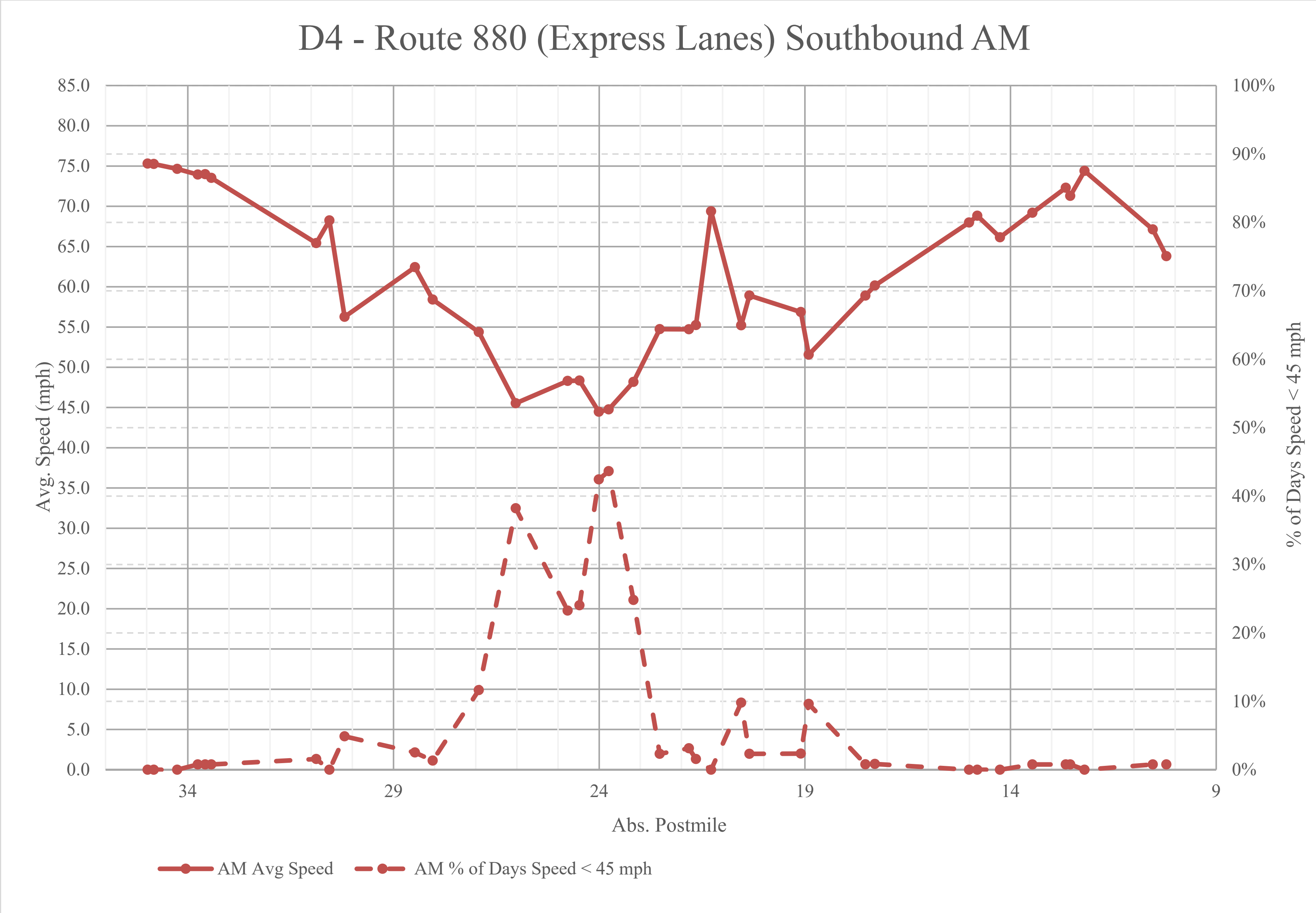


FIGURE 5.1 SPEED AND DEGRADATION PROFILE – NORTHBOUND ROUTE 101, AM

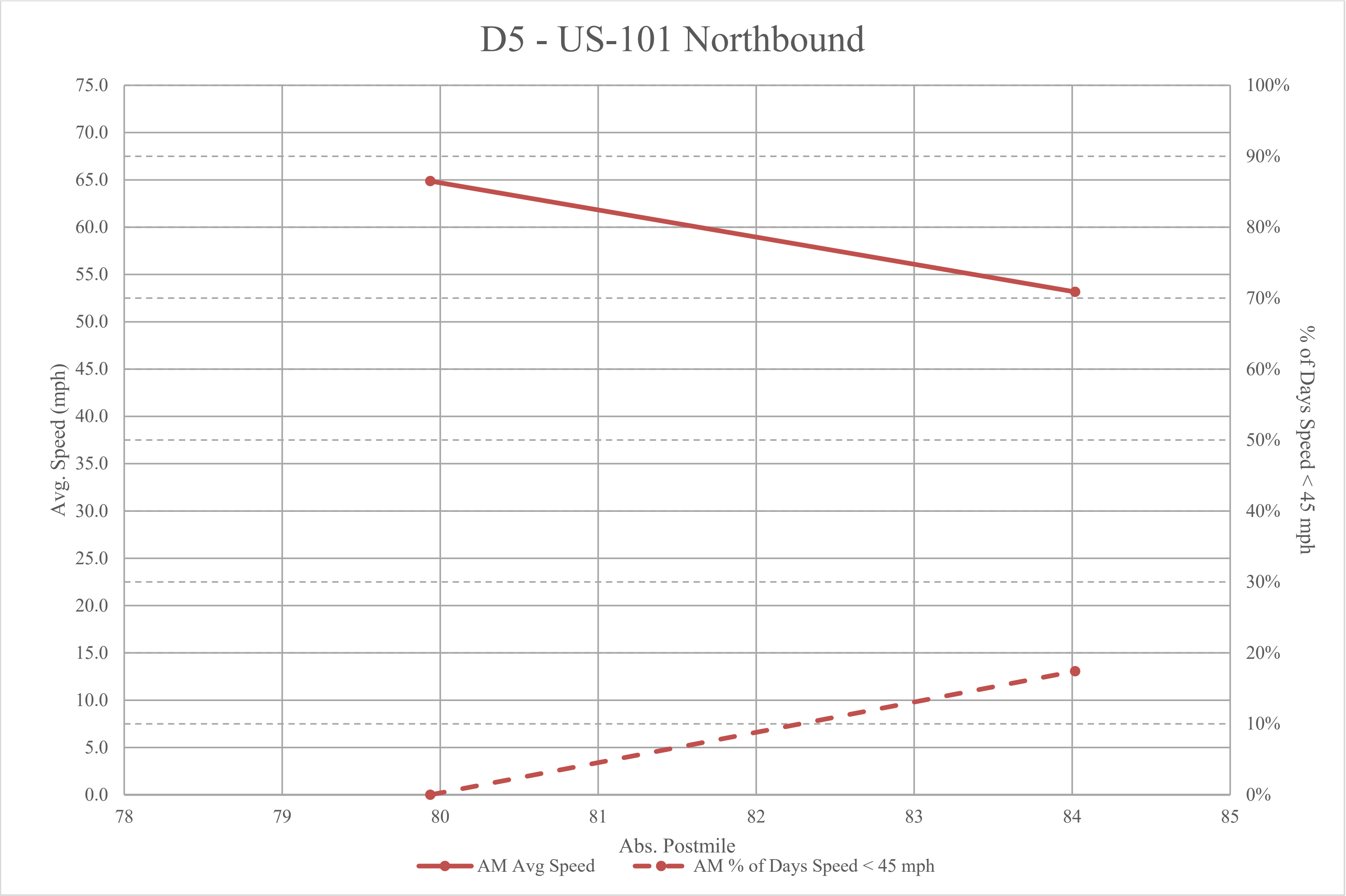


FIGURE 7.1 SPEED AND DEGRADATION PROFILE – NORTHBOUND ROUTE 5, AM

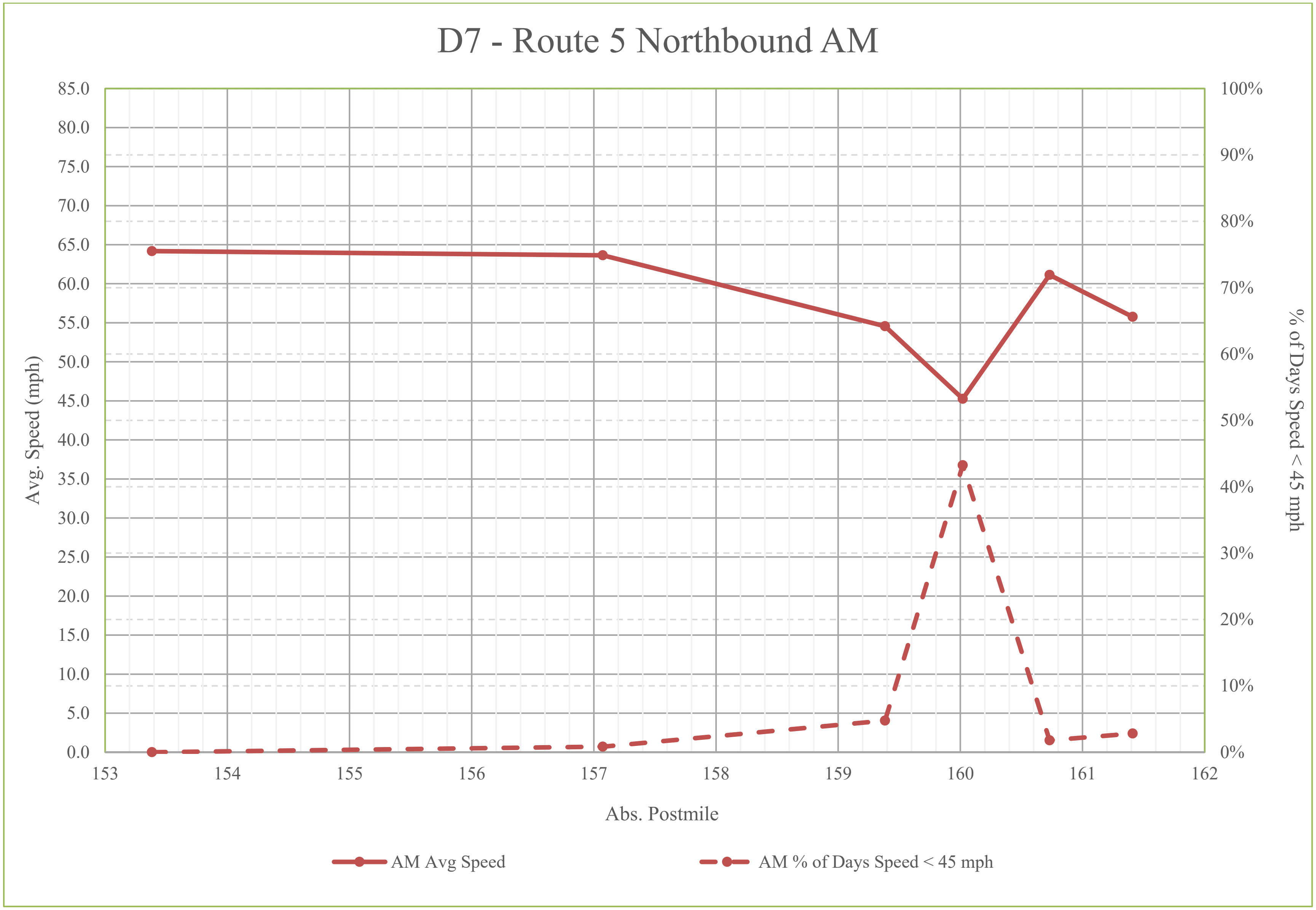


FIGURE 7.2 SPEED AND DEGRADATION PROFILE – NORTHBOUND ROUTE 5, PM

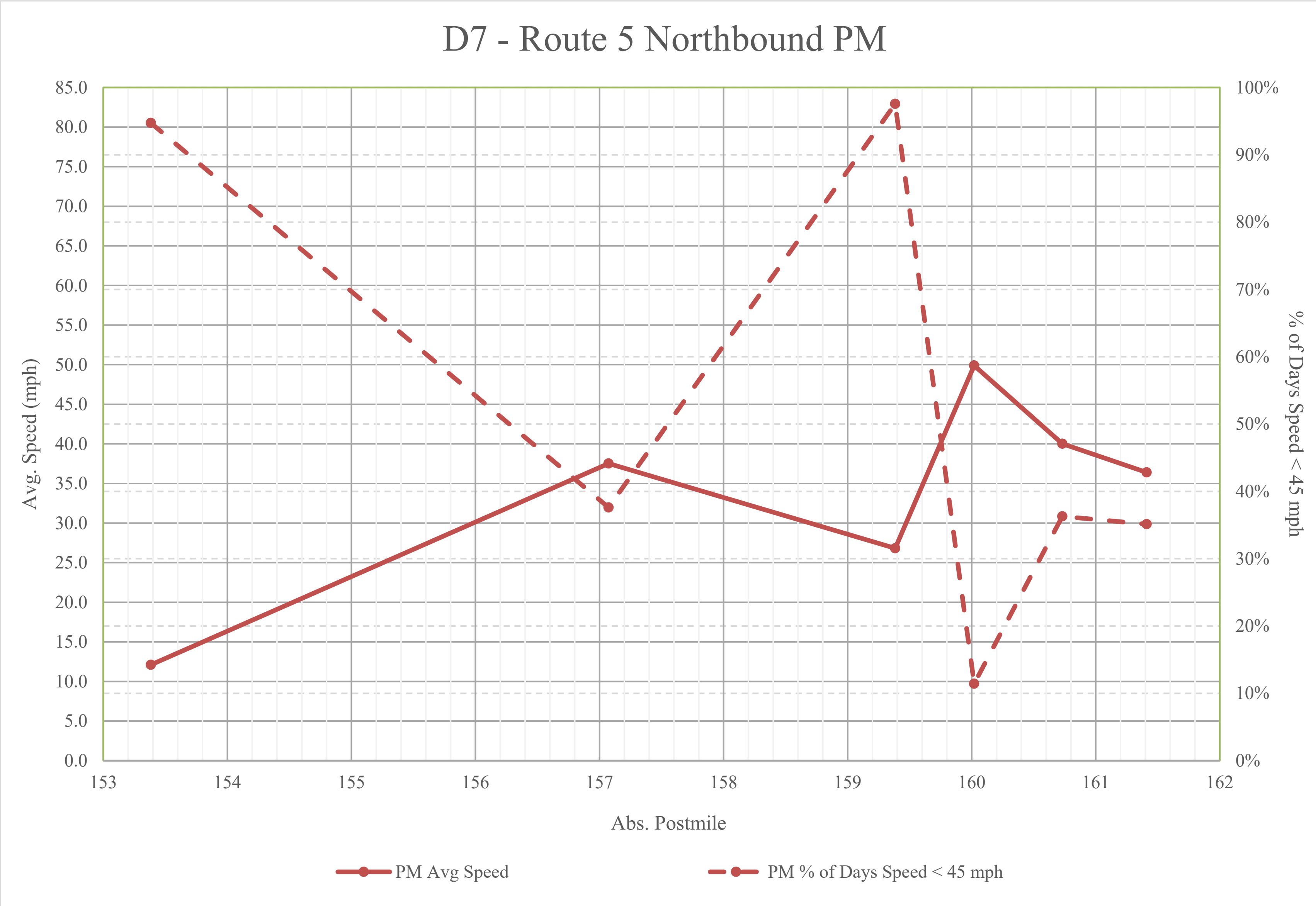


FIGURE 7.3 SPEED AND DEGRADATION PROFILE – SOUTHBOUND ROUTE 5, AM

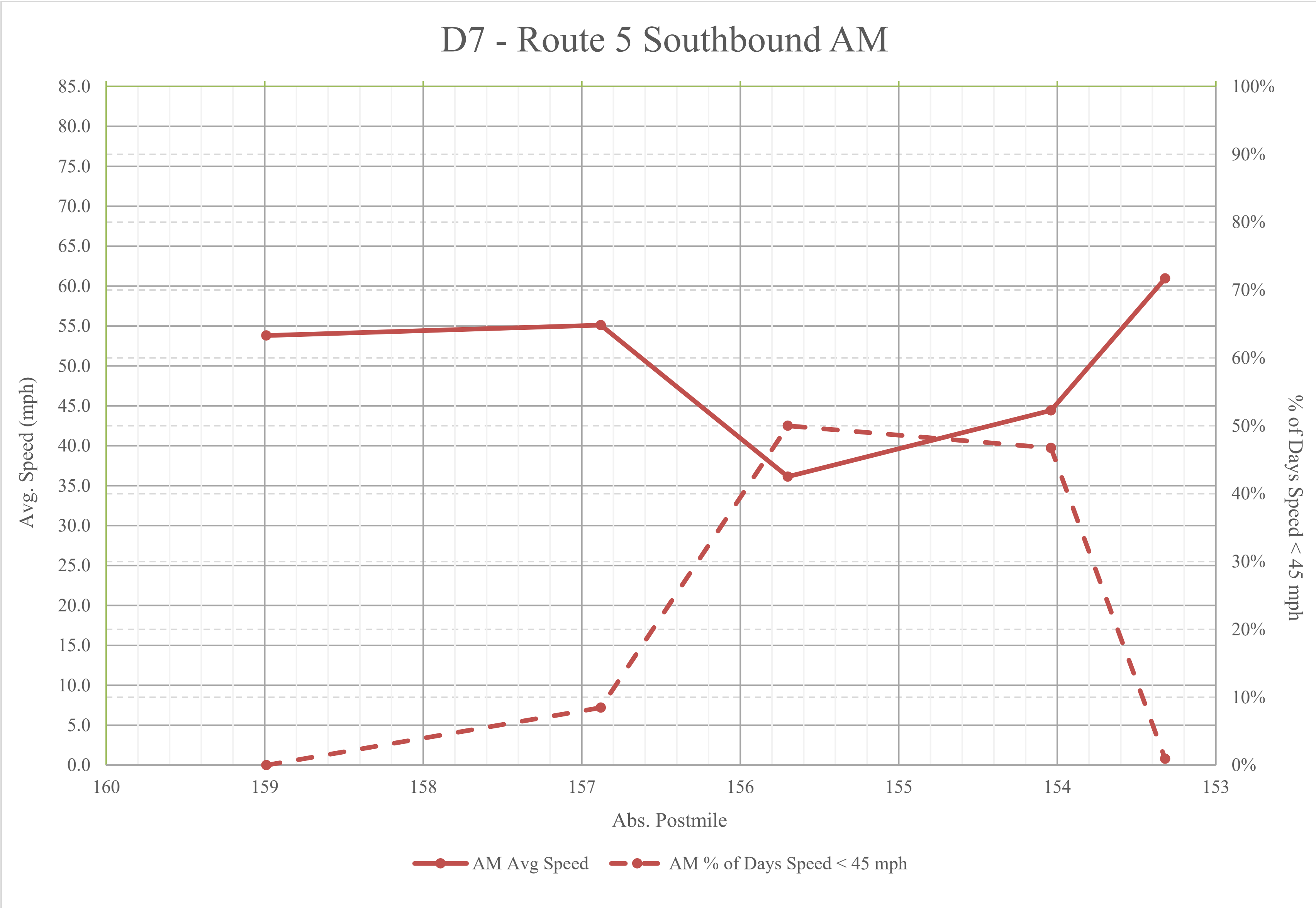


FIGURE 7.4 SPEED AND DEGRADATION PROFILE – SOUTHBOUND ROUTE 5, PM

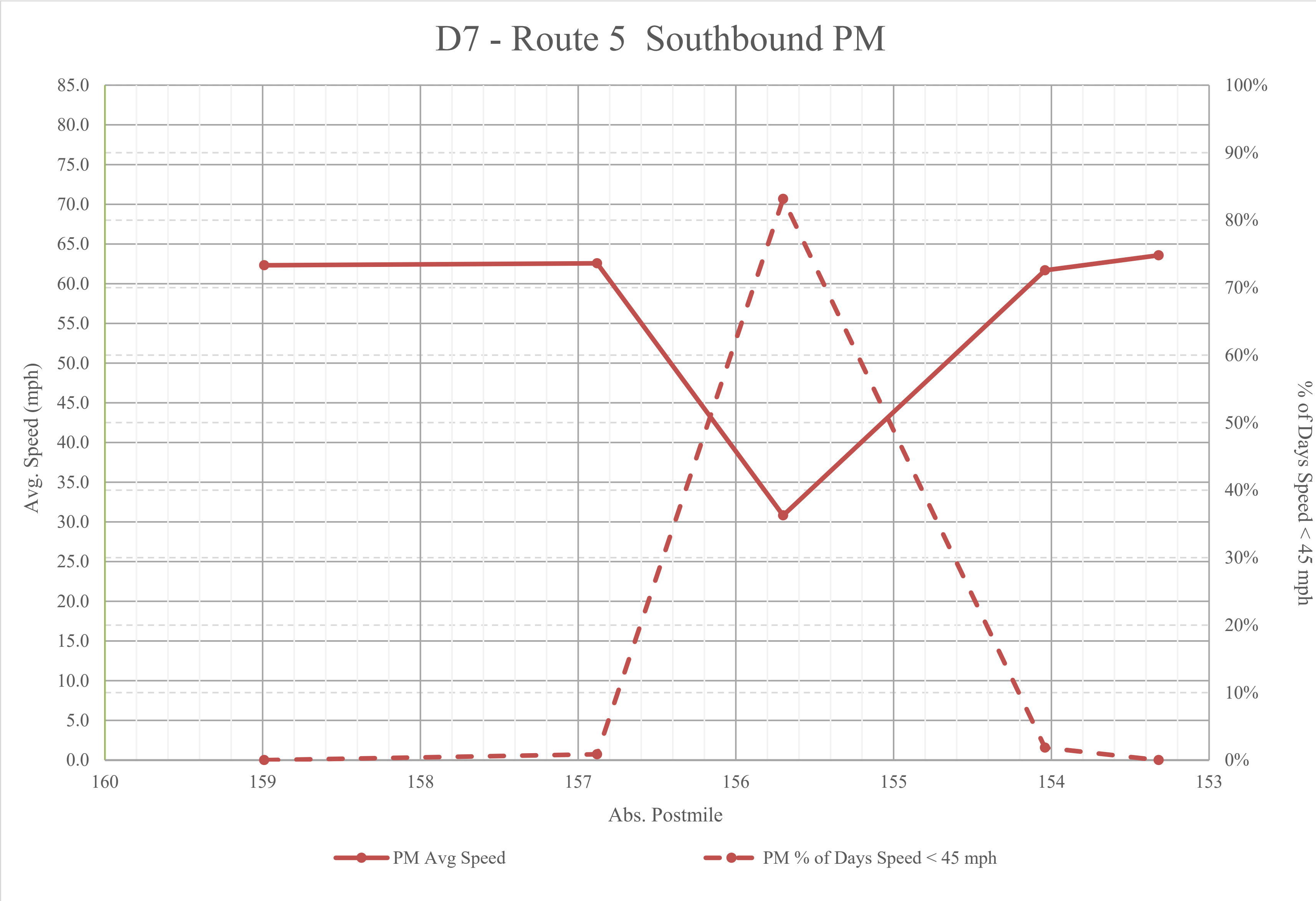


FIGURE 7.5 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 10 (HOT), PM

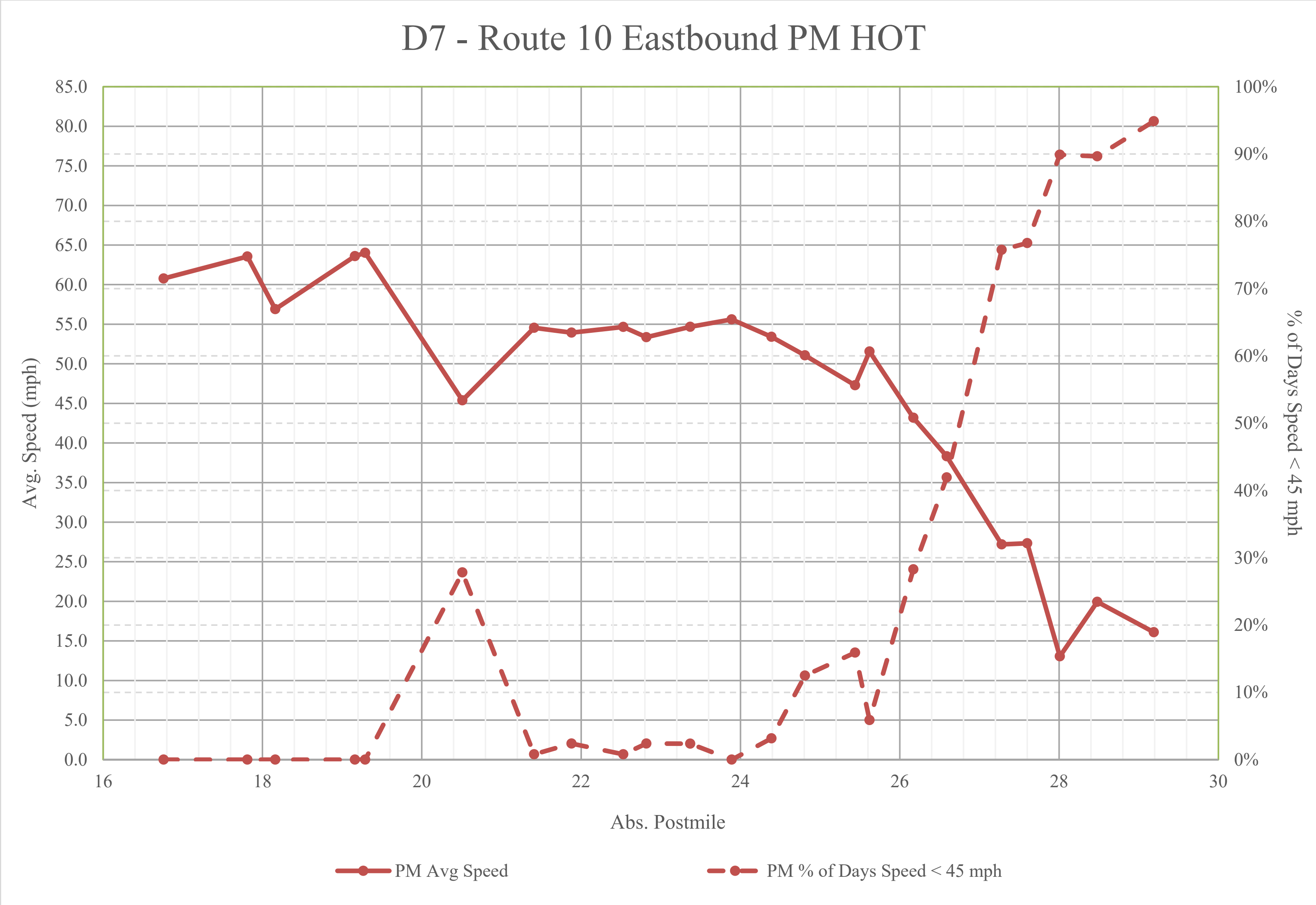


FIGURE 7.6 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 10 (HOT), AM

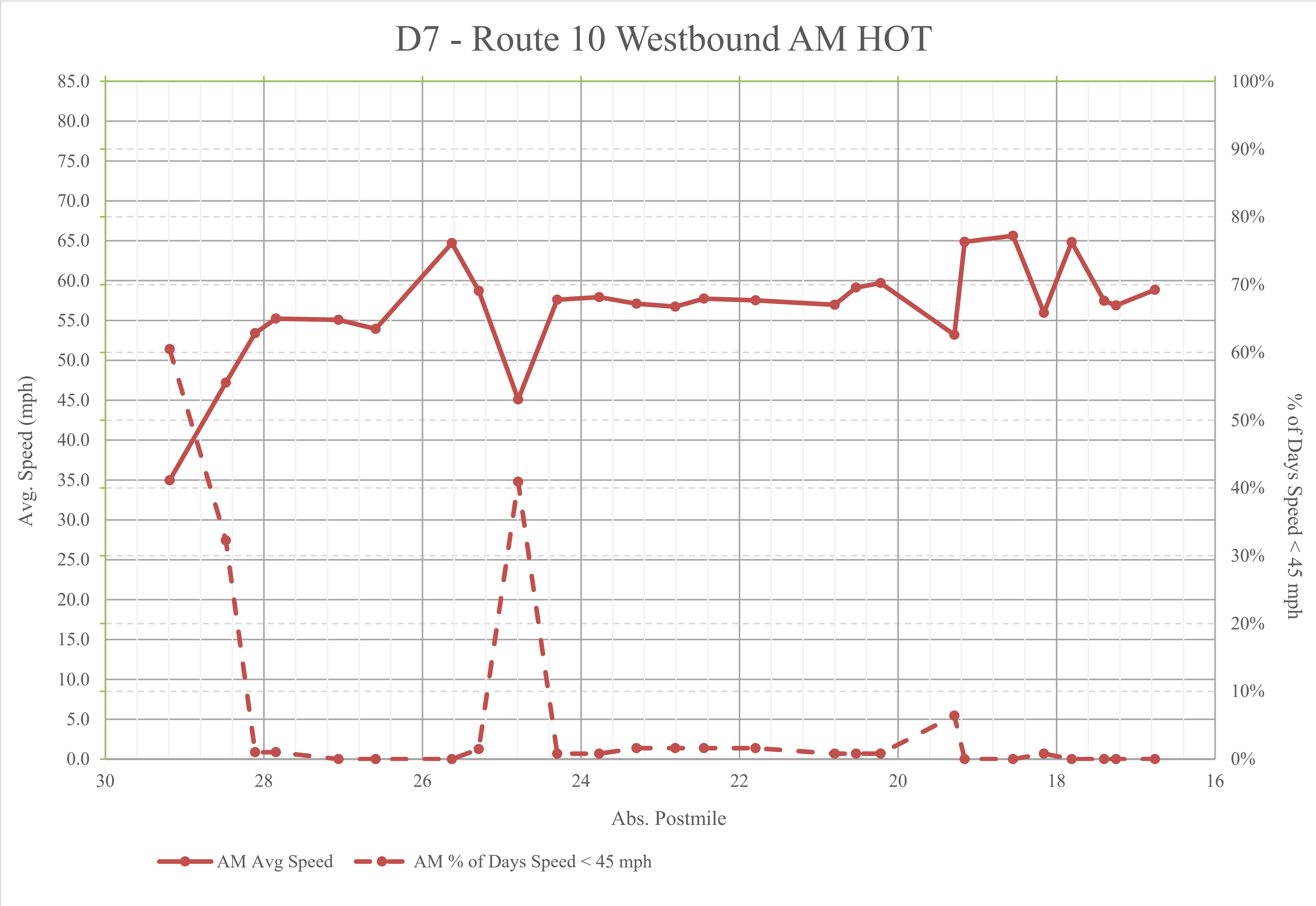


FIGURE 7.7 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 10 (HOT), PM

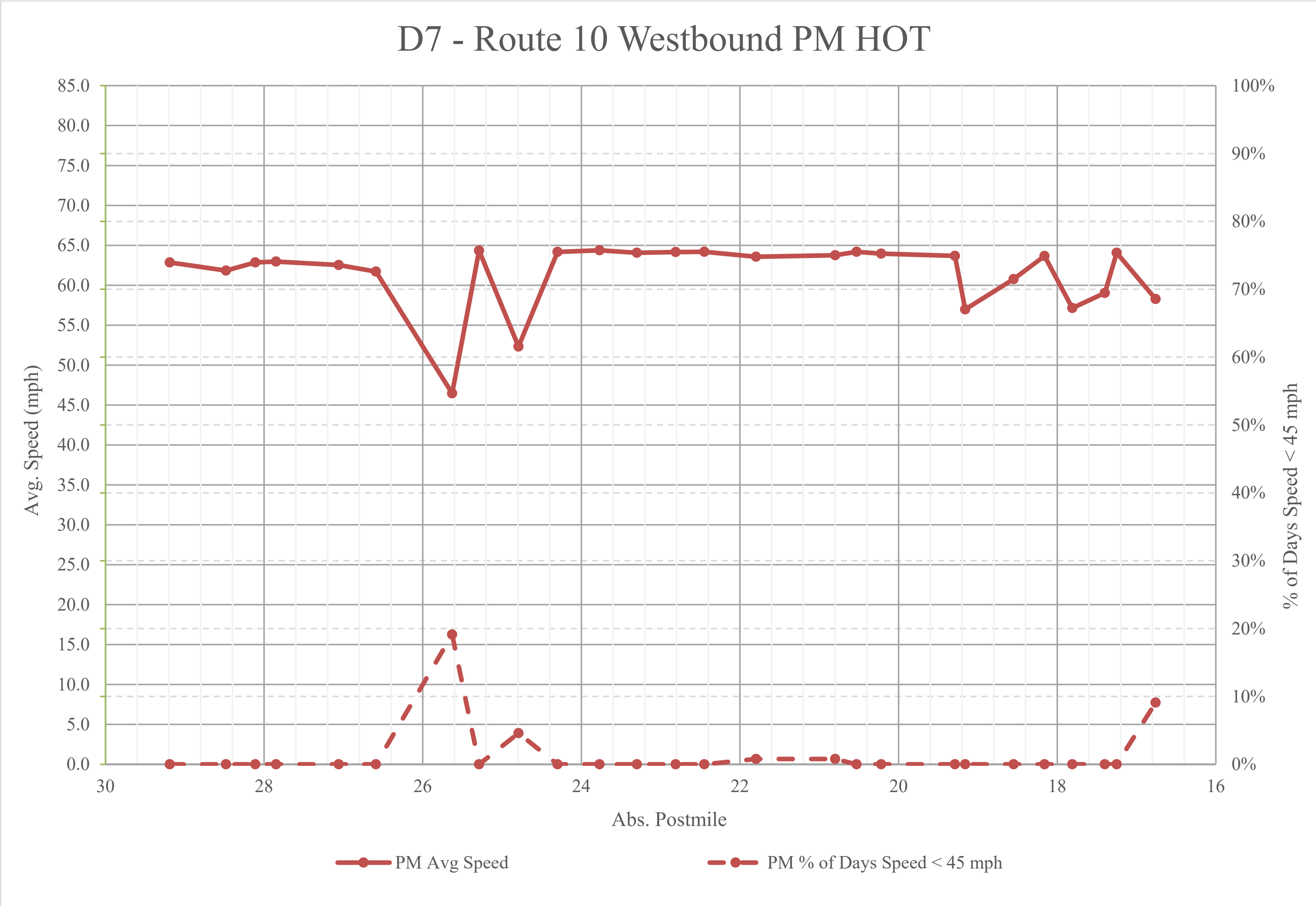


FIGURE 7.8 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 10 (HOV), AM

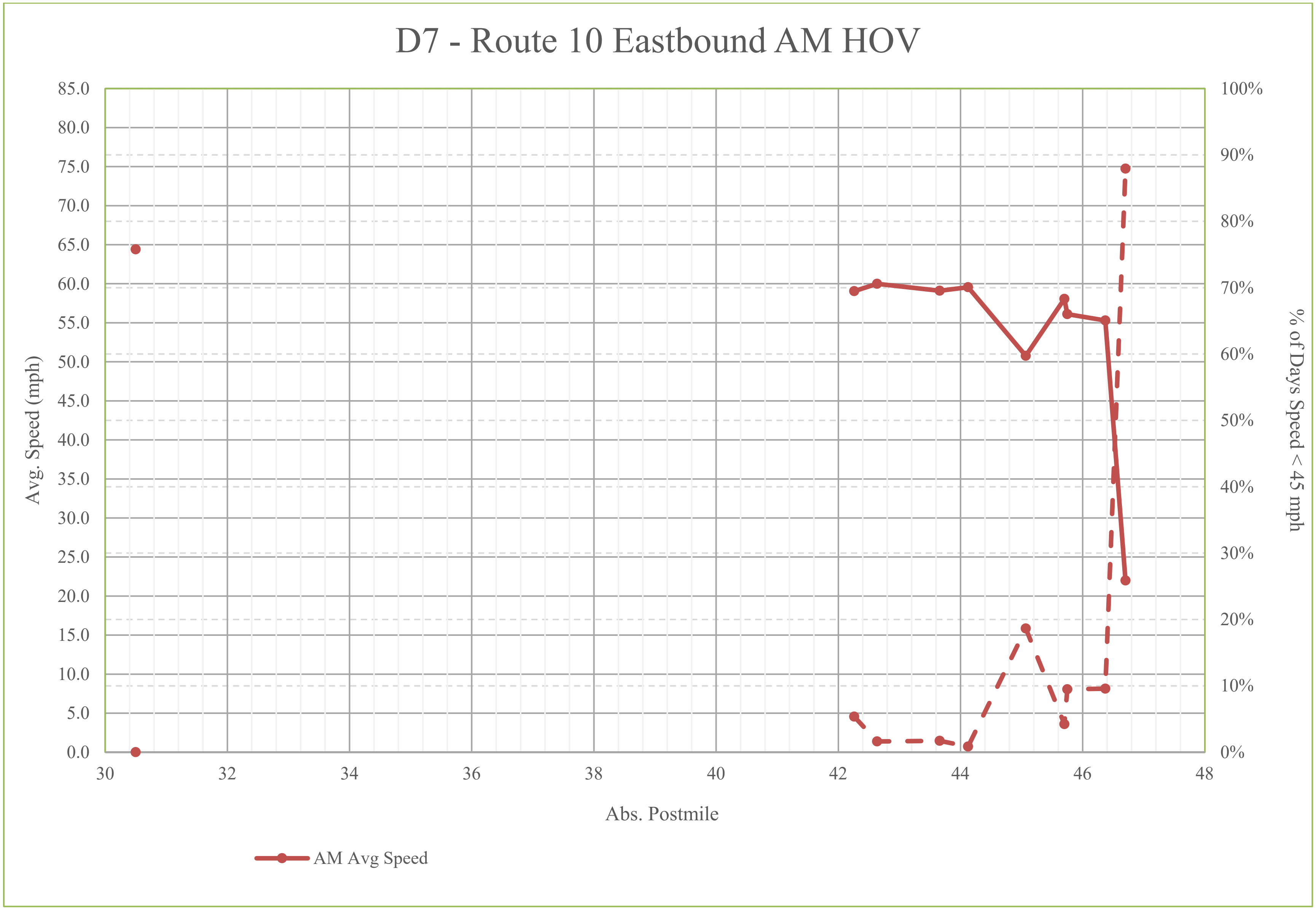


FIGURE 7.9 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 10 (HOV), PM

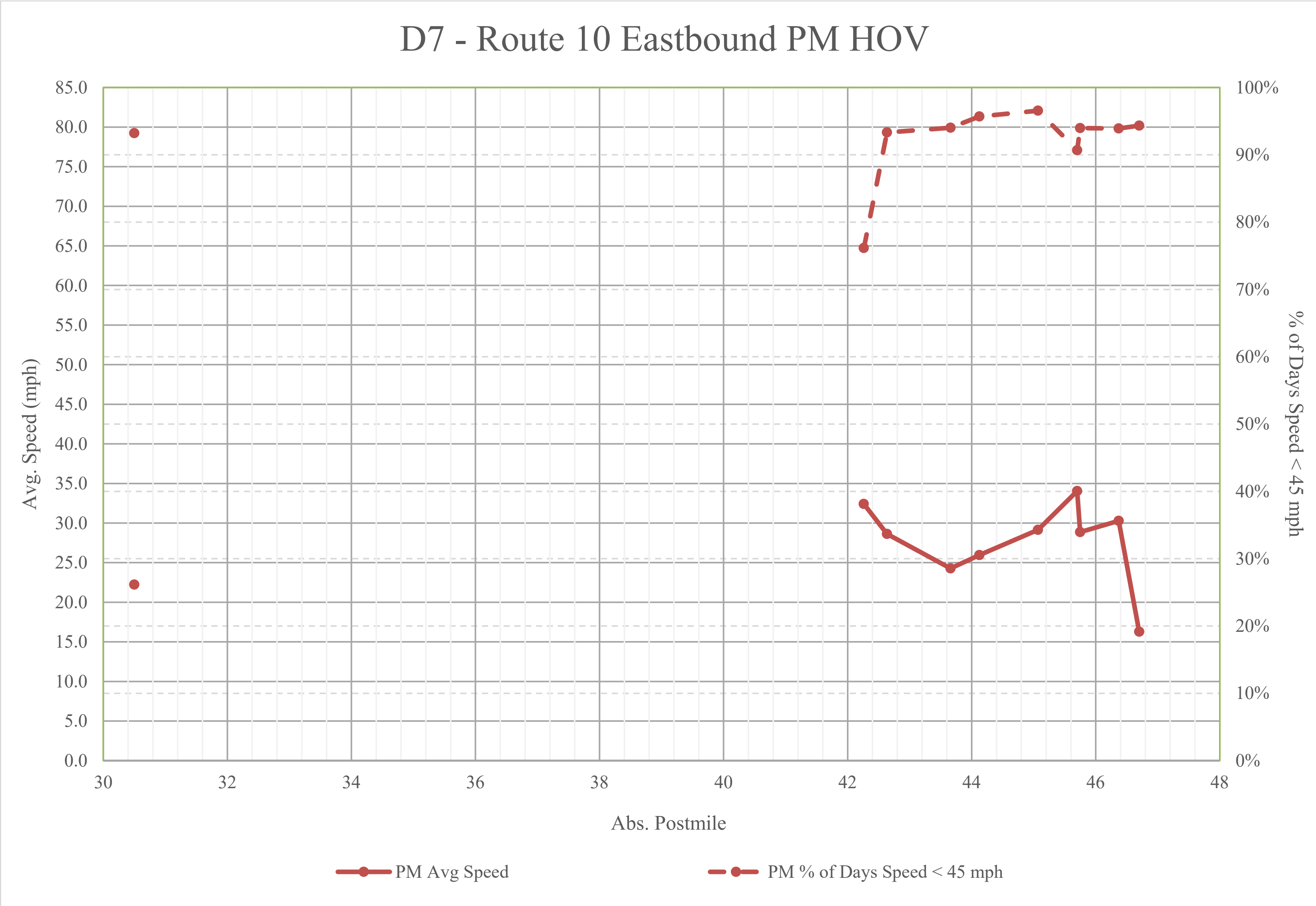


FIGURE 7.10 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 10 (HOV), AM

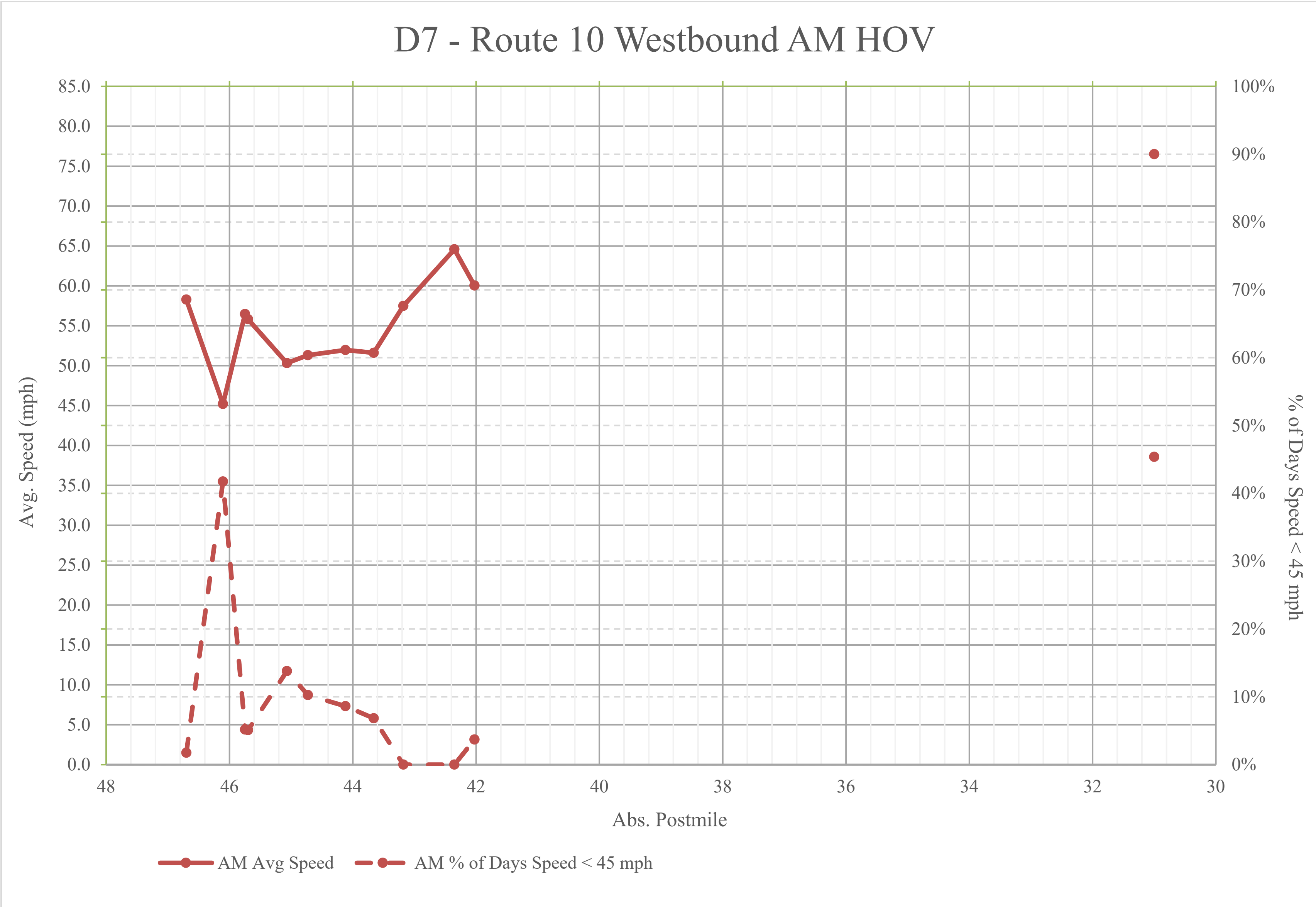


FIGURE 7.11 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 10 (HOV), PM

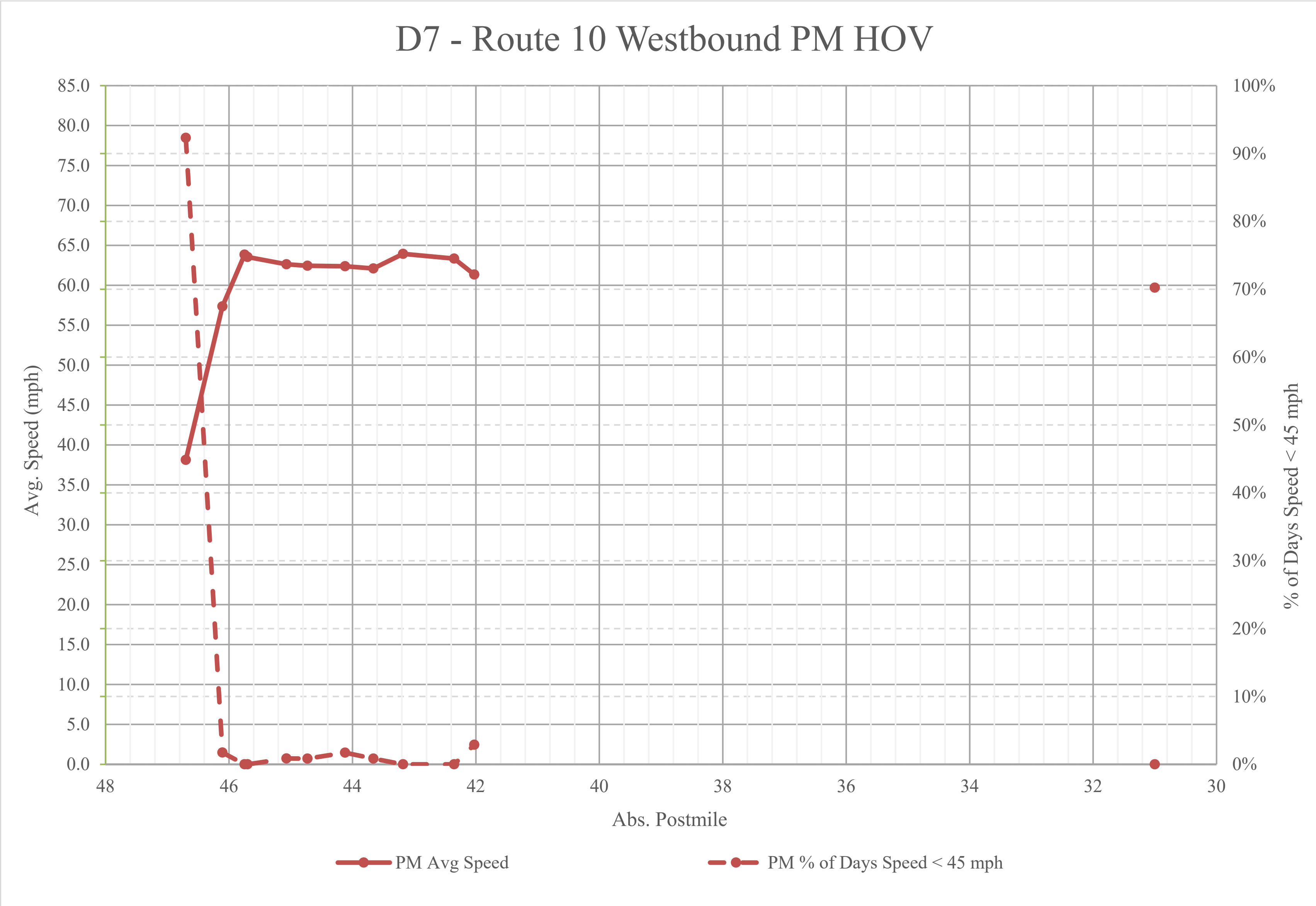


FIGURE 7.12 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 14, PM

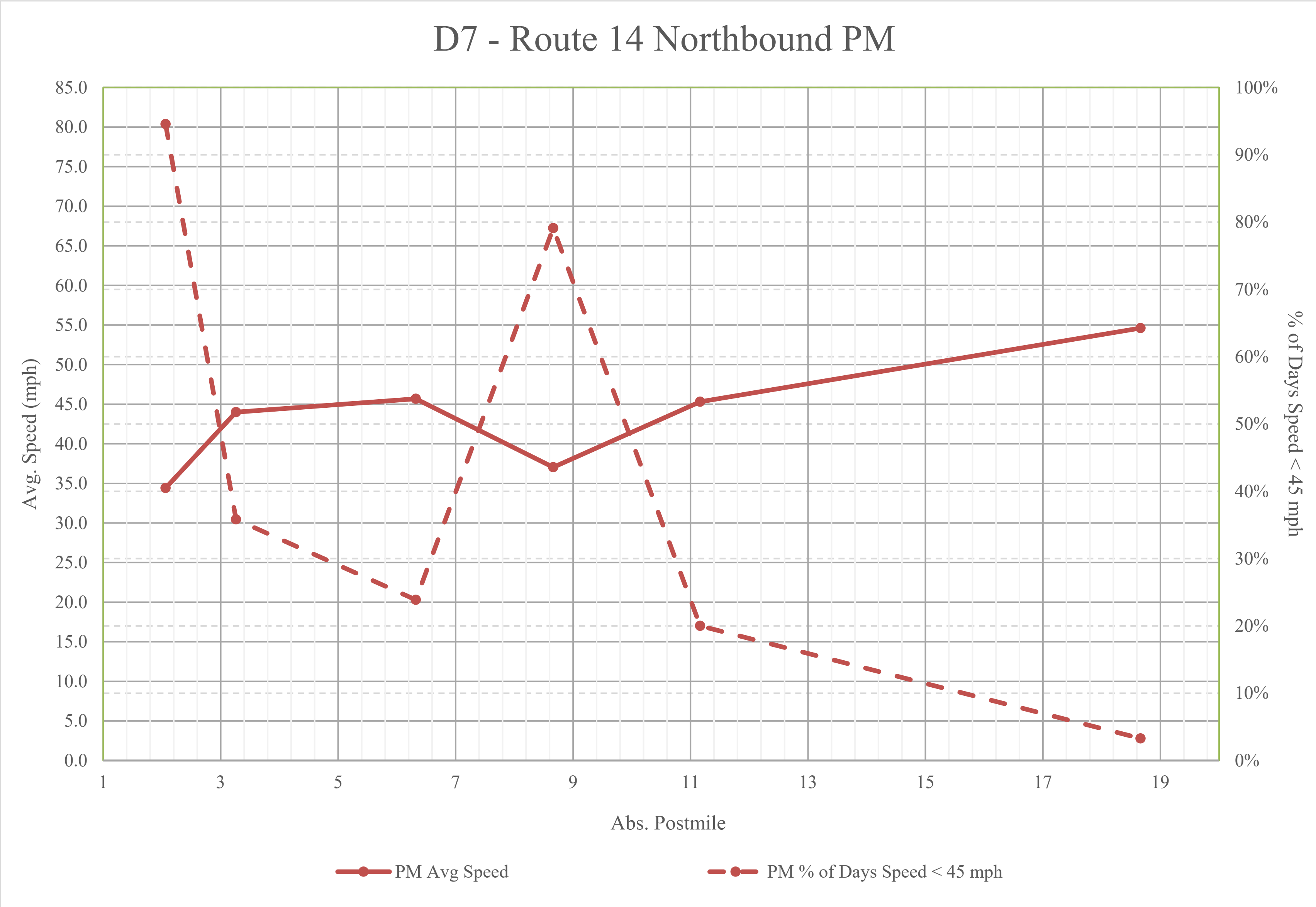


FIGURE 7.13 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 14, AM

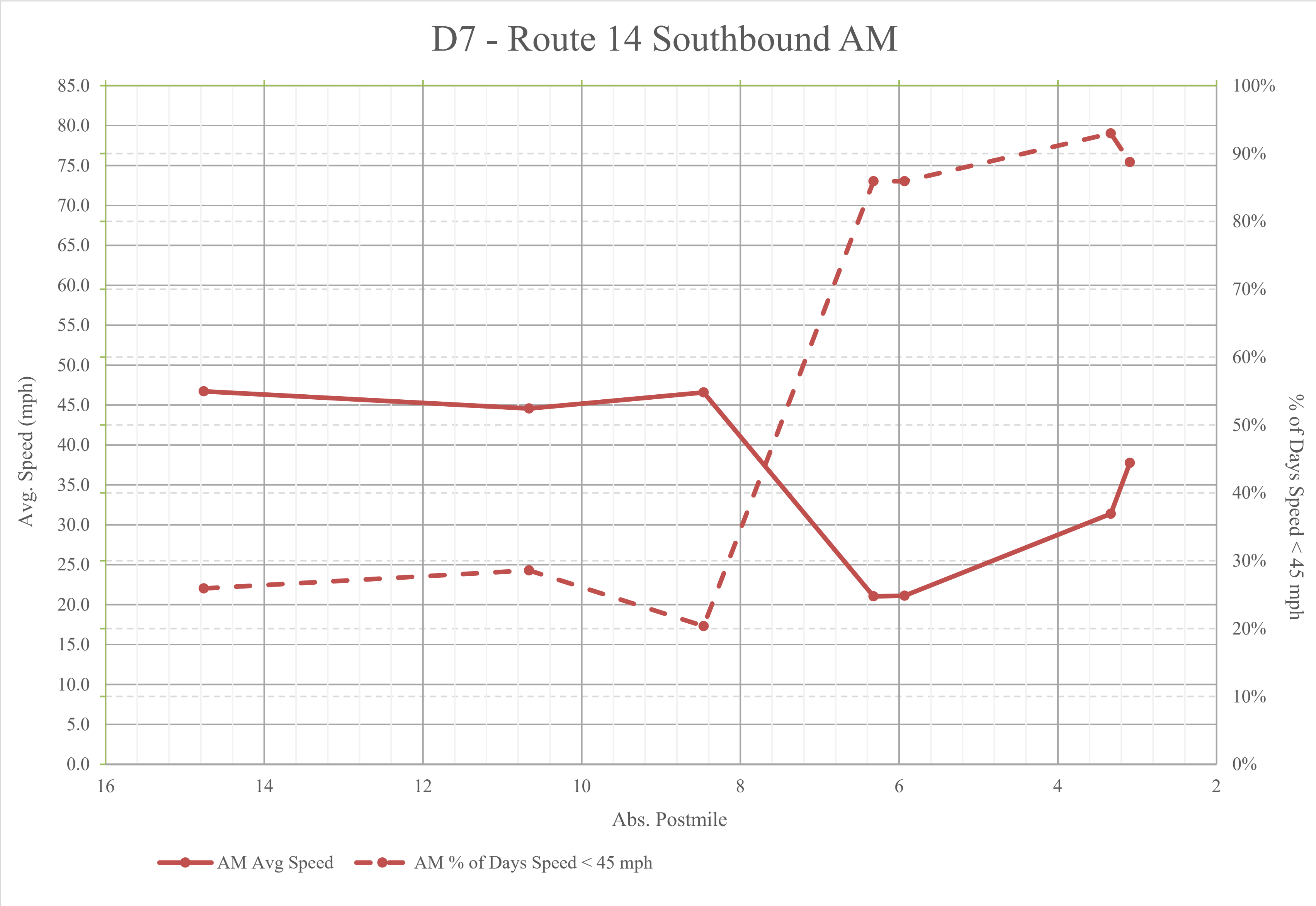


FIGURE 7.14 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 57, AM

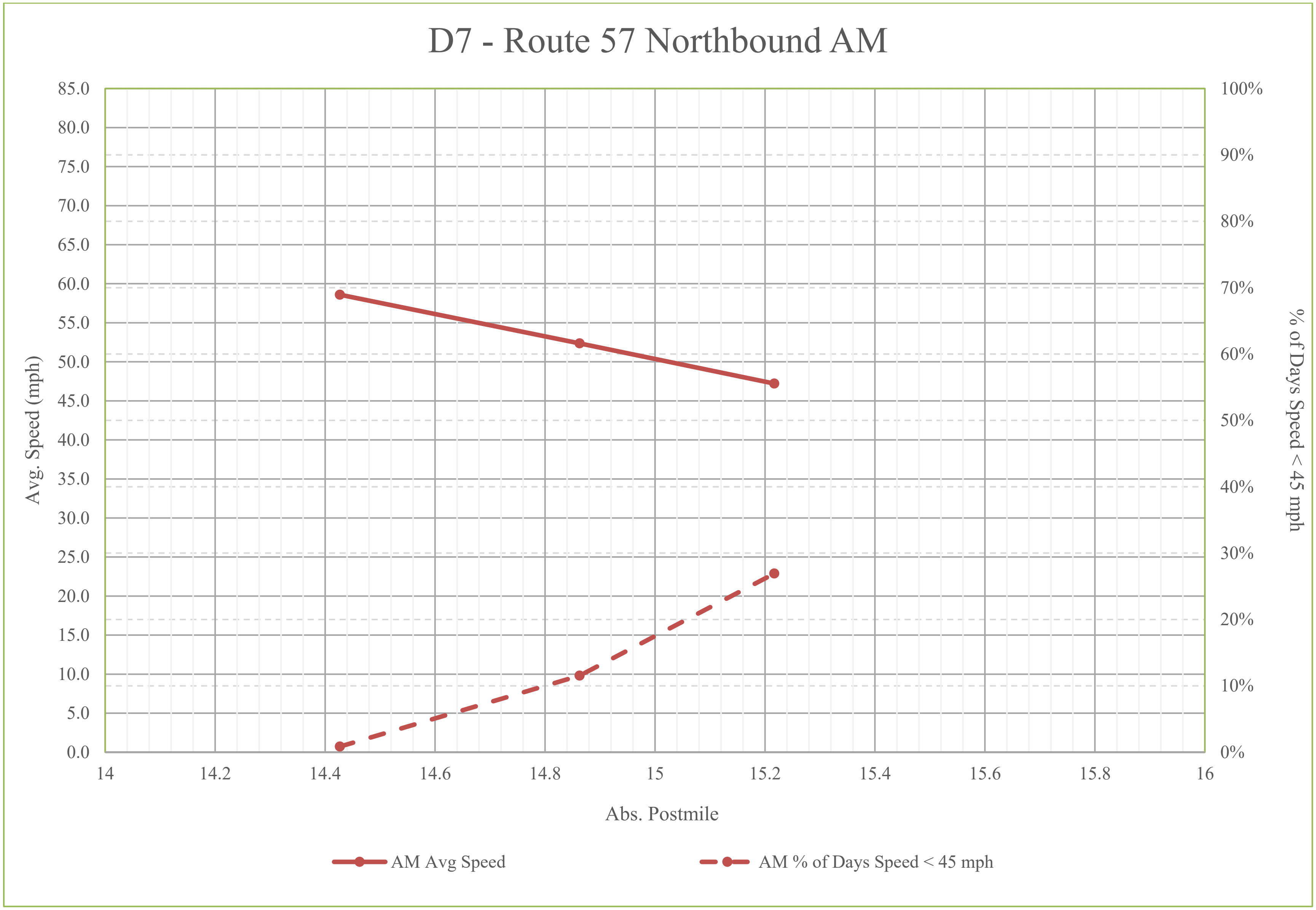


FIGURE 7.15 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 57, PM

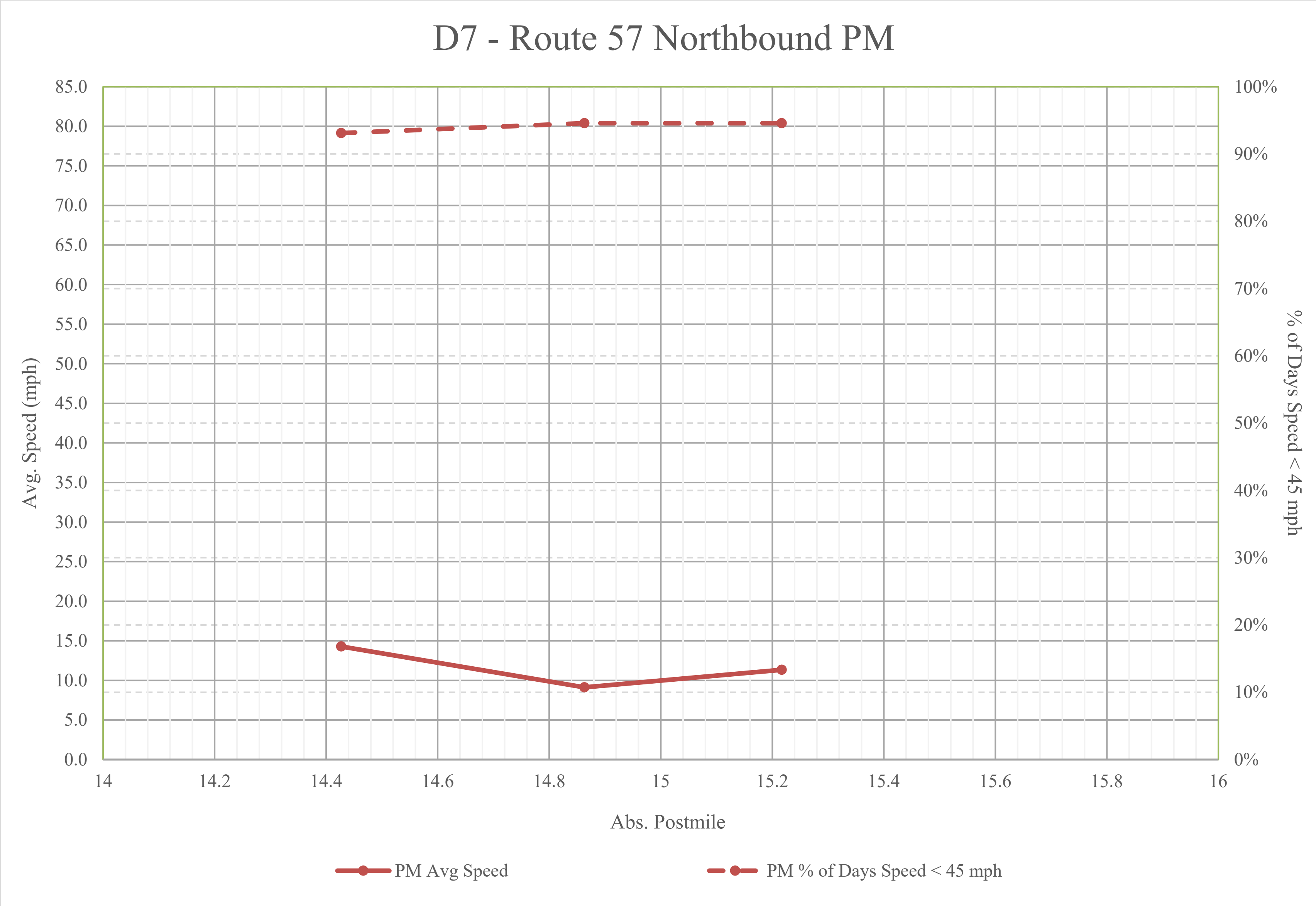


FIGURE 7.16 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 60, AM

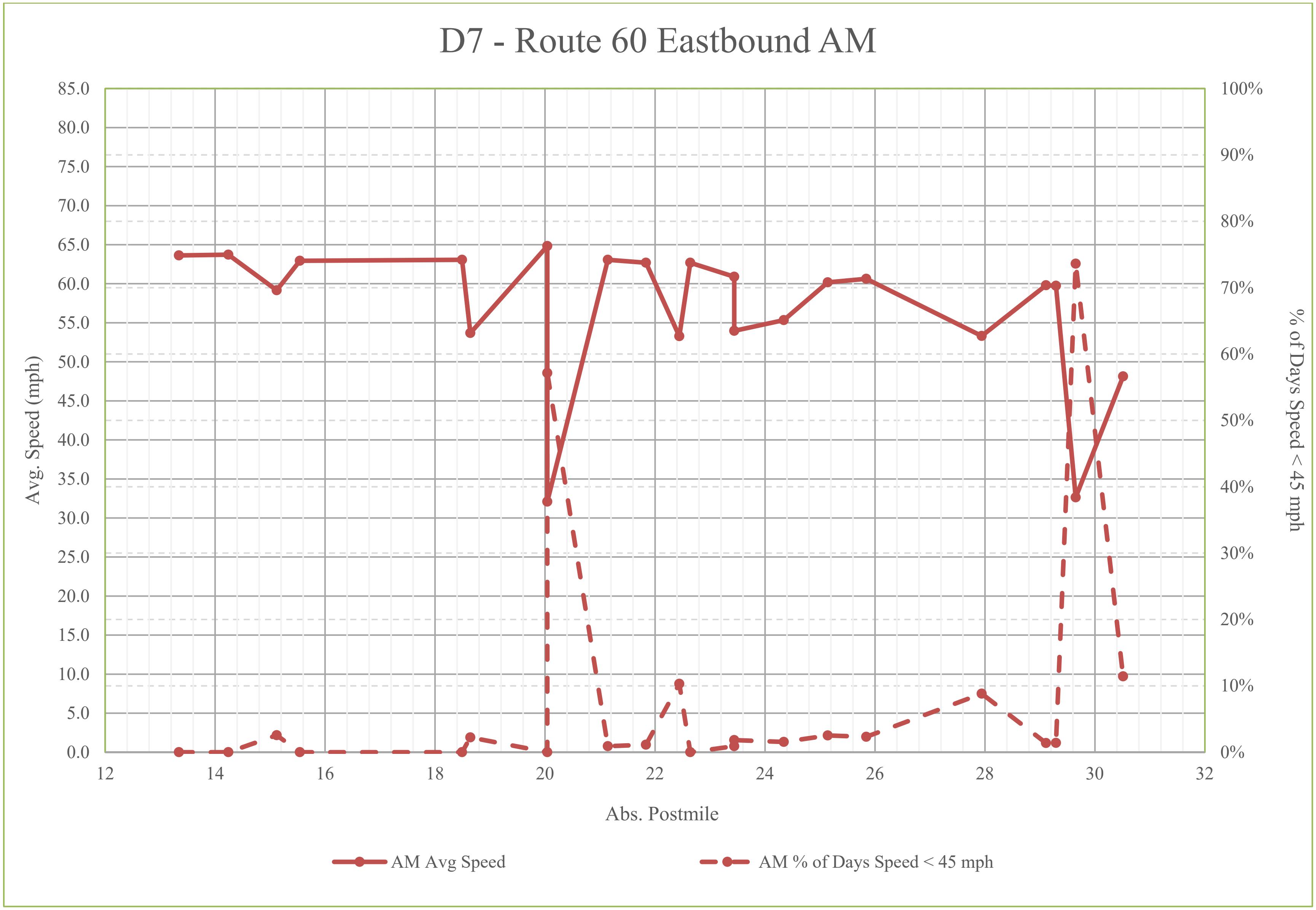


FIGURE 7.17 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 60, PM

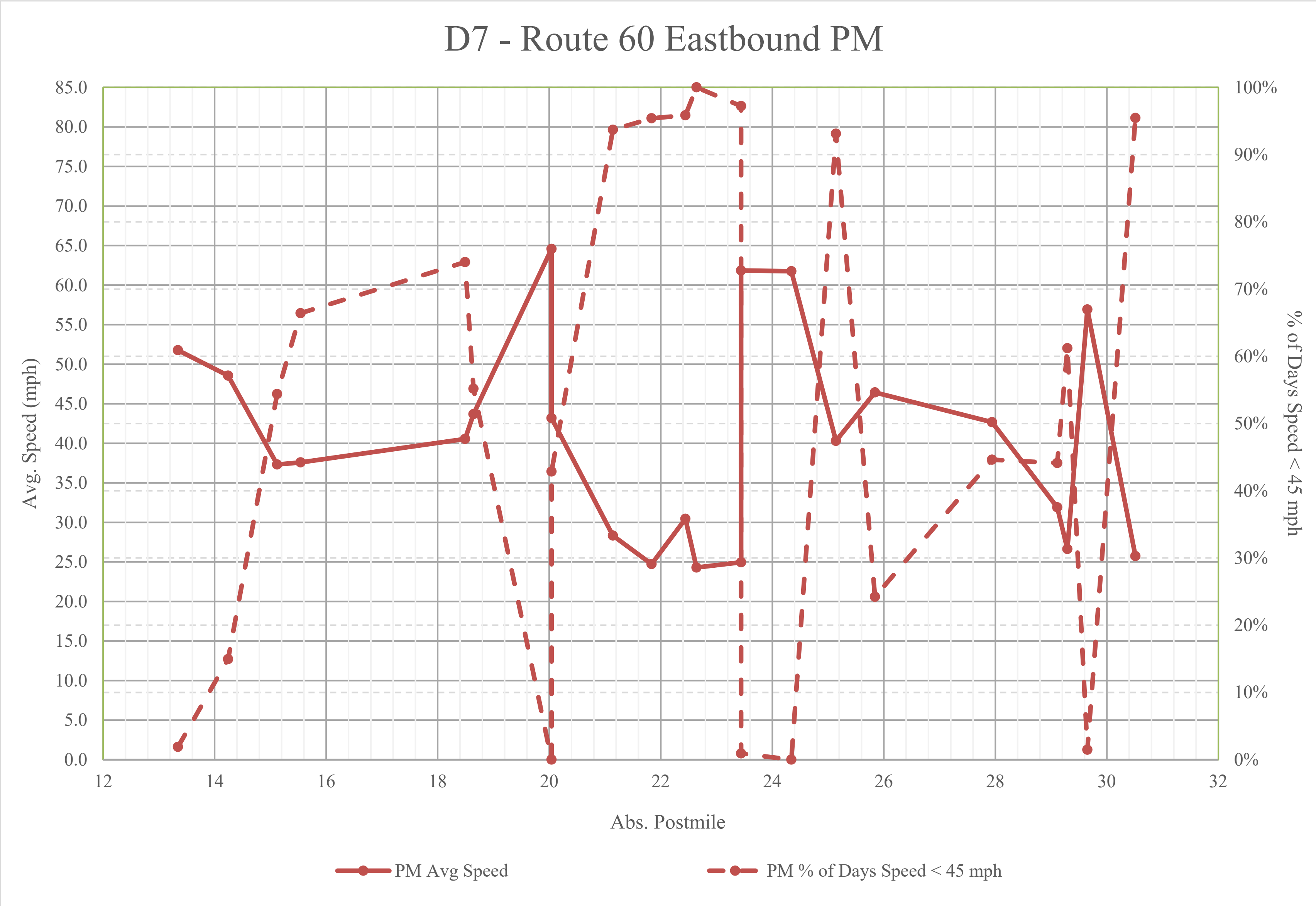


FIGURE 7.18 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 60, AM

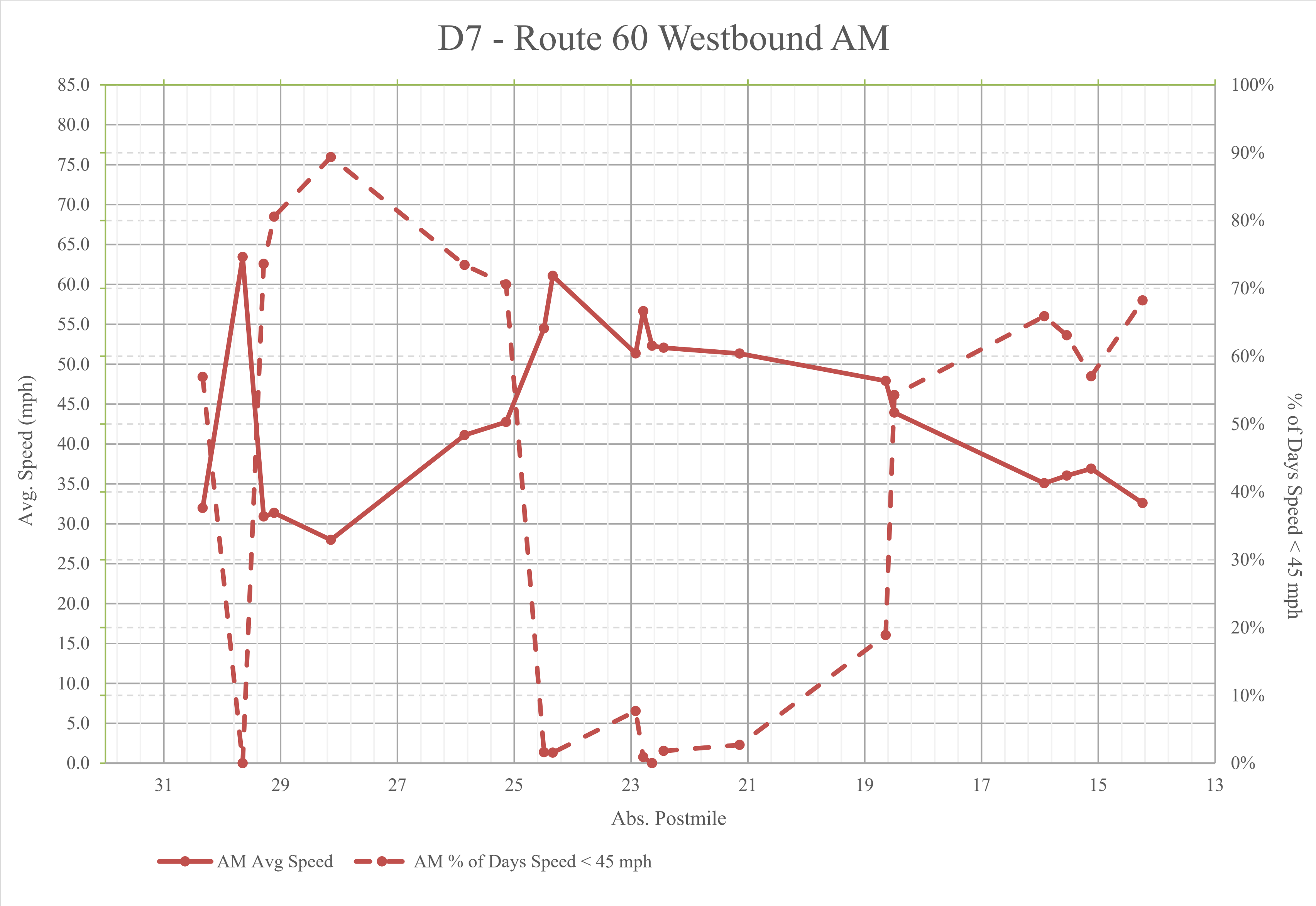


FIGURE 7.19 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 60, PM

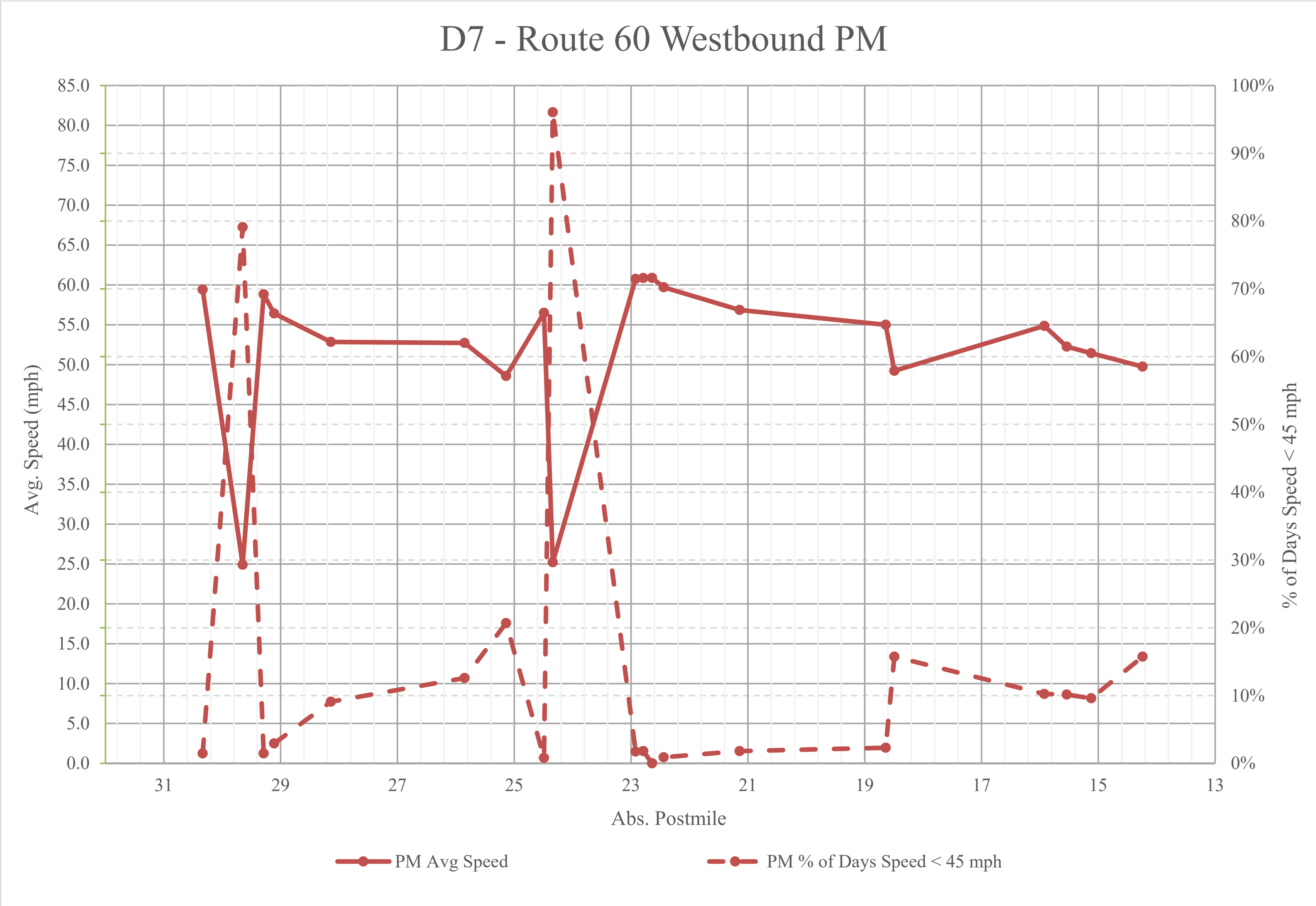


FIGURE 7.20 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 91, AM

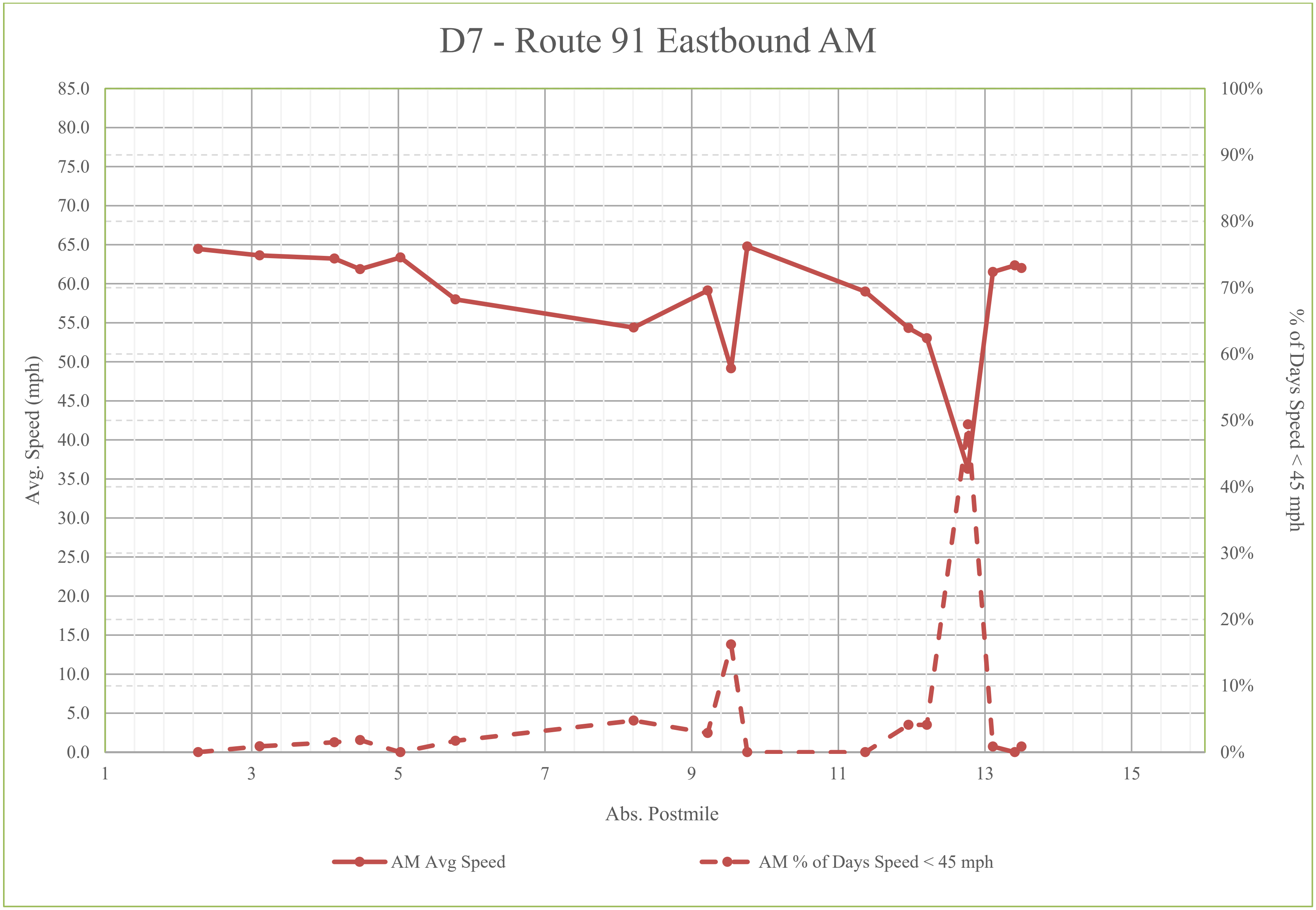


FIGURE 7.21 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 91, PM

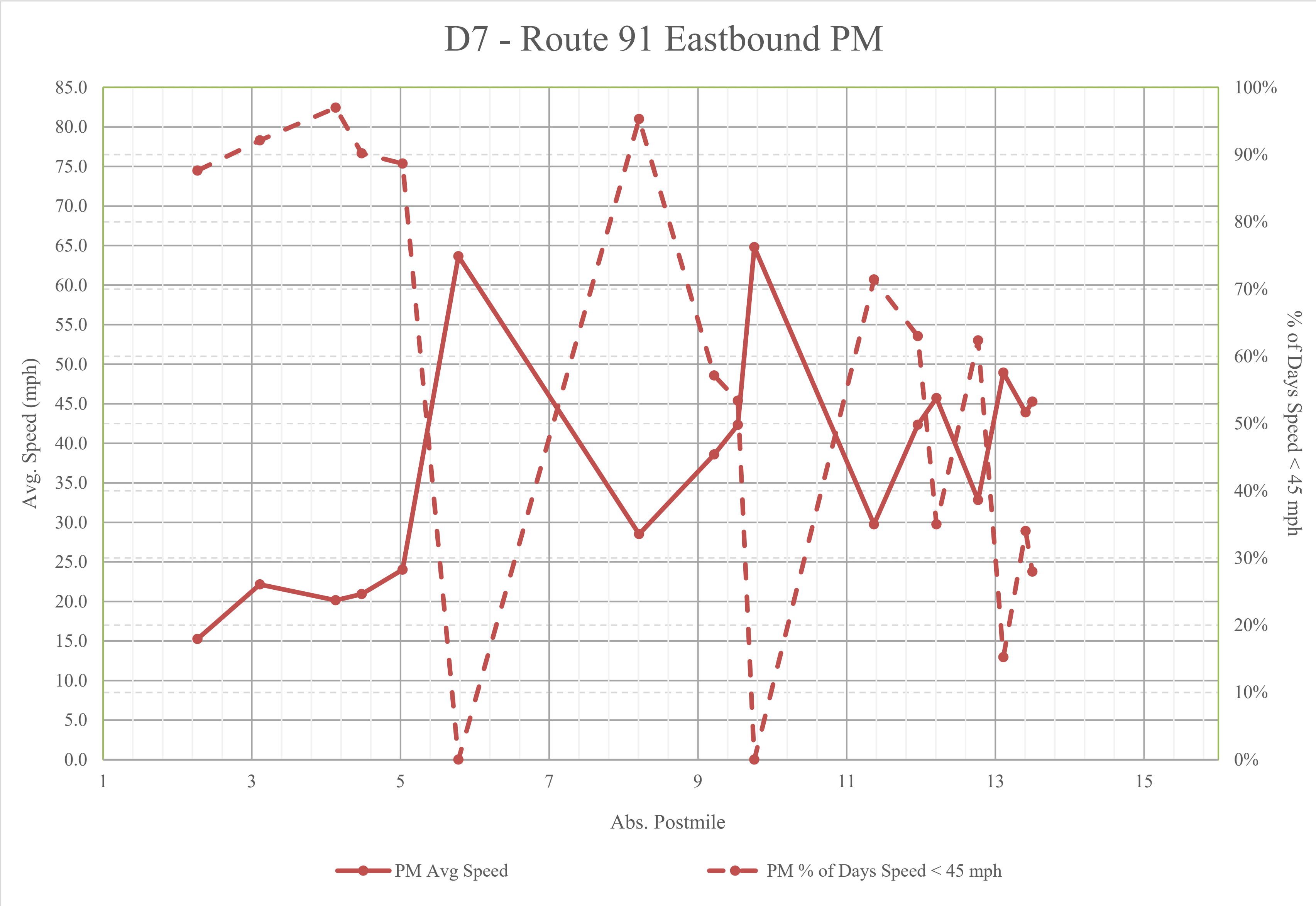


FIGURE 7.22 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 91, AM

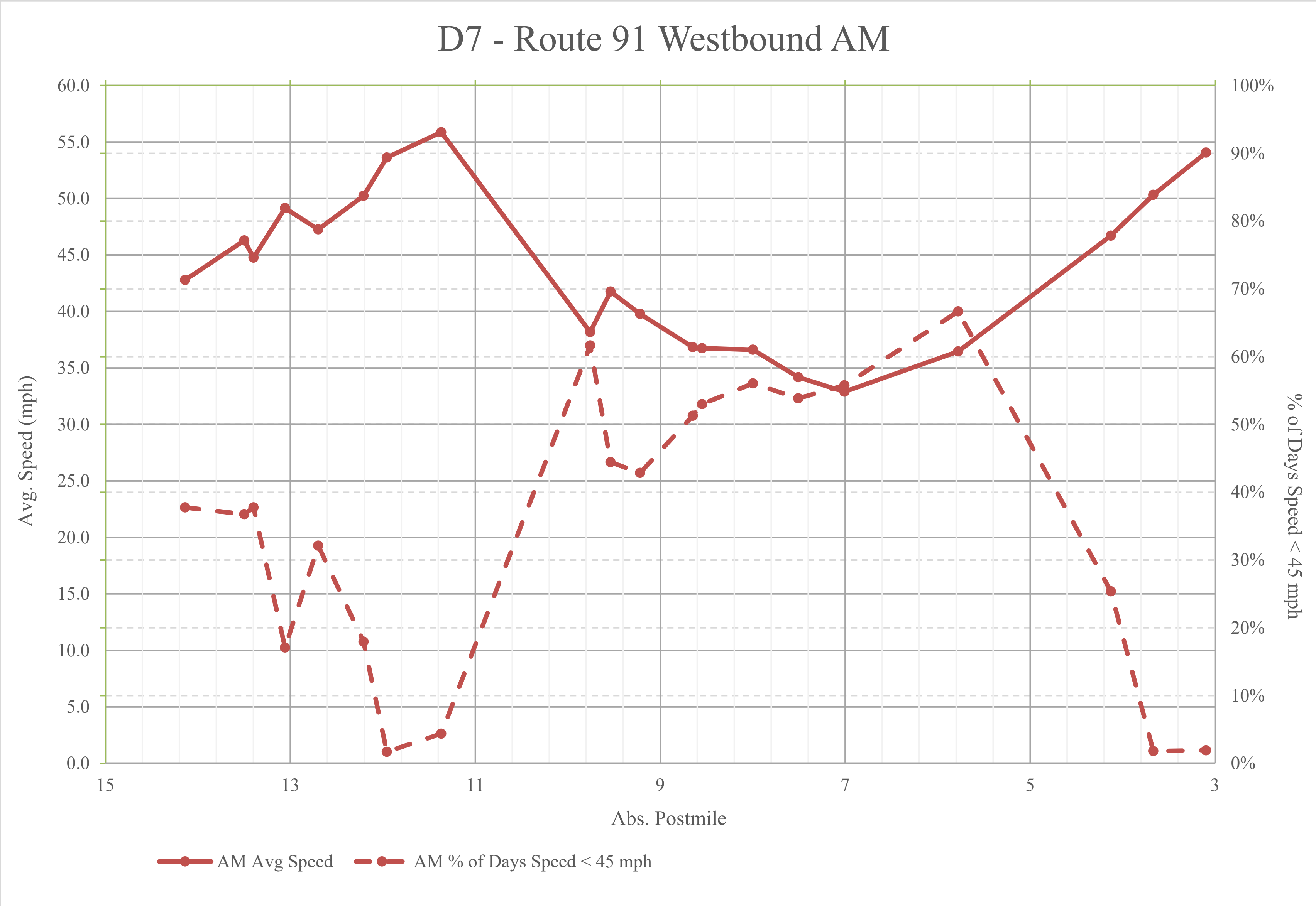


FIGURE 7.23 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 91, PM

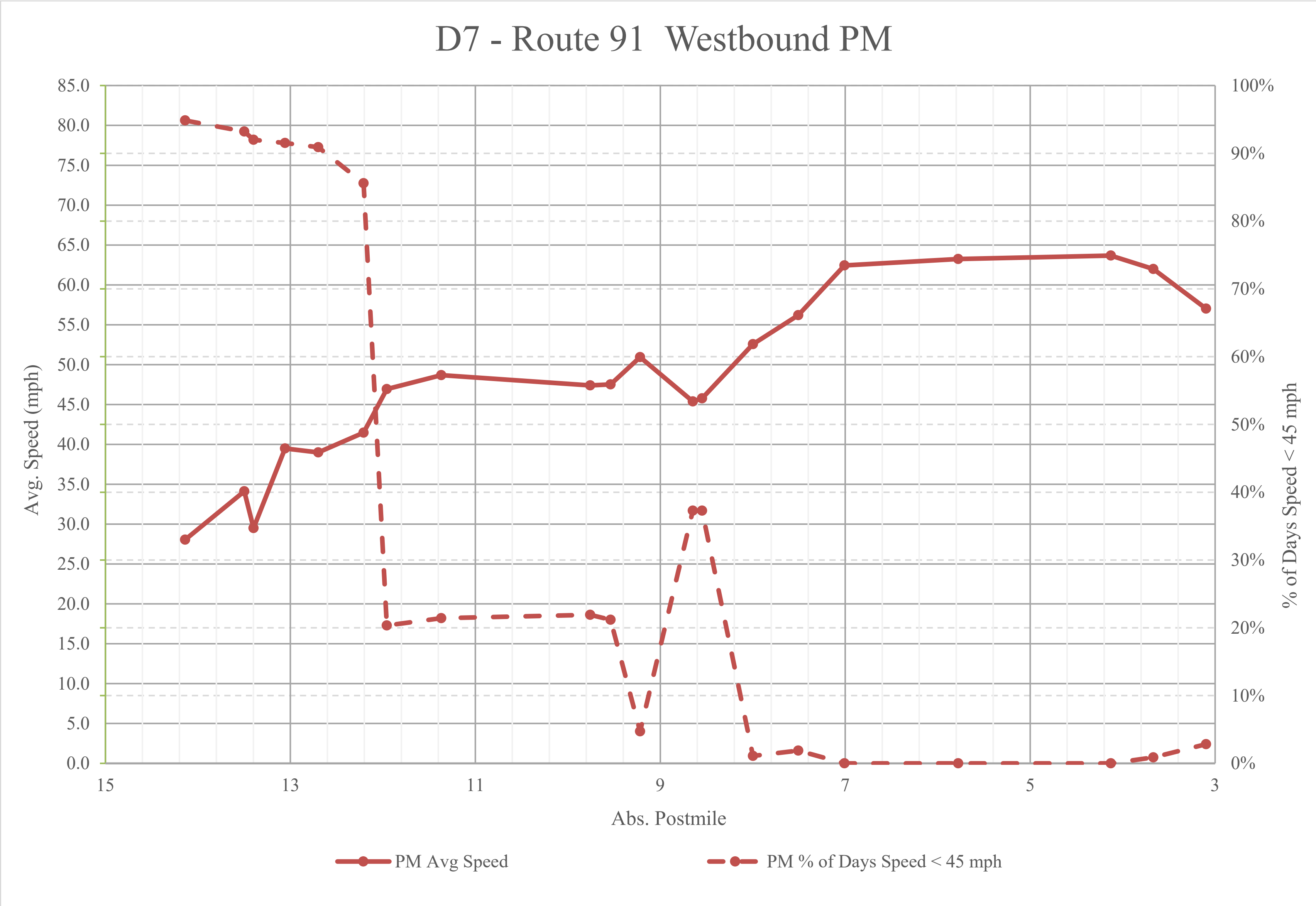


FIGURE 7.24 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 105, PM

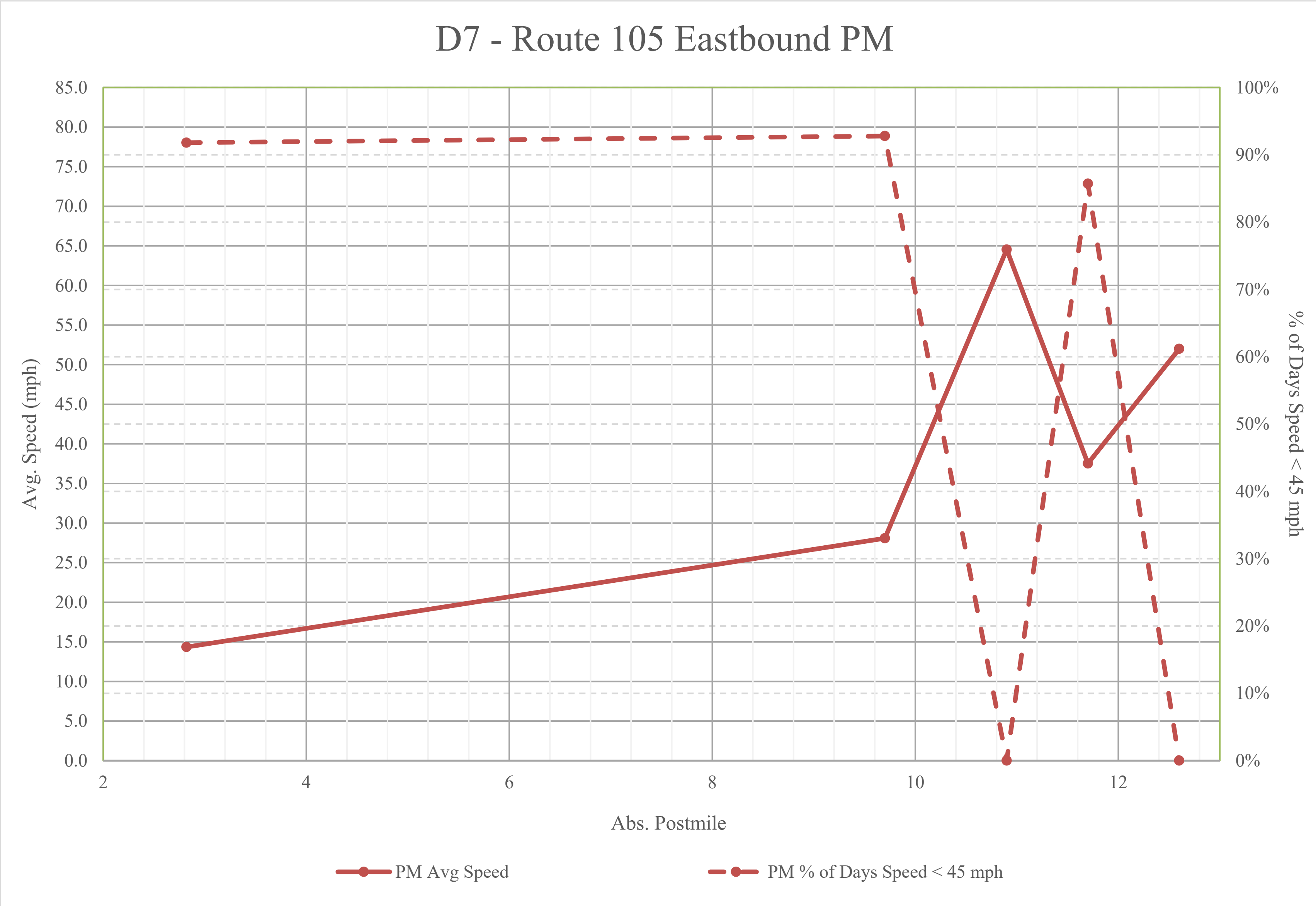


FIGURE 7.25 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 105, AM

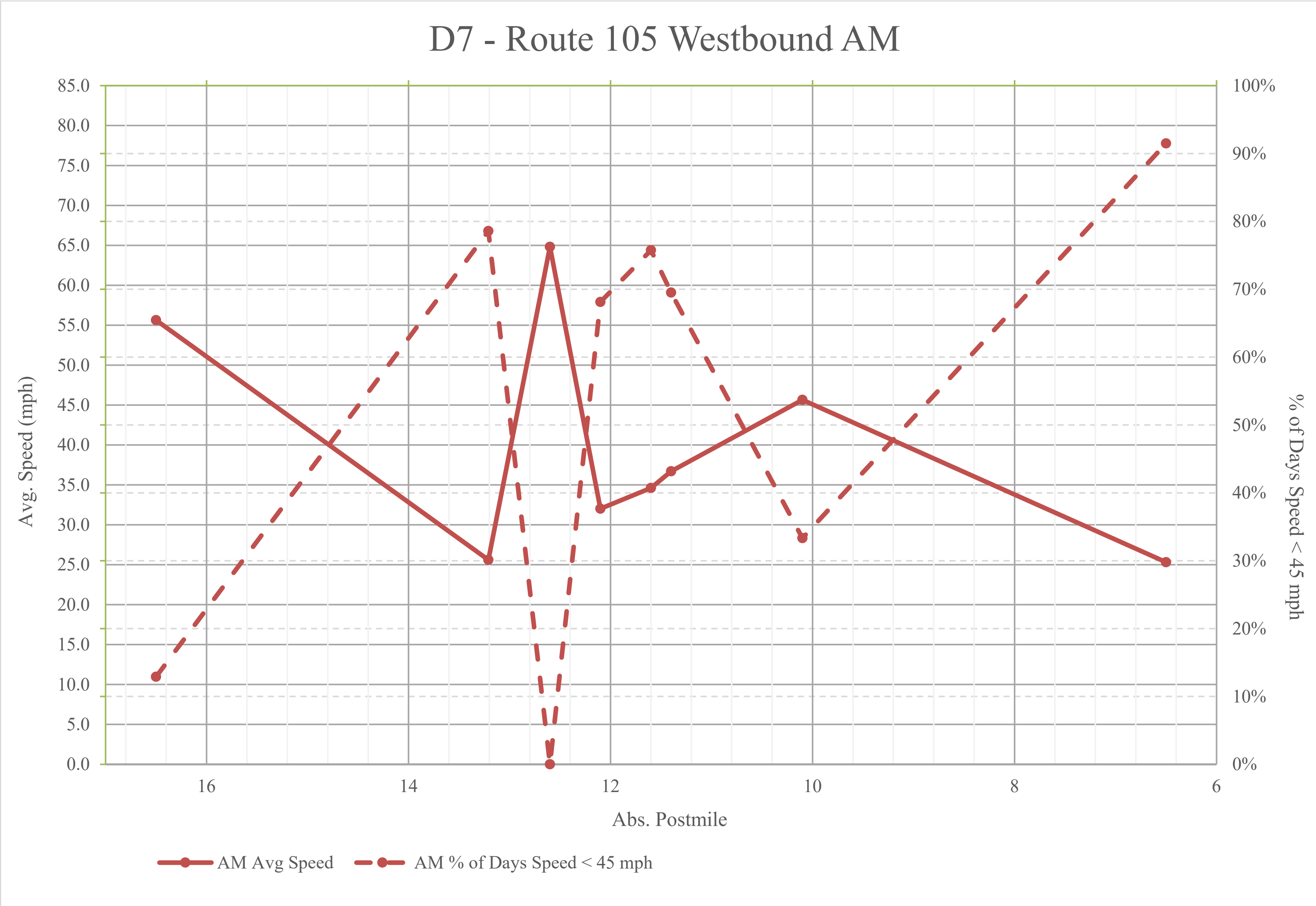


FIGURE 7.26 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 105, PM

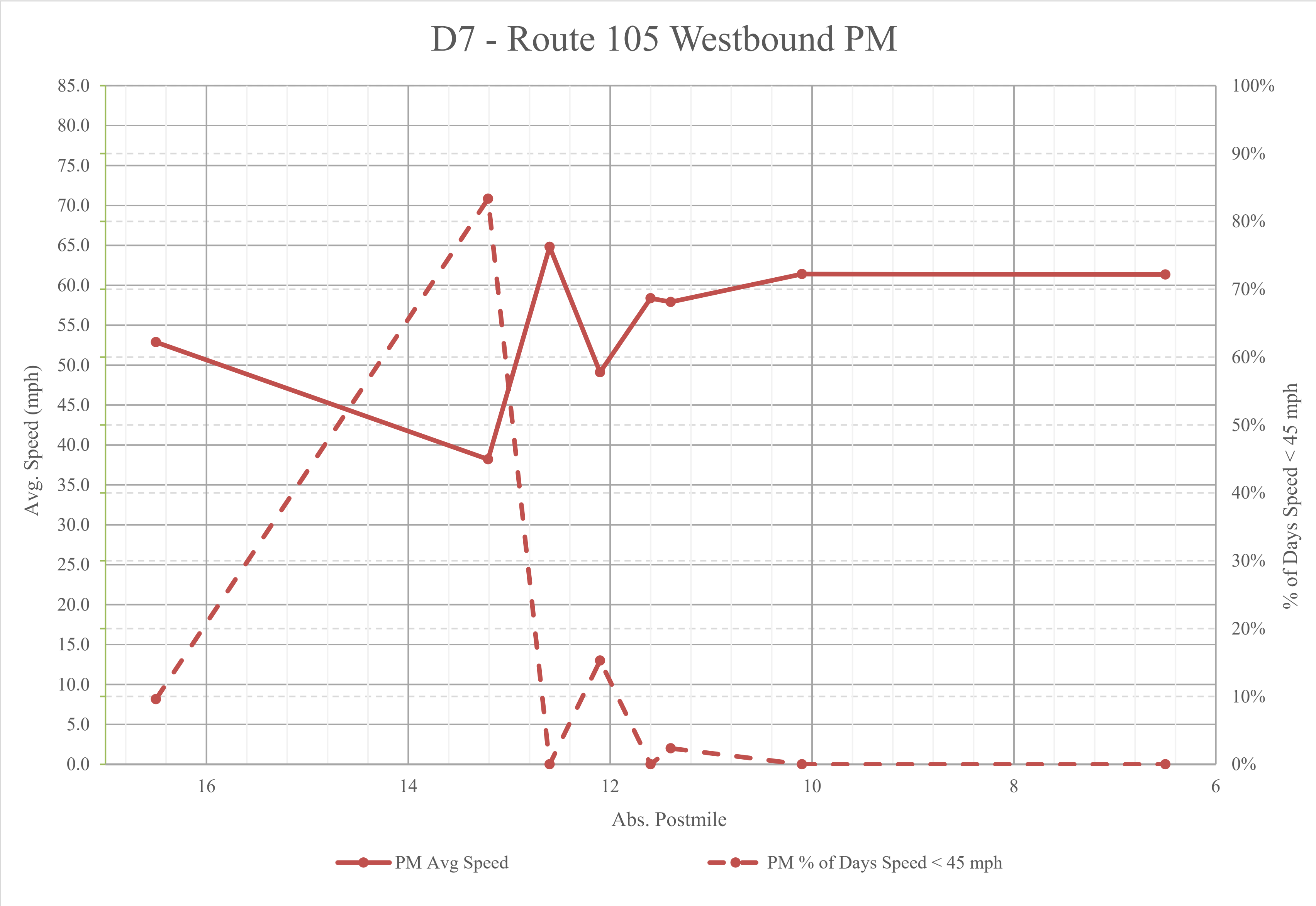


FIGURE 7.27 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 110, AM

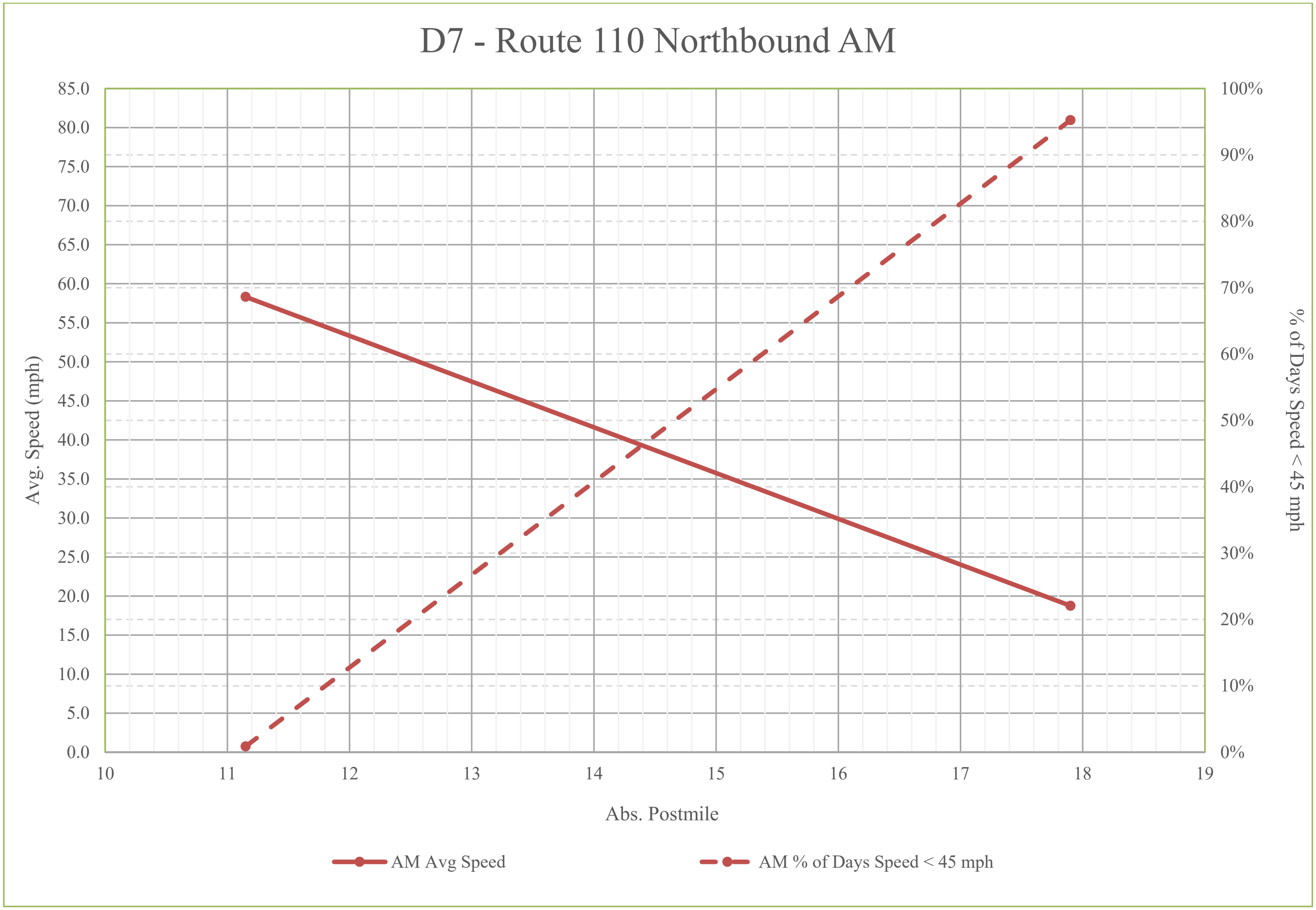


FIGURE 7.28 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 110, PM

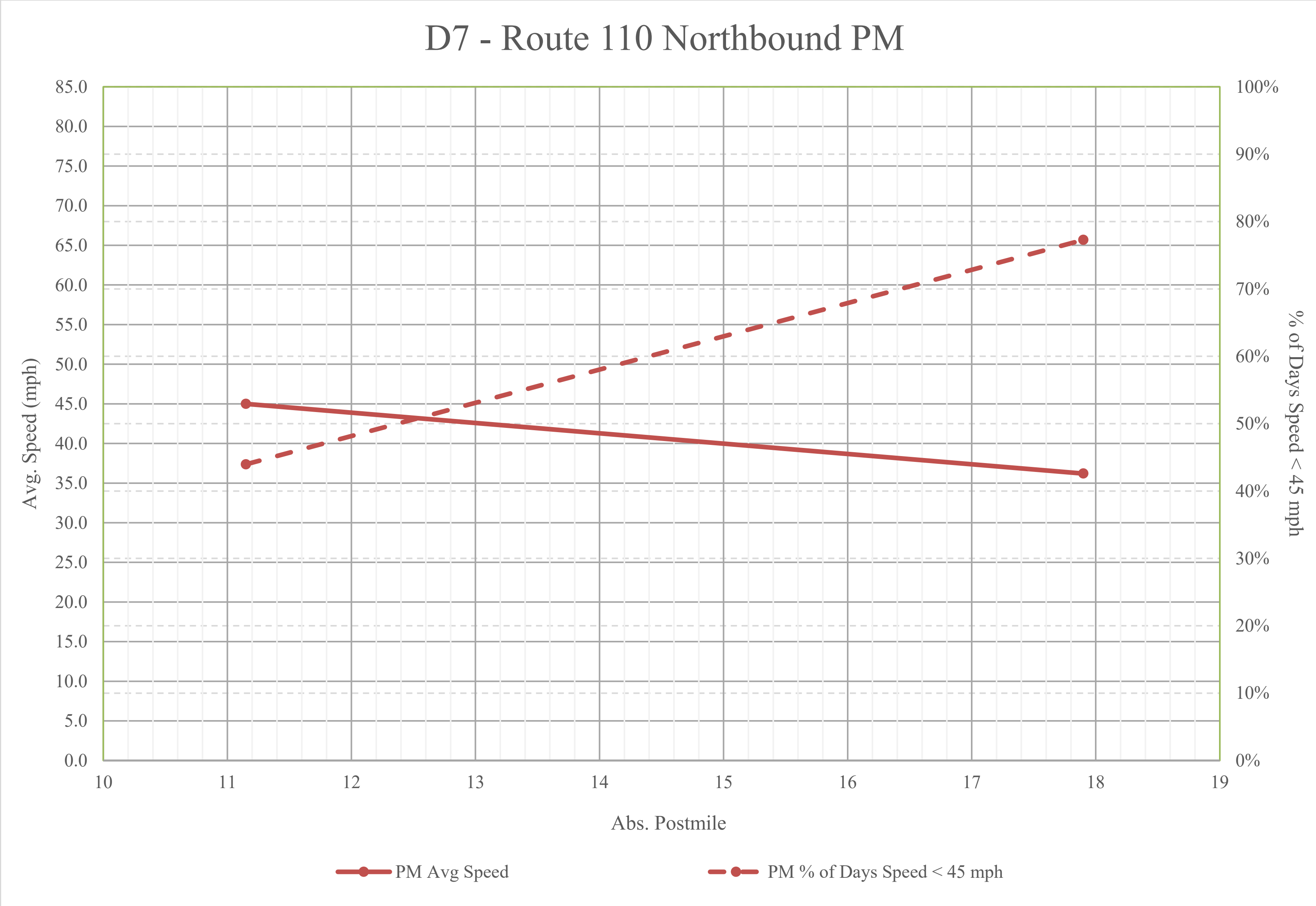


FIGURE 7.29 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 118, AM

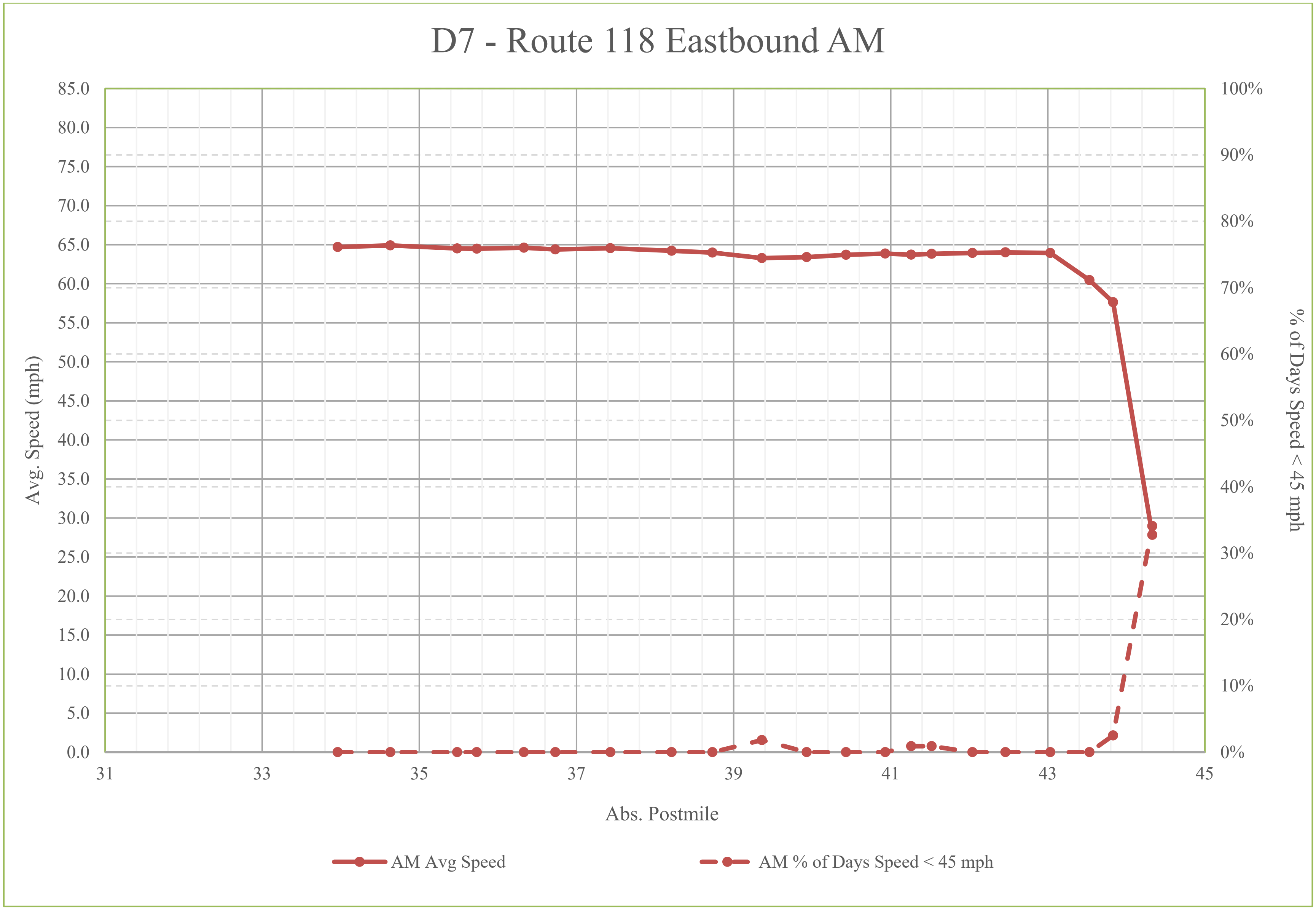


FIGURE 7.30 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 118, PM

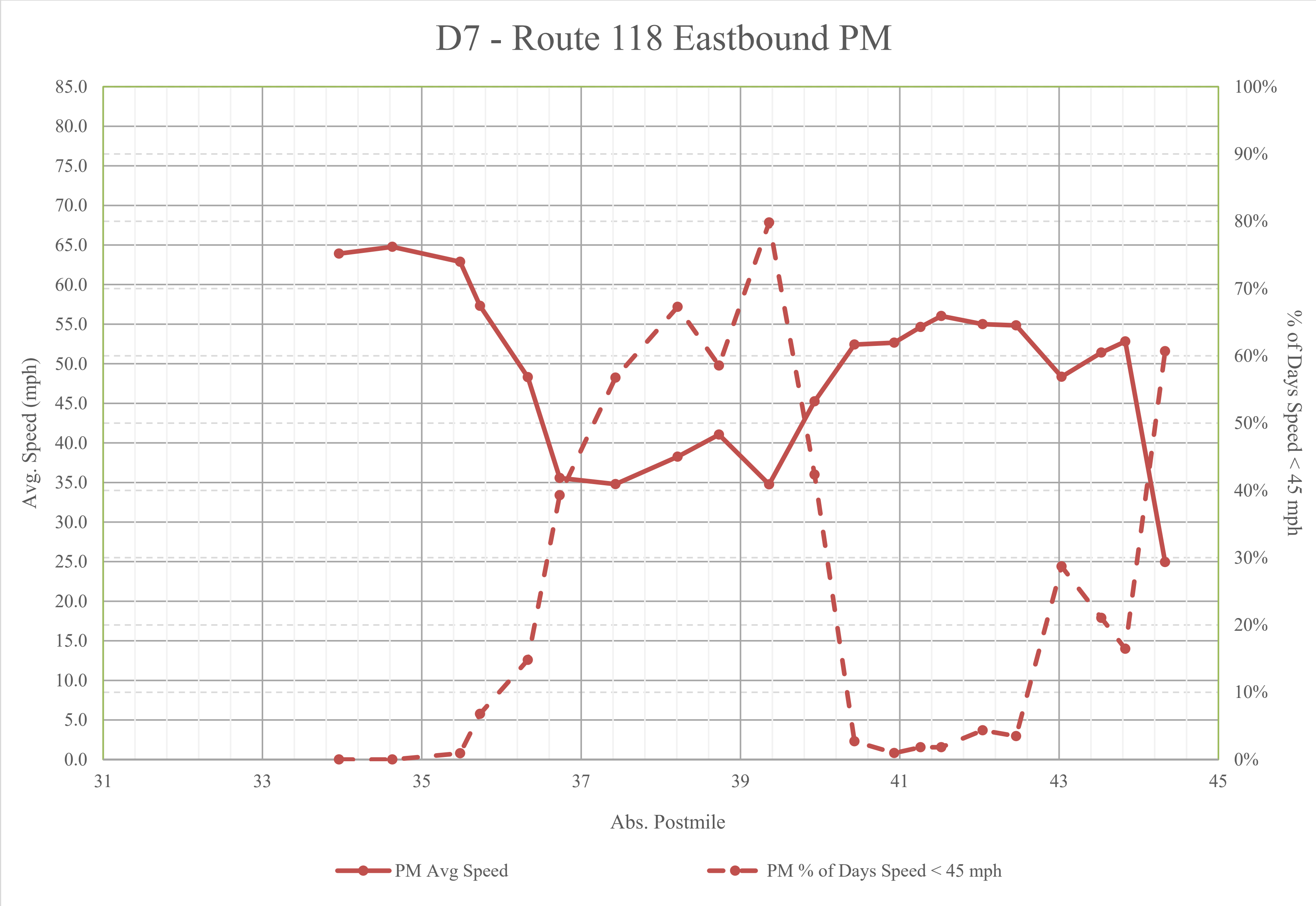


FIGURE 7.31 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 134 (a), PM

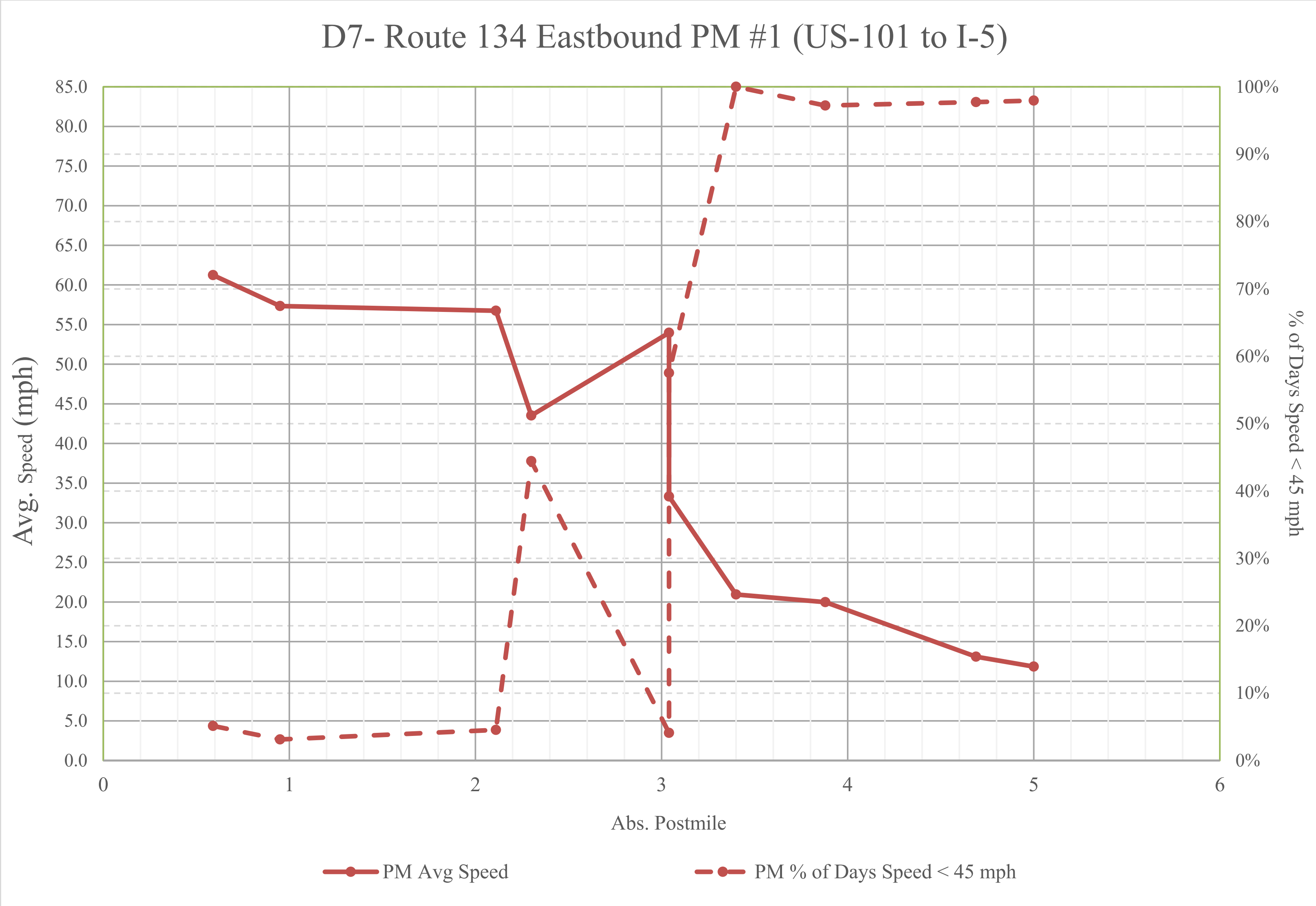


FIGURE 7.32 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 134 (b), AM

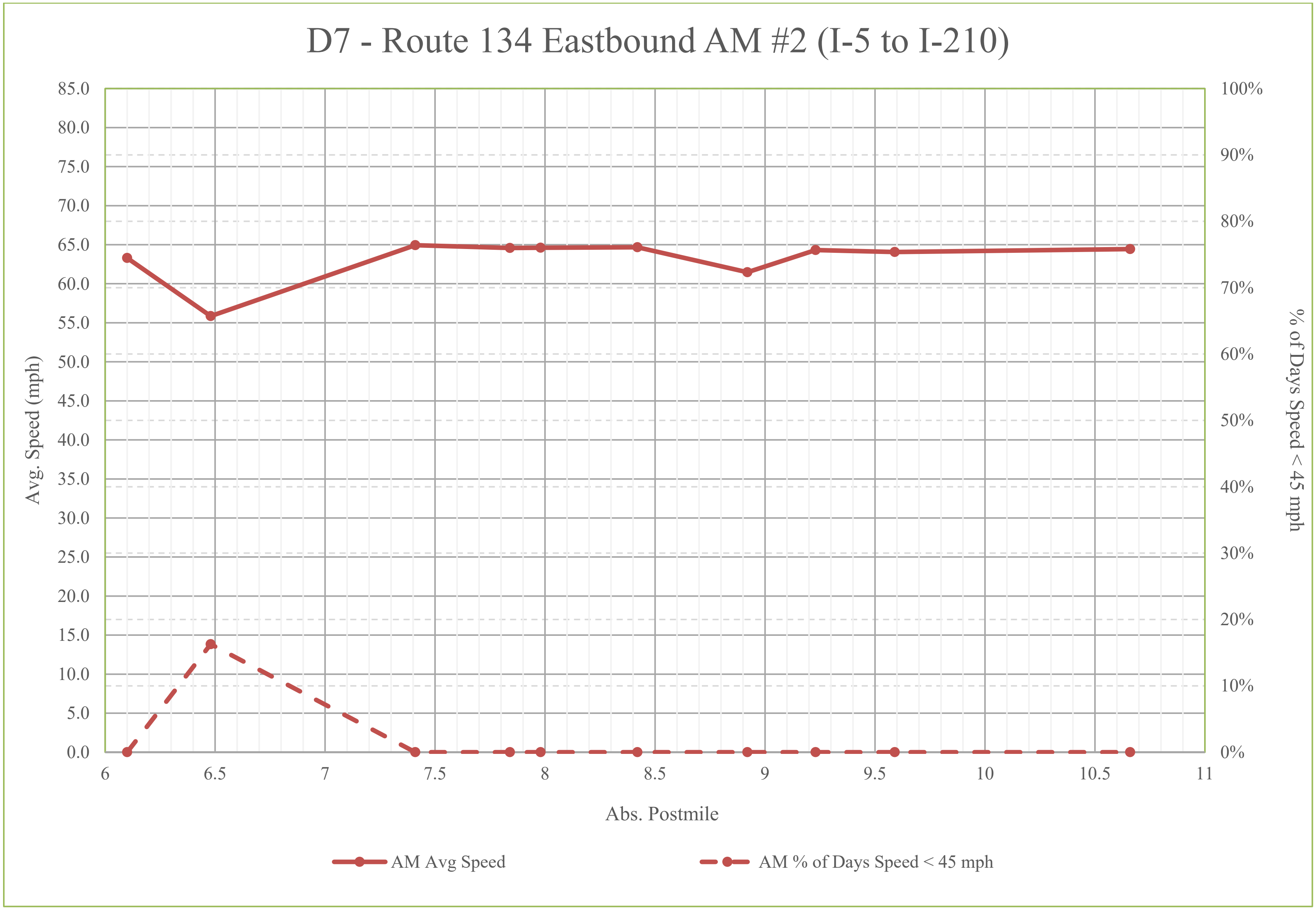


FIGURE 7.33 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 134 (b), PM

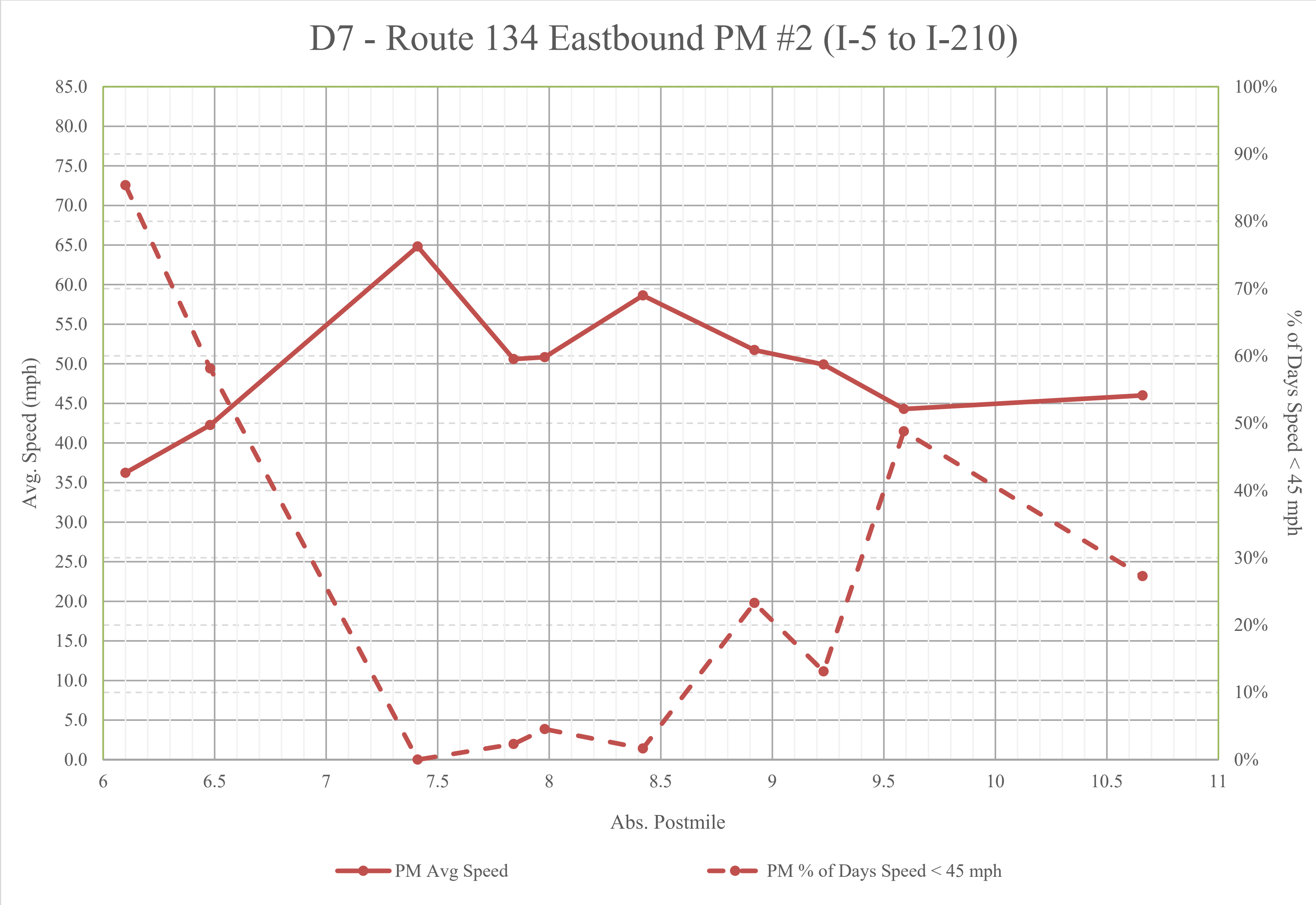


FIGURE 7.34 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 134 (a), PM

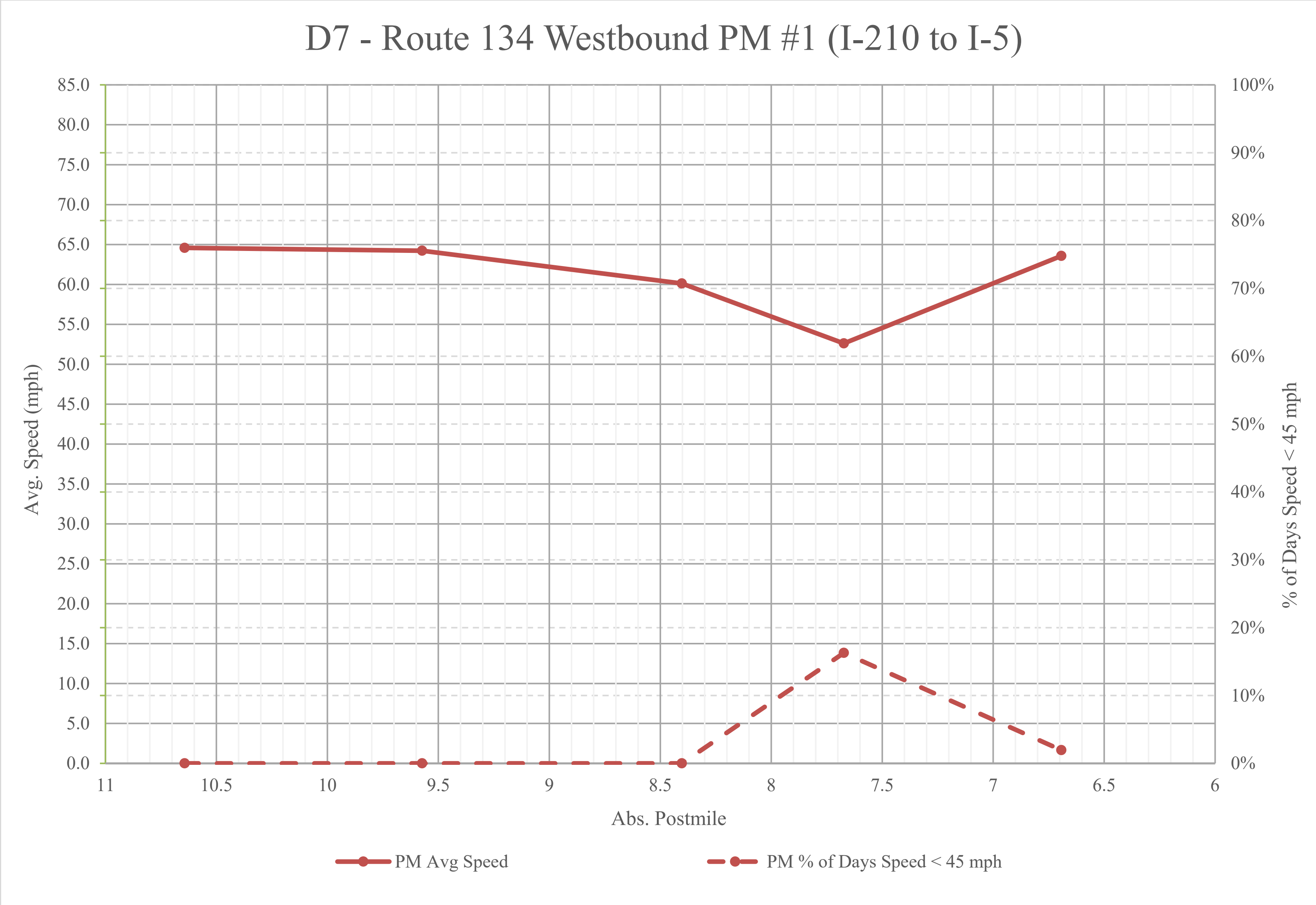


FIGURE 7.35 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 210, AM

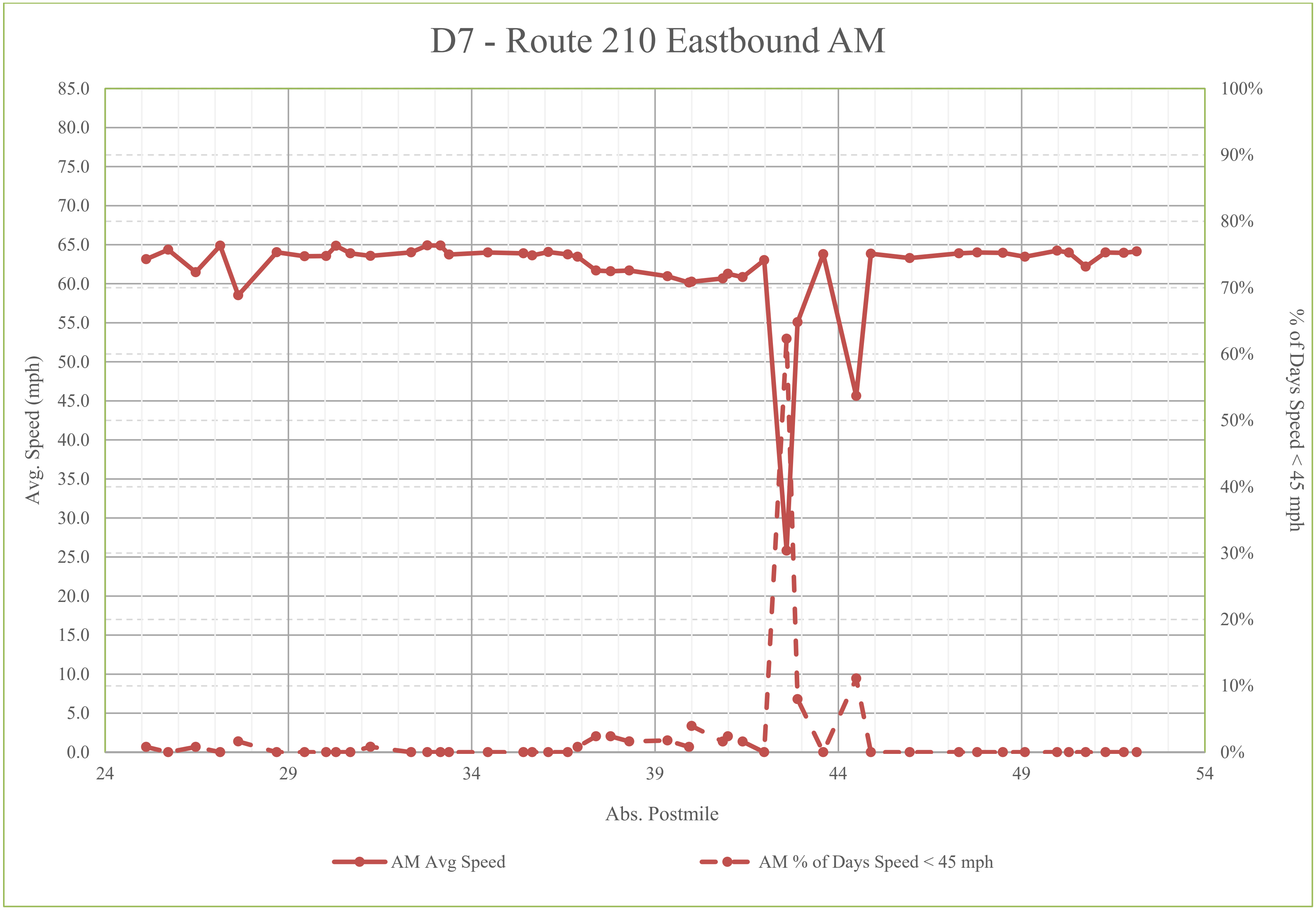


FIGURE 7.36 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 210, PM

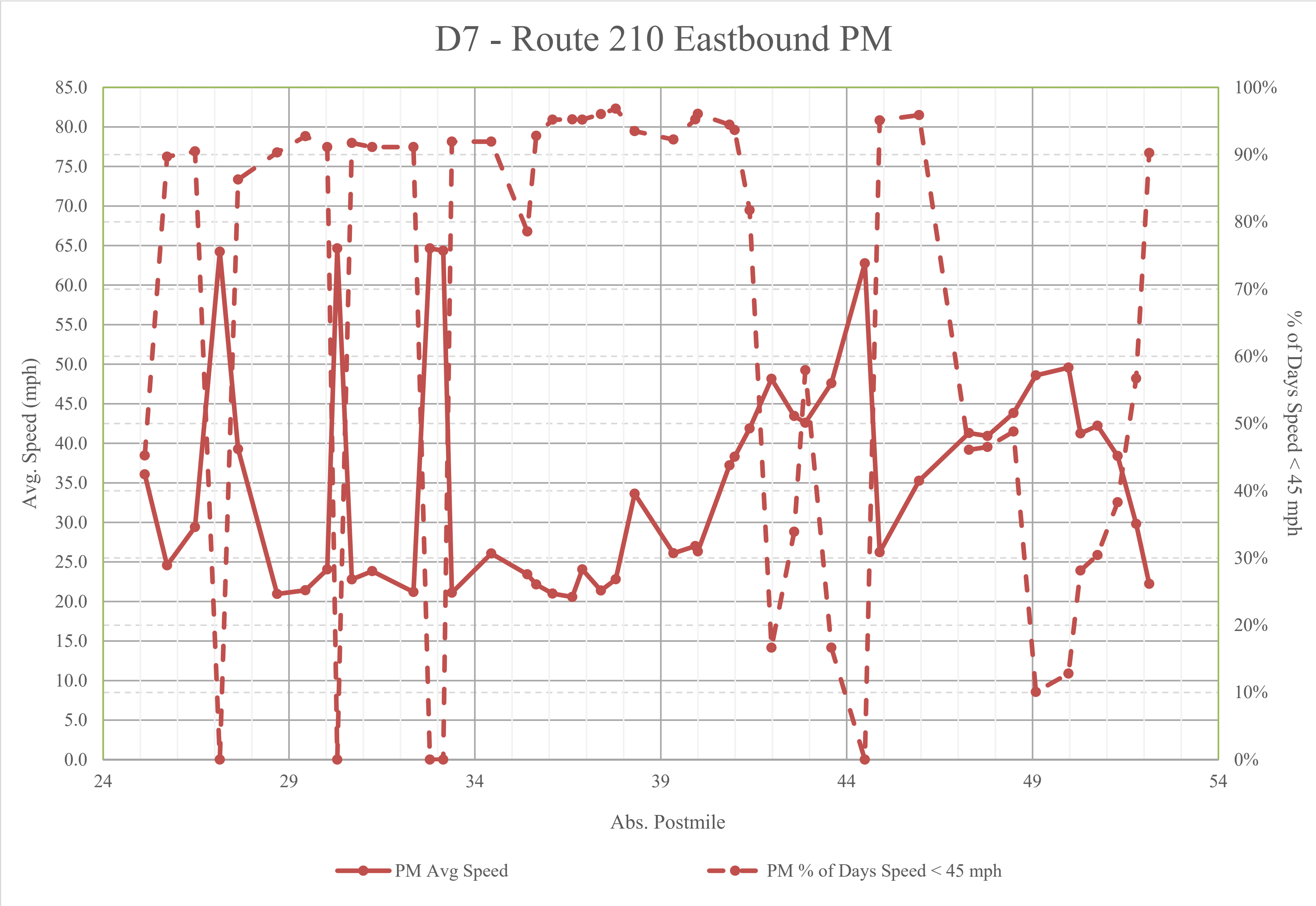


FIGURE 7.37 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 210, AM

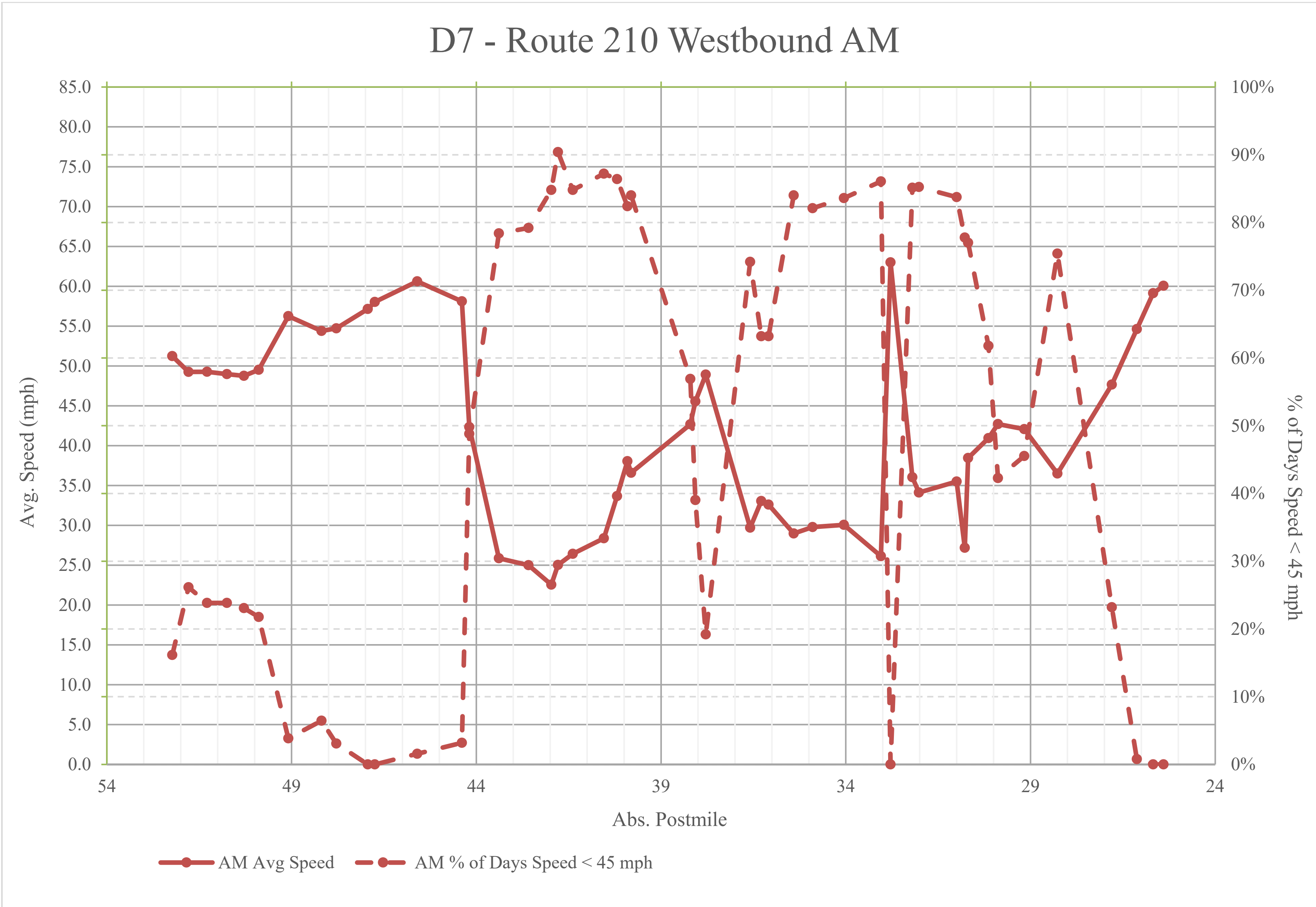


FIGURE 7.38 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 210, PM

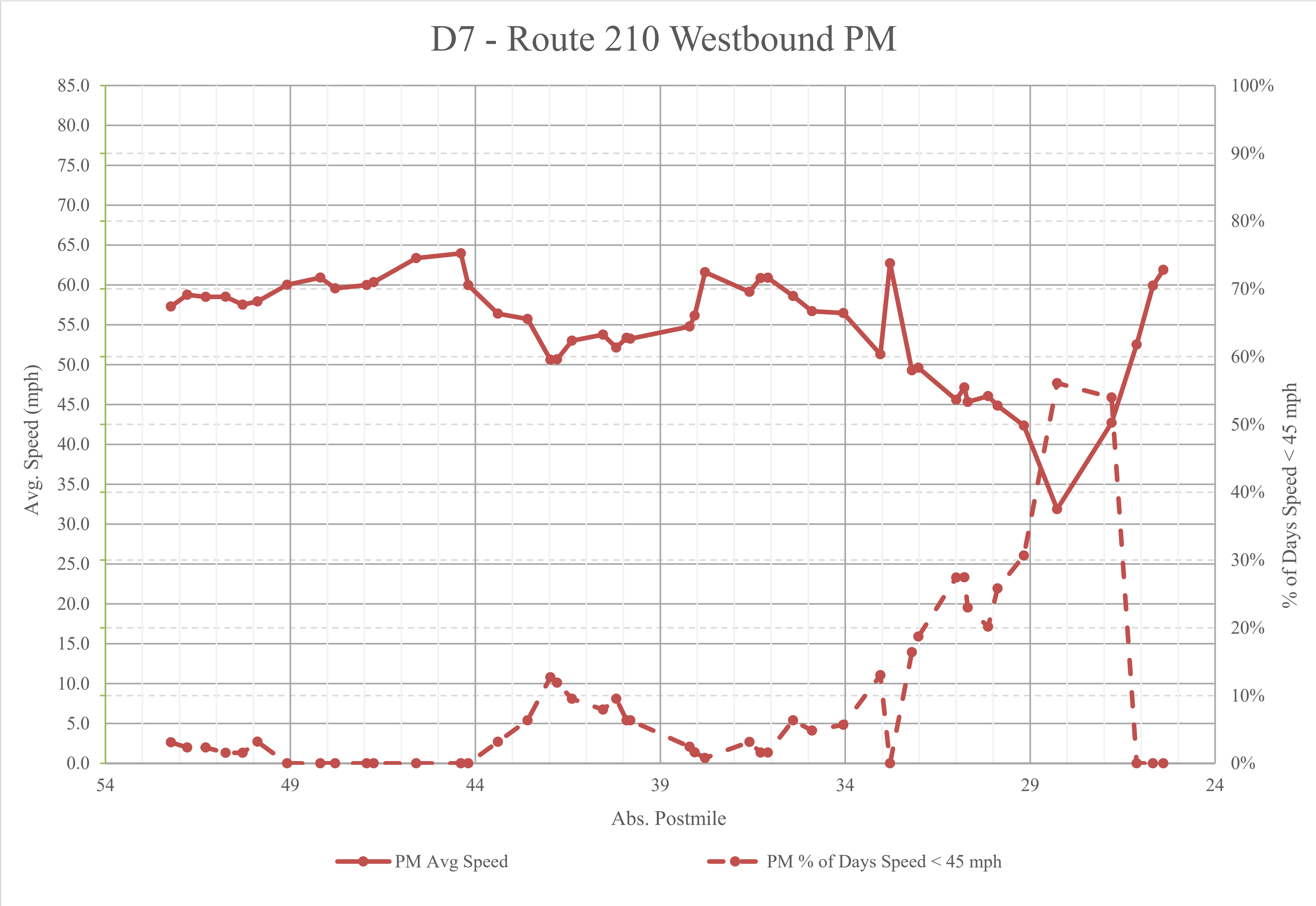


FIGURE 7.39 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 405 (a), AM

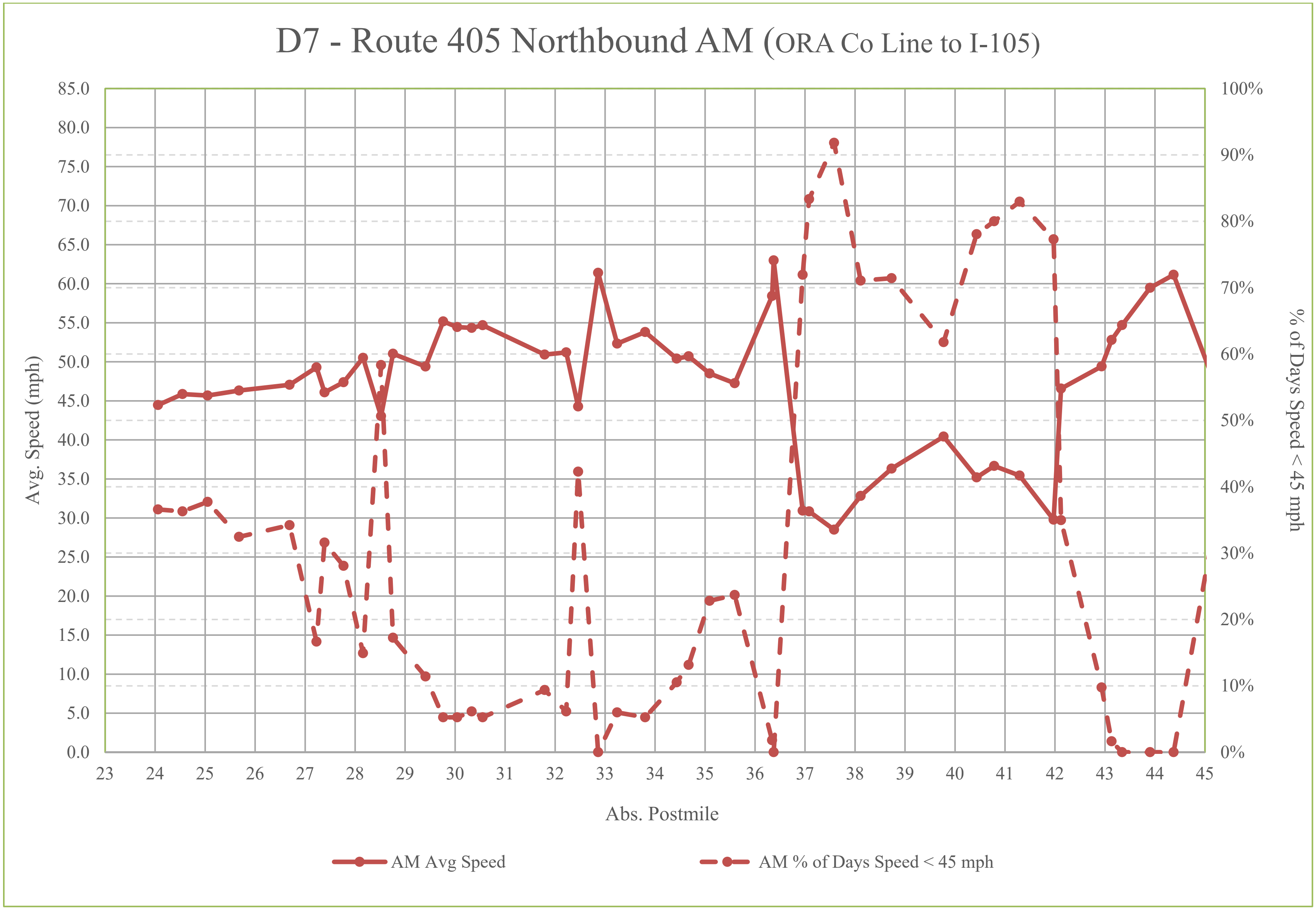


FIGURE 7.40 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 405 (b), AM

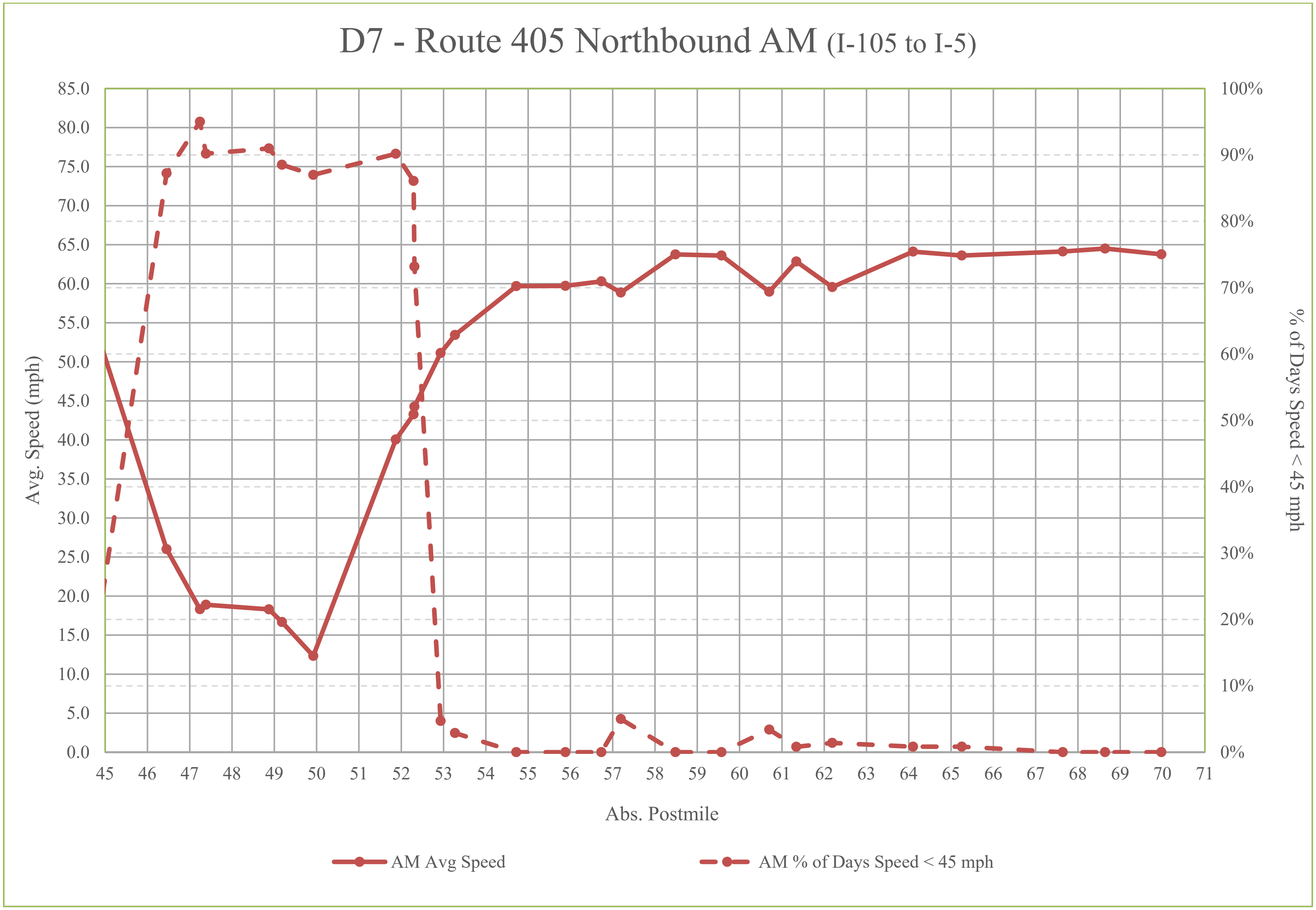


FIGURE 7.41 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 405 (a), PM

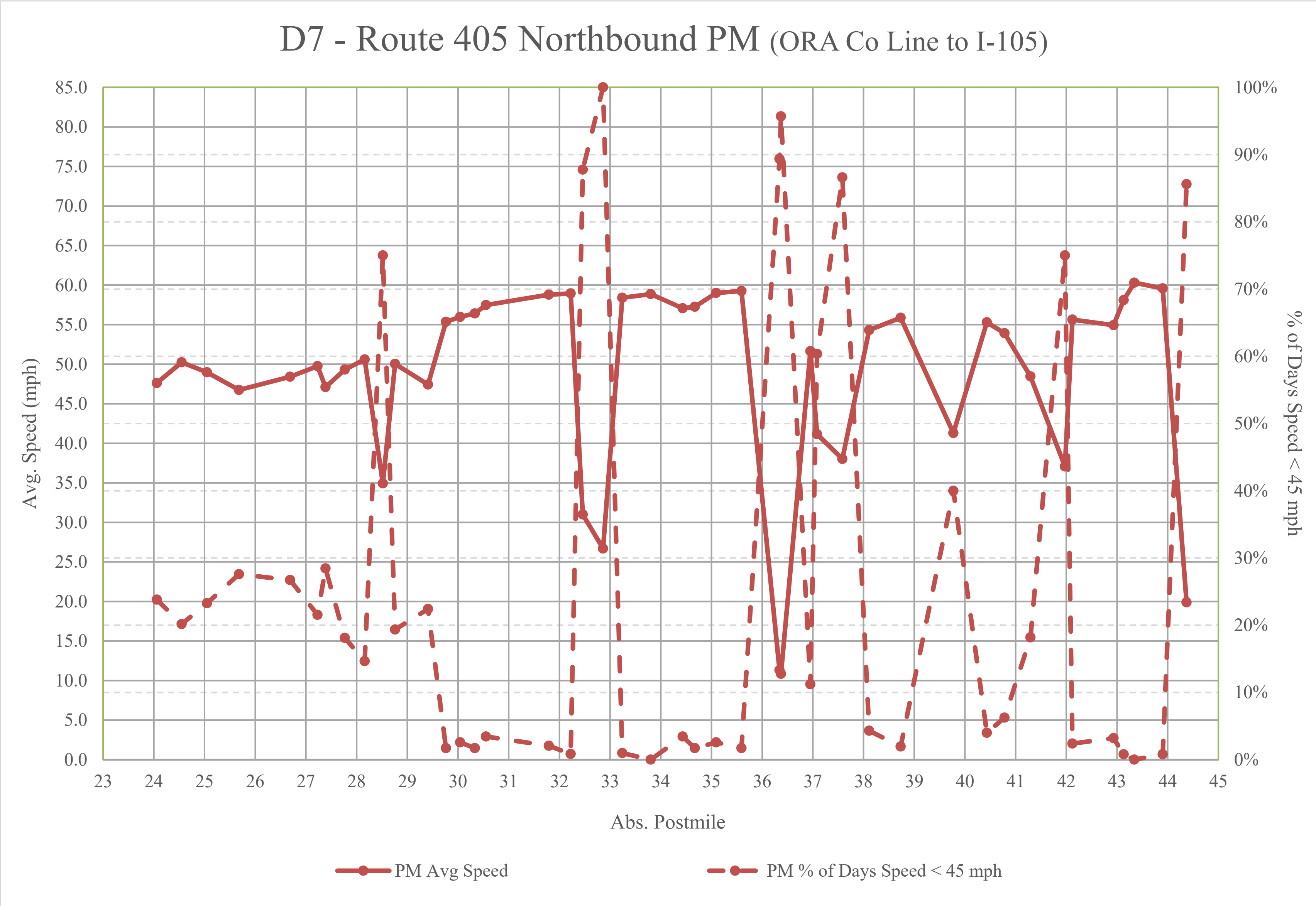


FIGURE 7.42 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 405 (b), PM

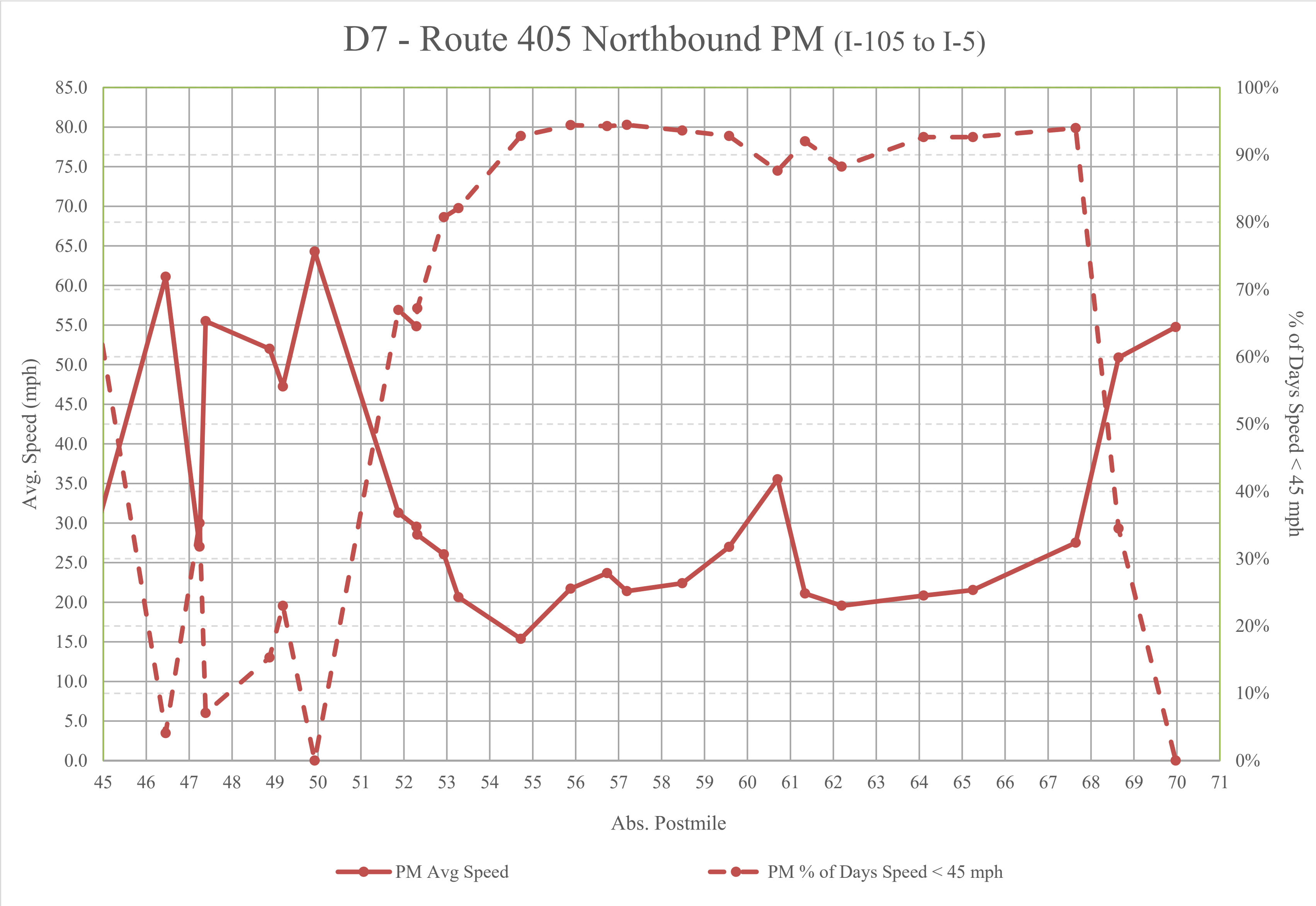


FIGURE 7.43 SPEED AND DEGRADATION PROFILE – SOUTHBOUND ROUTE 405 (a), AM

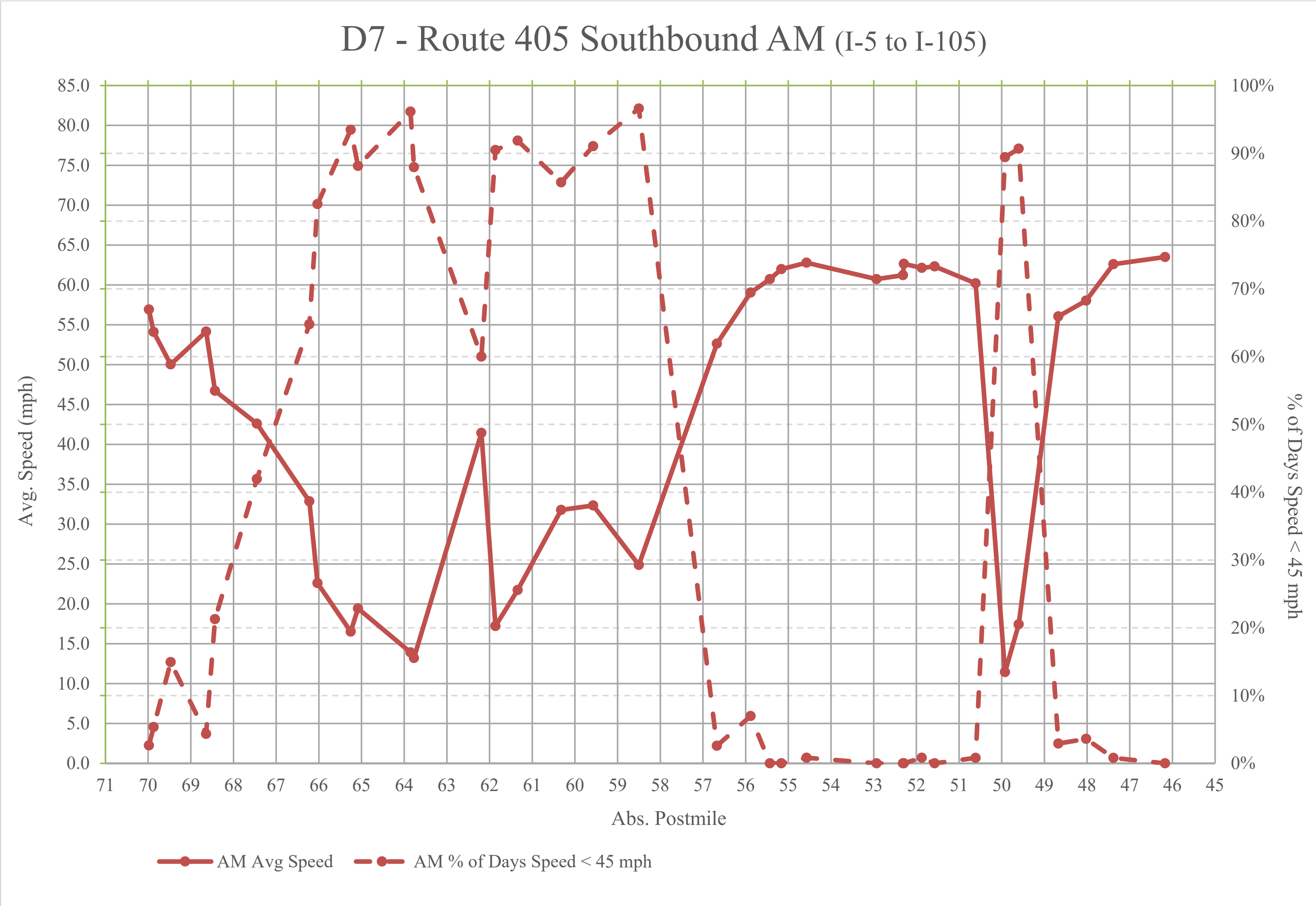


FIGURE 7.44 SPEED AND DEGRADATION PROFILE – SOUTHBOUND ROUTE 405 (b), AM

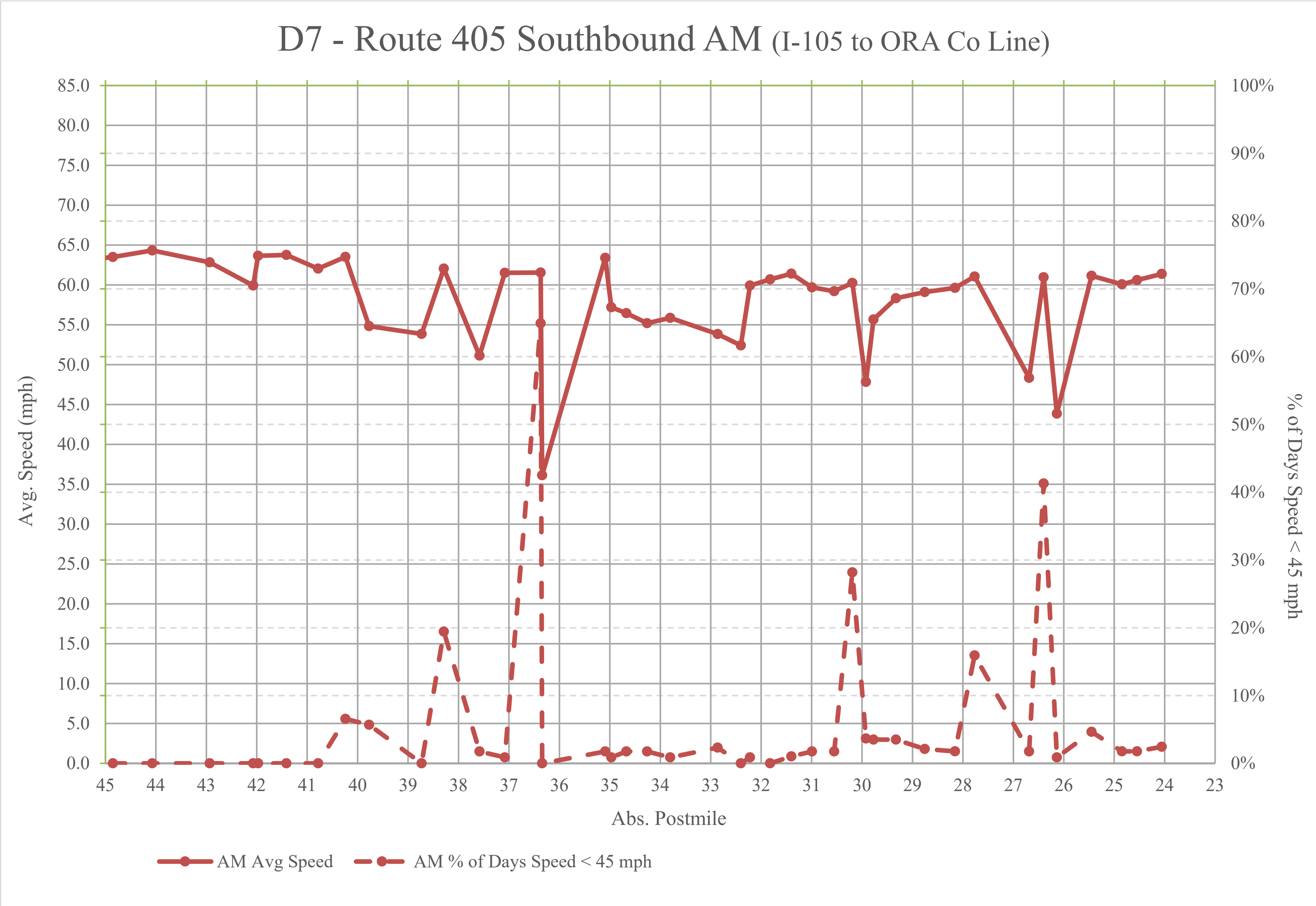


FIGURE 7.45 SPEED AND DEGRADATION PROFILE – SOUTHBOUND ROUTE 405 (a), PM

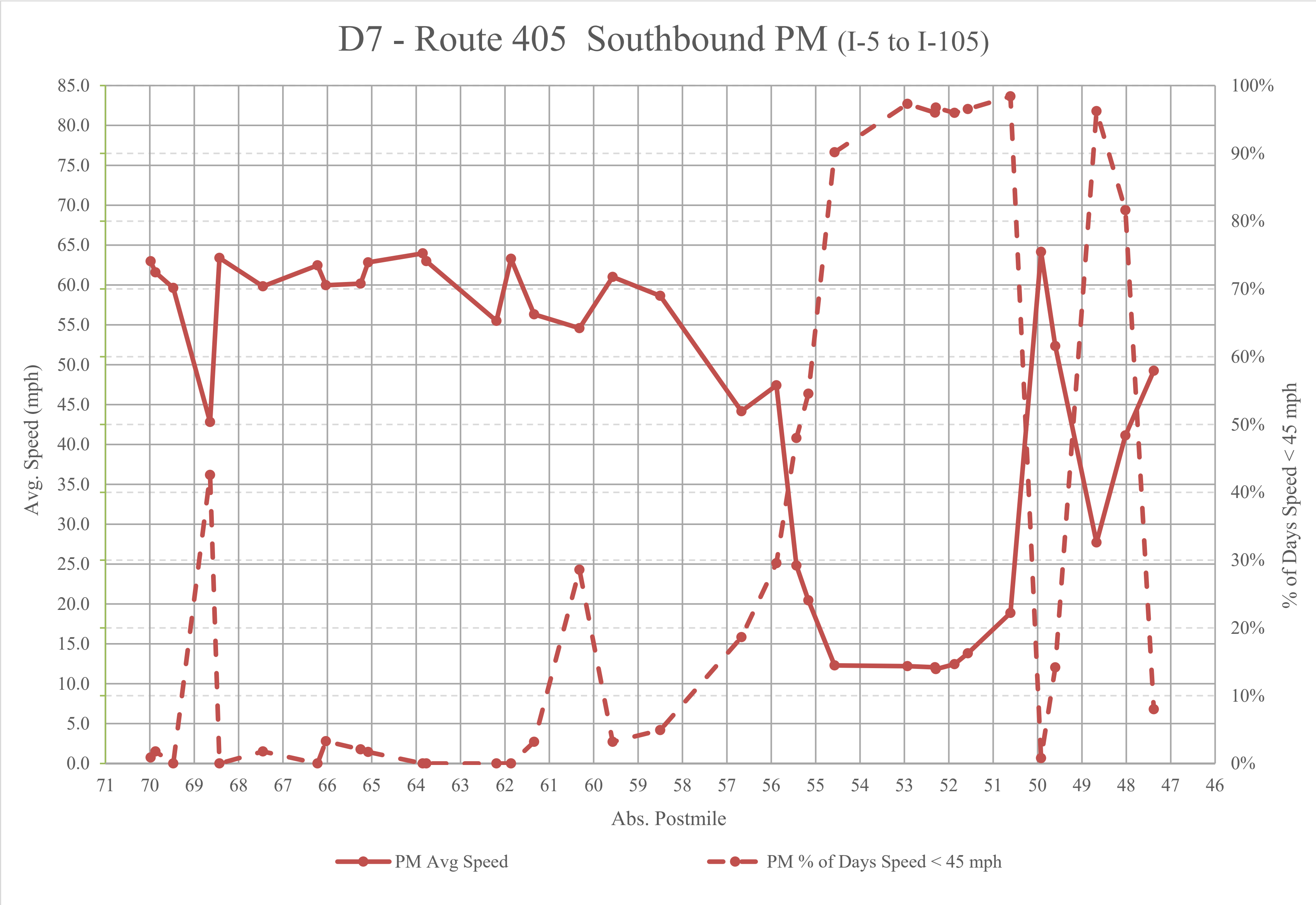


FIGURE 7.46 SPEED AND DEGRADATION PROFILE – SOUTHBOUND ROUTE 405 (b), PM

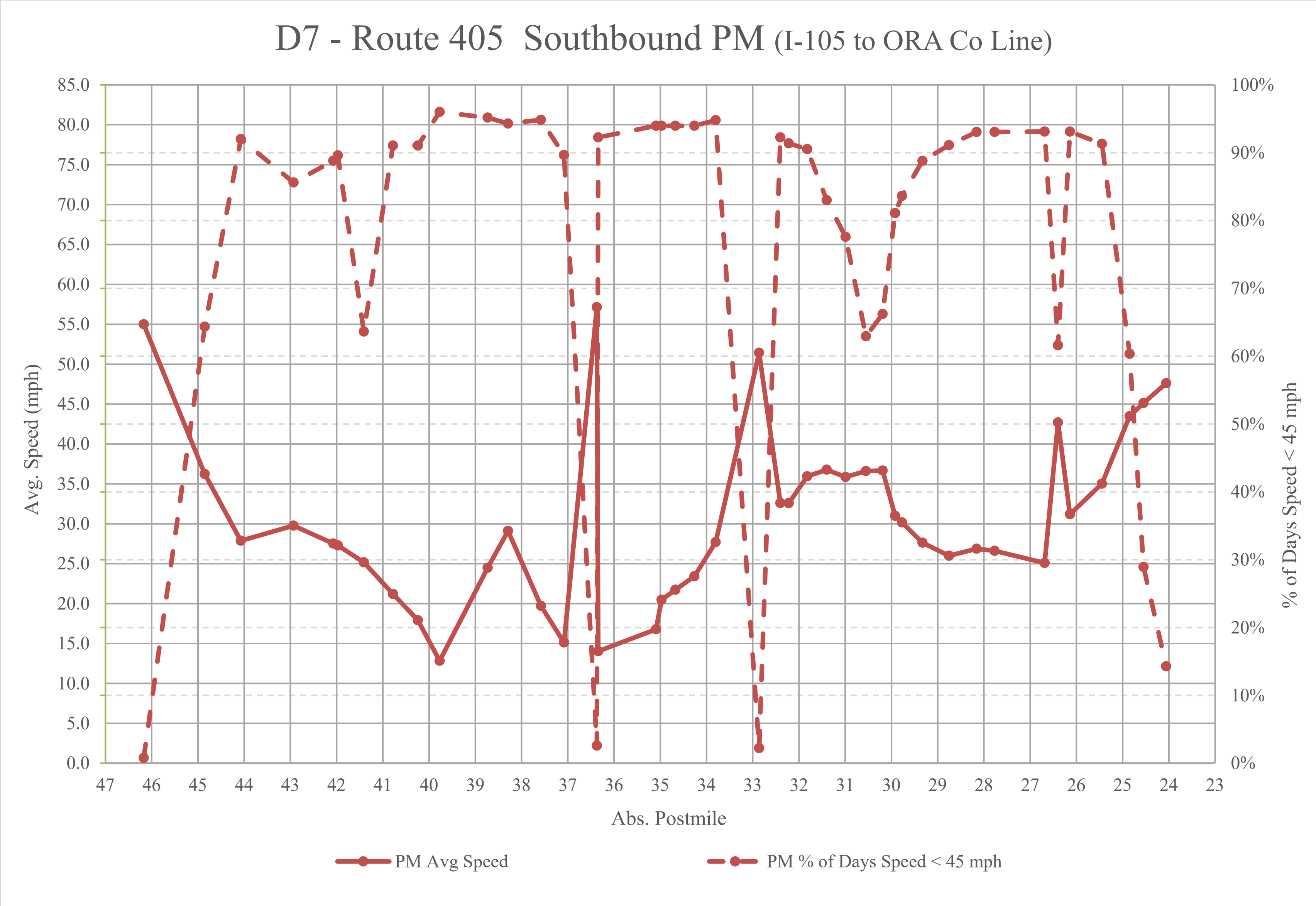


FIGURE 7.47 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 605, AM

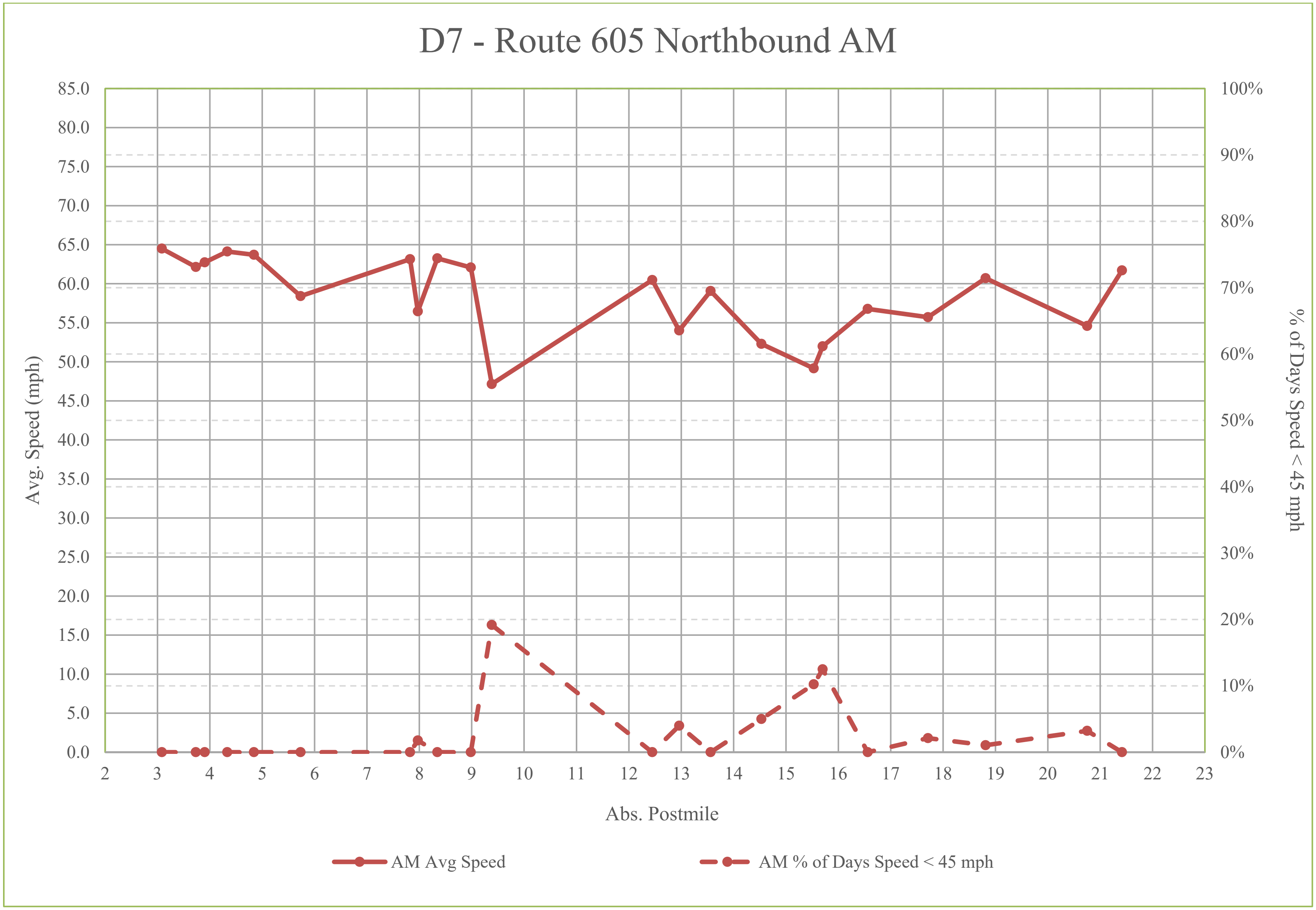


FIGURE 7.48 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 605, PM

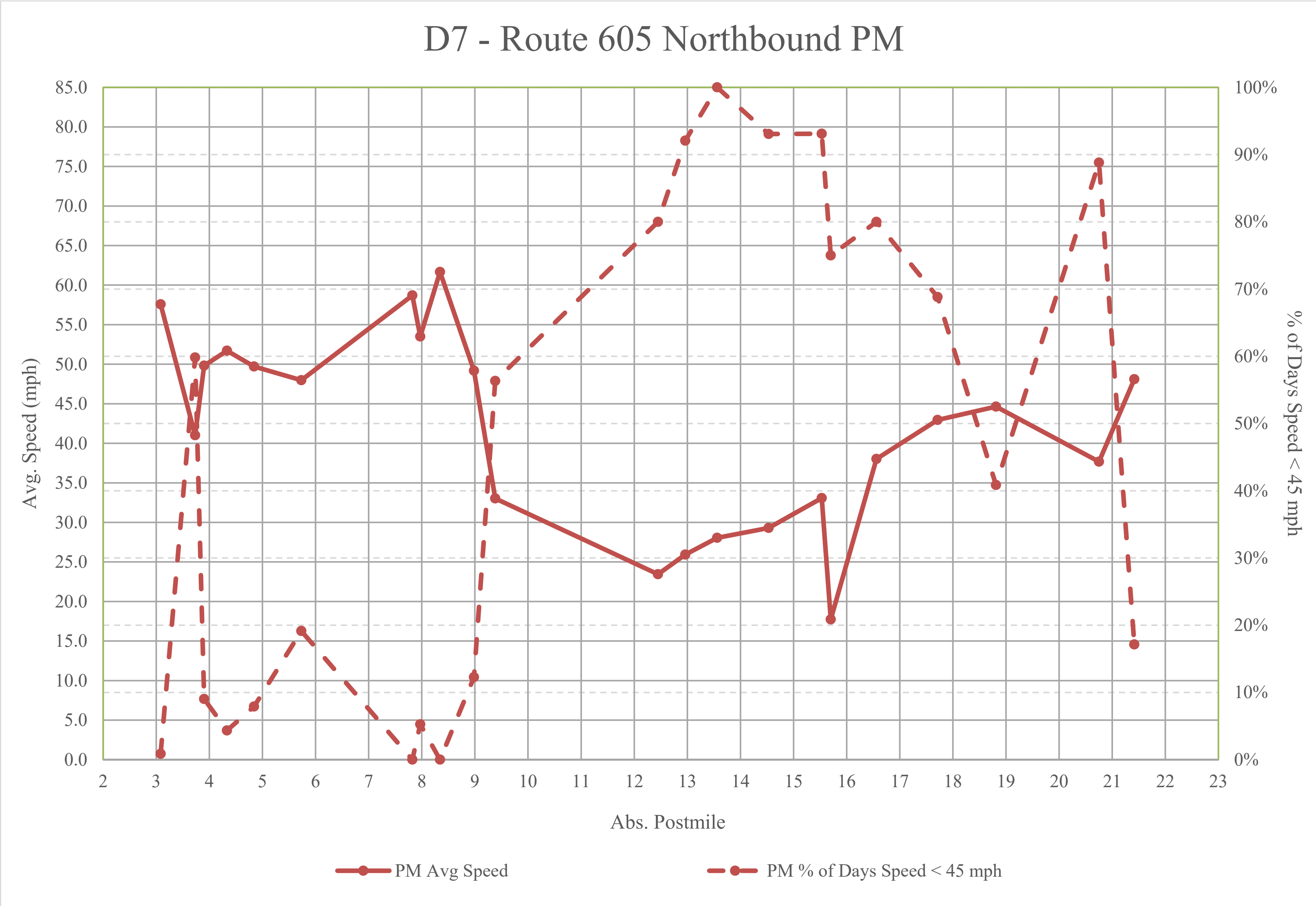


FIGURE 7.49 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 605, AM

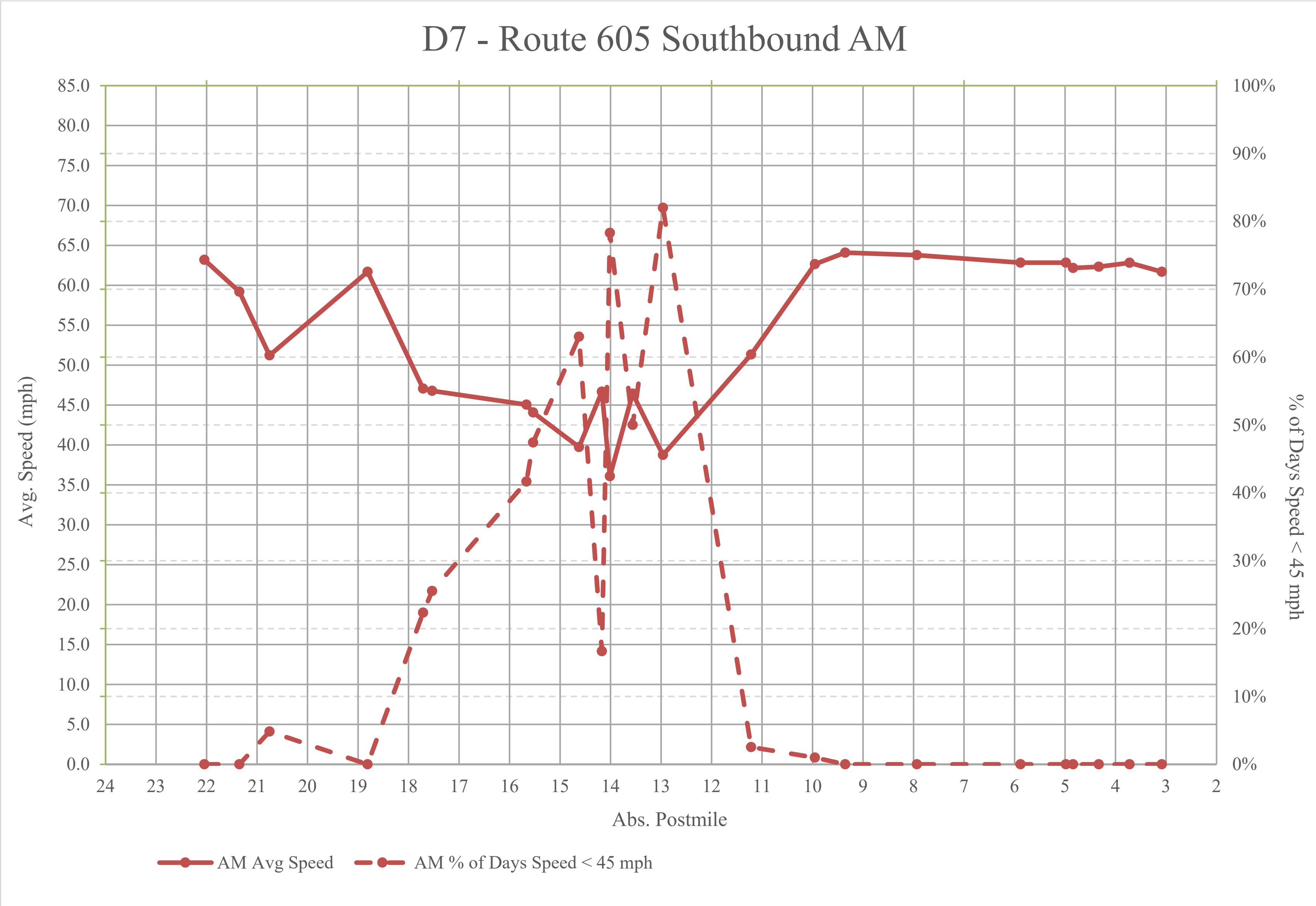


FIGURE 7.50 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 605, PM

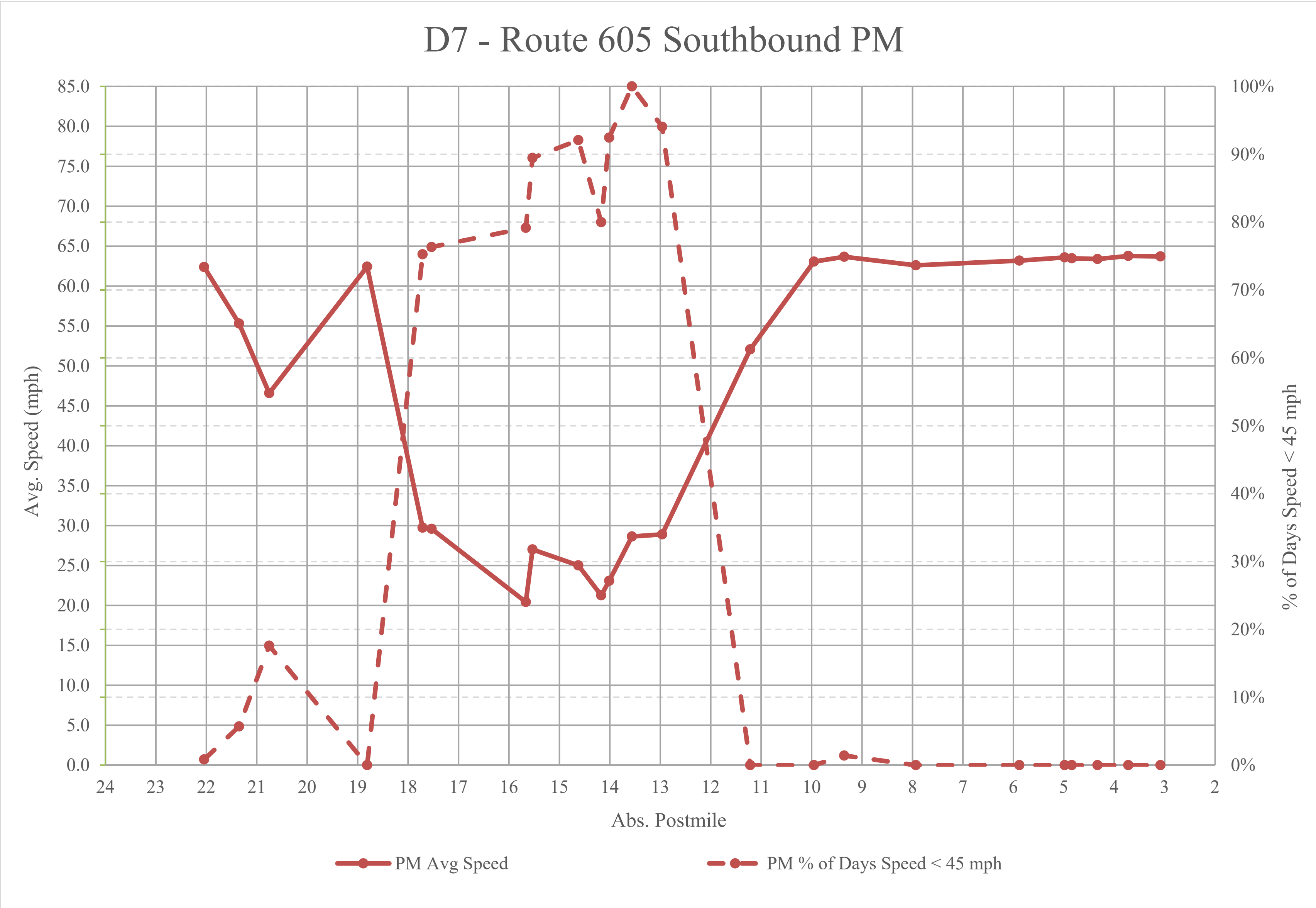


FIGURE 8.1 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 10, AM

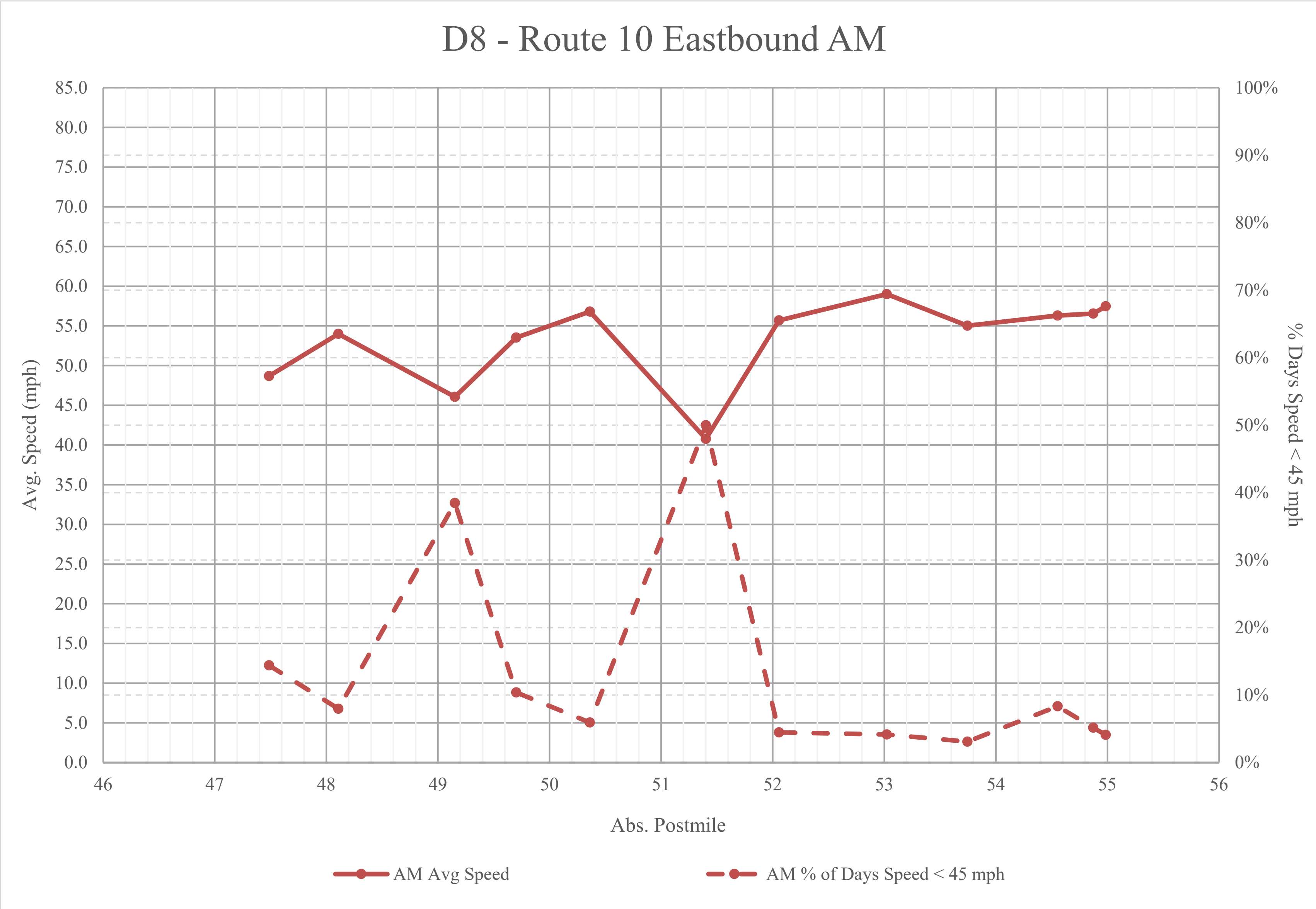


FIGURE 8.2 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 10, PM

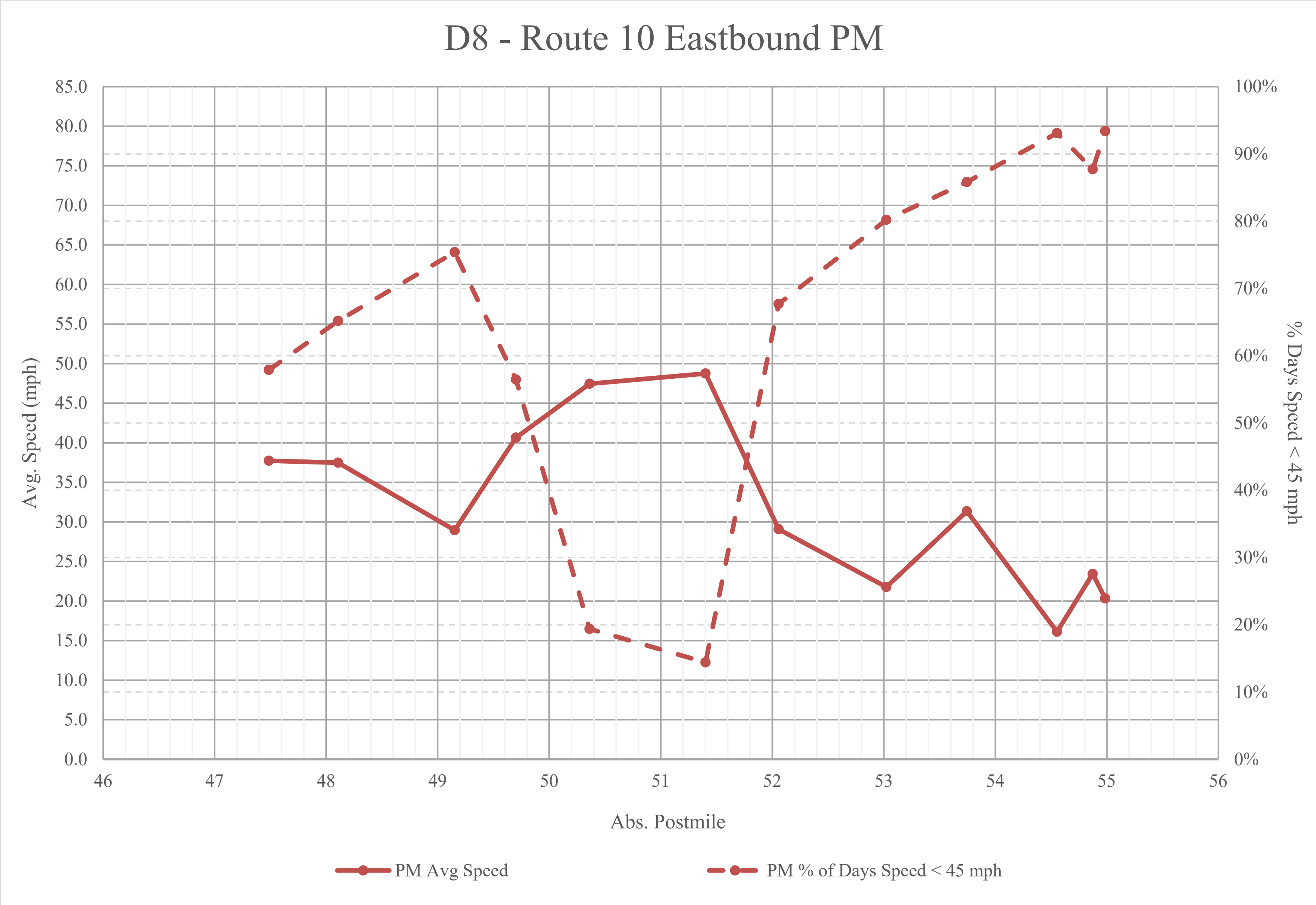


FIGURE 8.3 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 10, AM

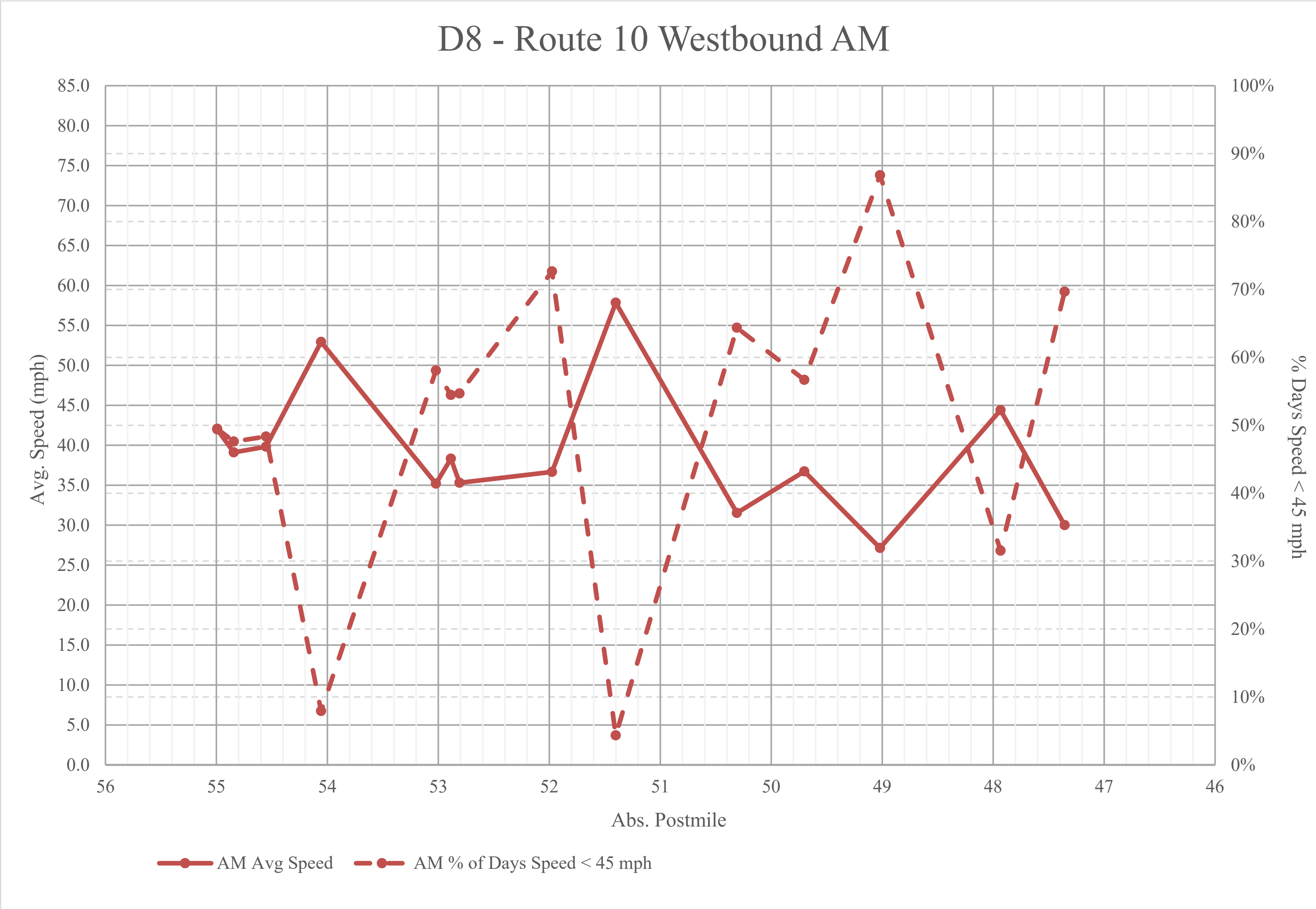


FIGURE 8.4 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 10, PM

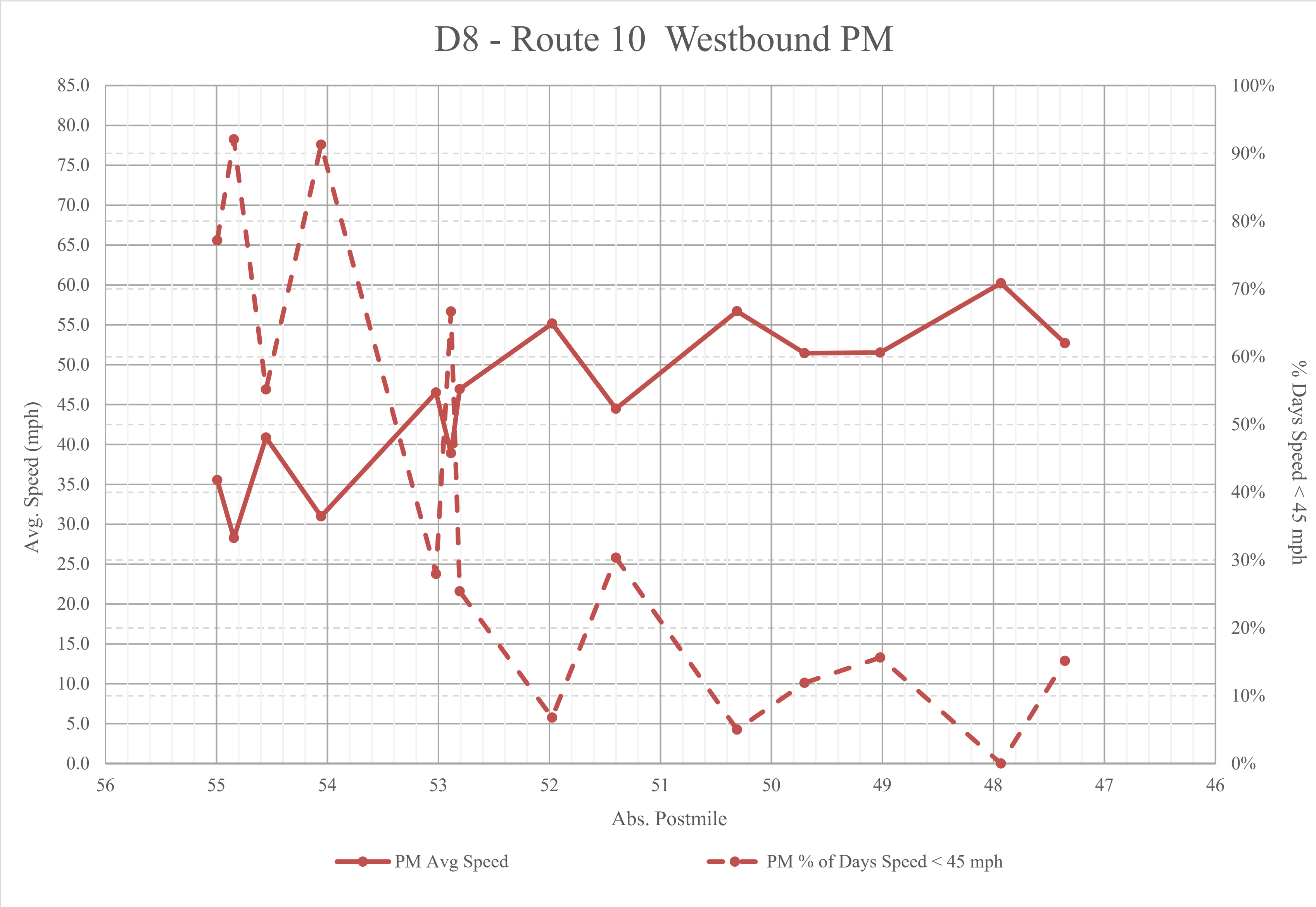


FIGURE 8.5 SPEED AND DEGRADATION PROFILE – NORTHBOUND ROUTE 15, AM

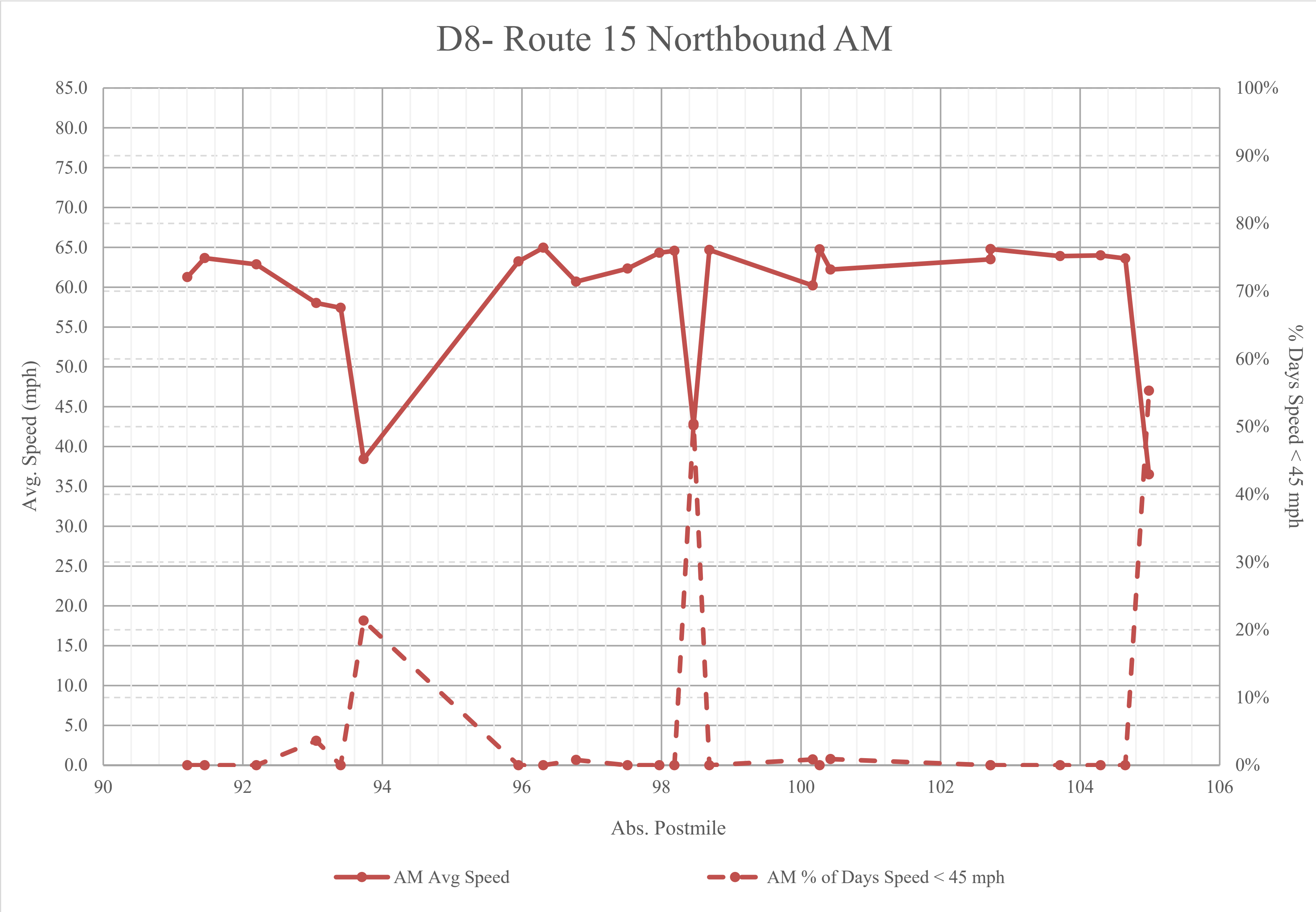


FIGURE 8.6 SPEED AND DEGRADATION PROFILE – NORTHBOUND ROUTE 15, PM

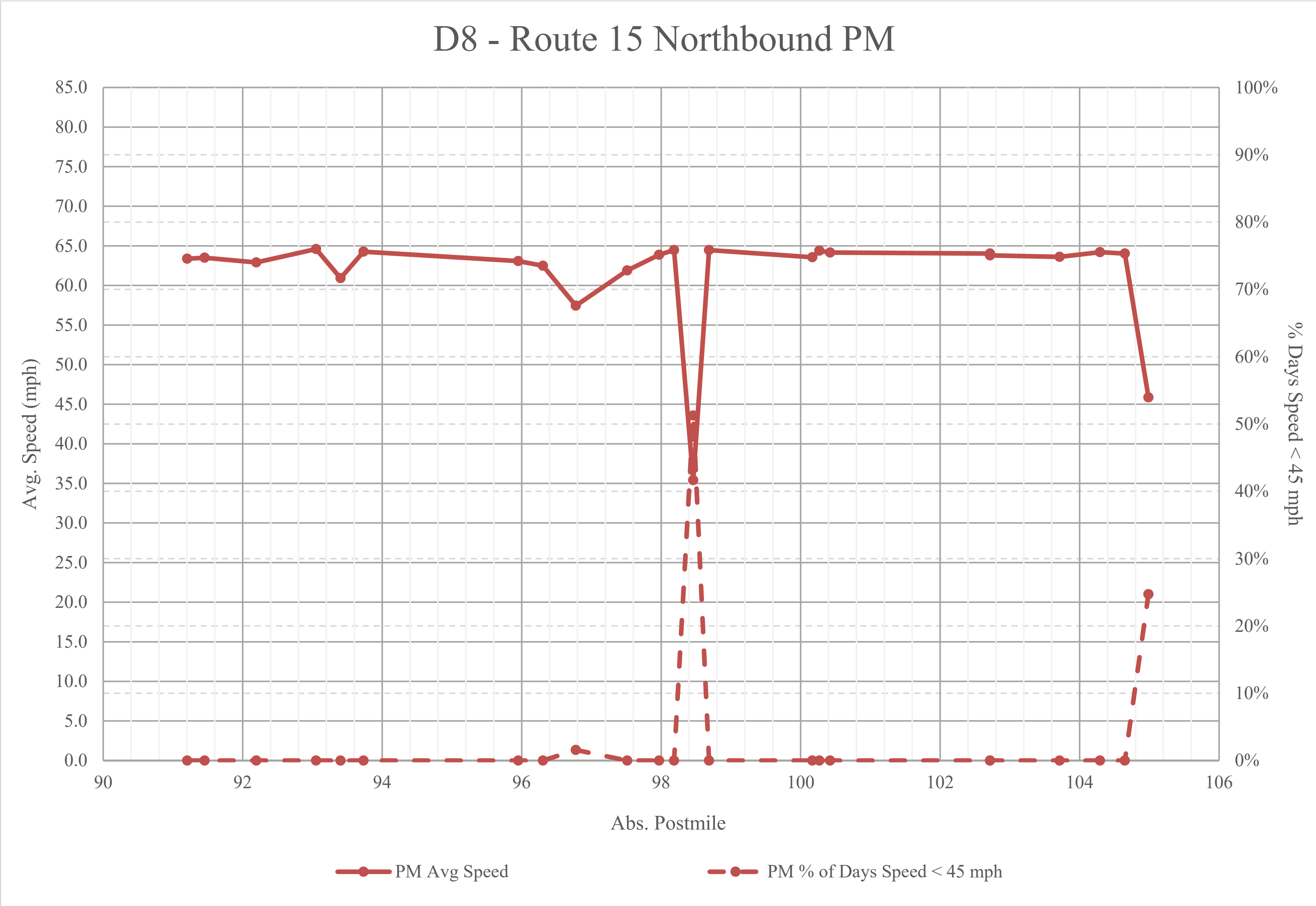


FIGURE 8.7 SPEED AND DEGRADATION PROFILE – SOUTHBOUND ROUTE 15, PM

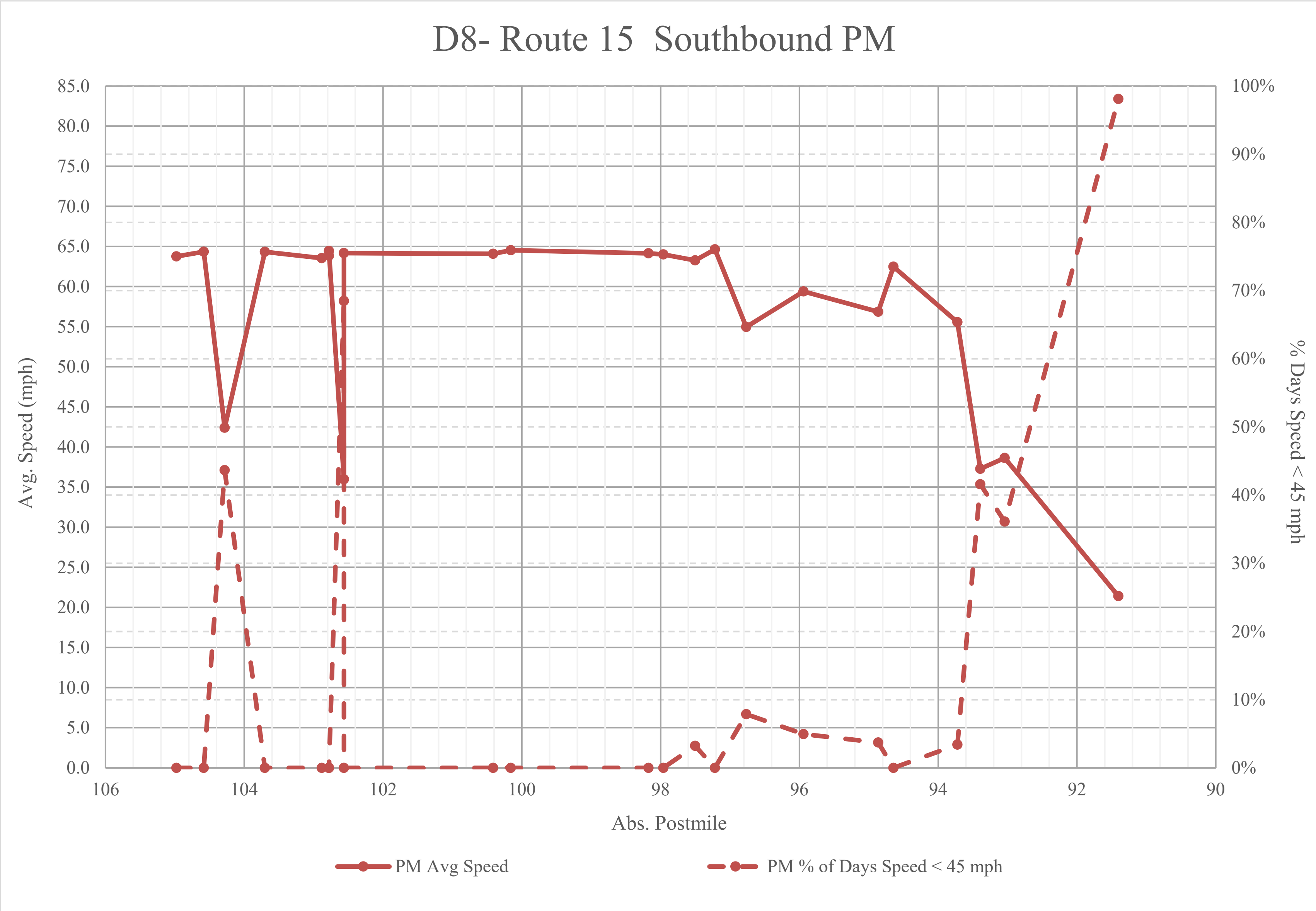


FIGURE 8.8 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 60, AM

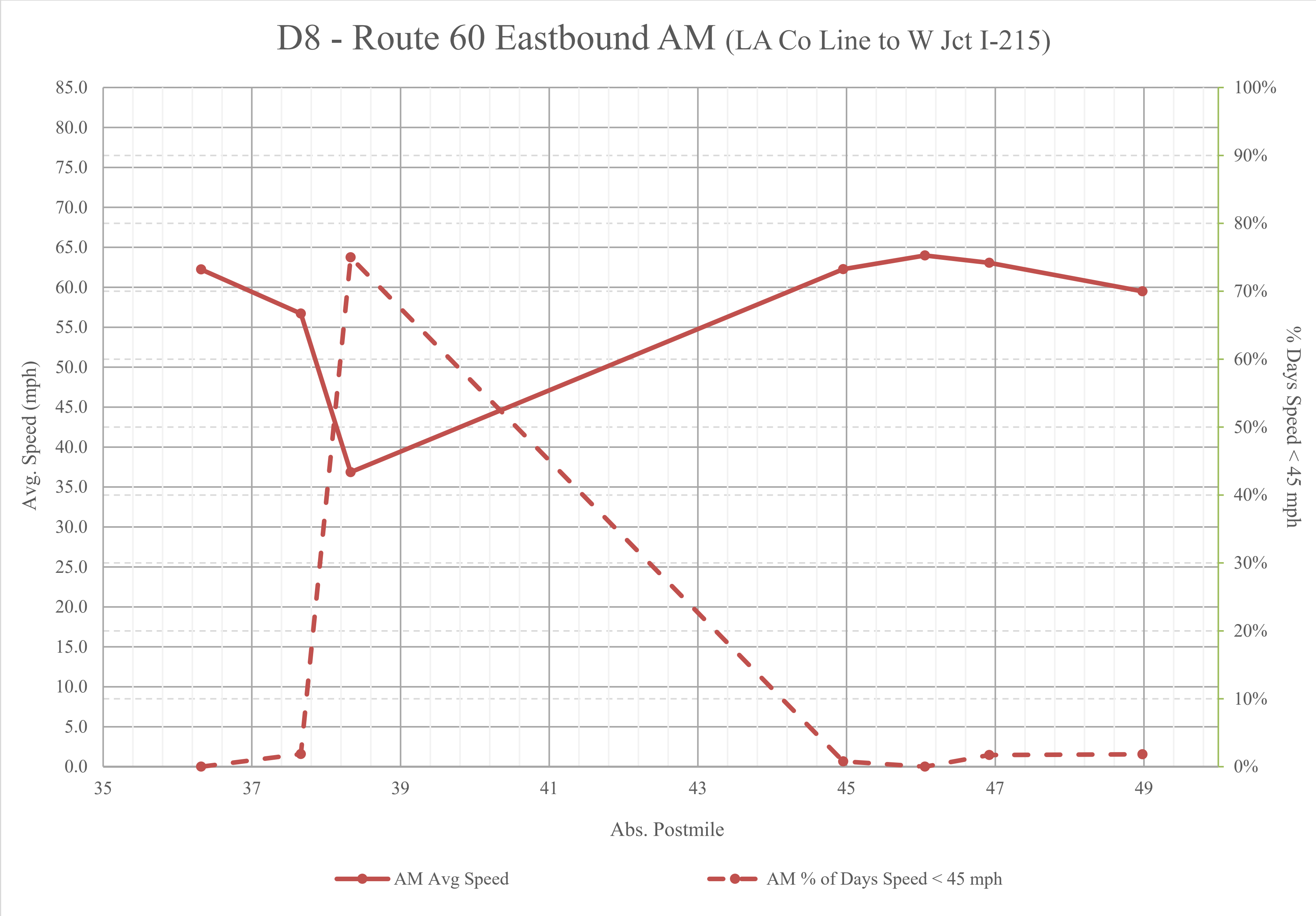


FIGURE 8.9 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 60, PM

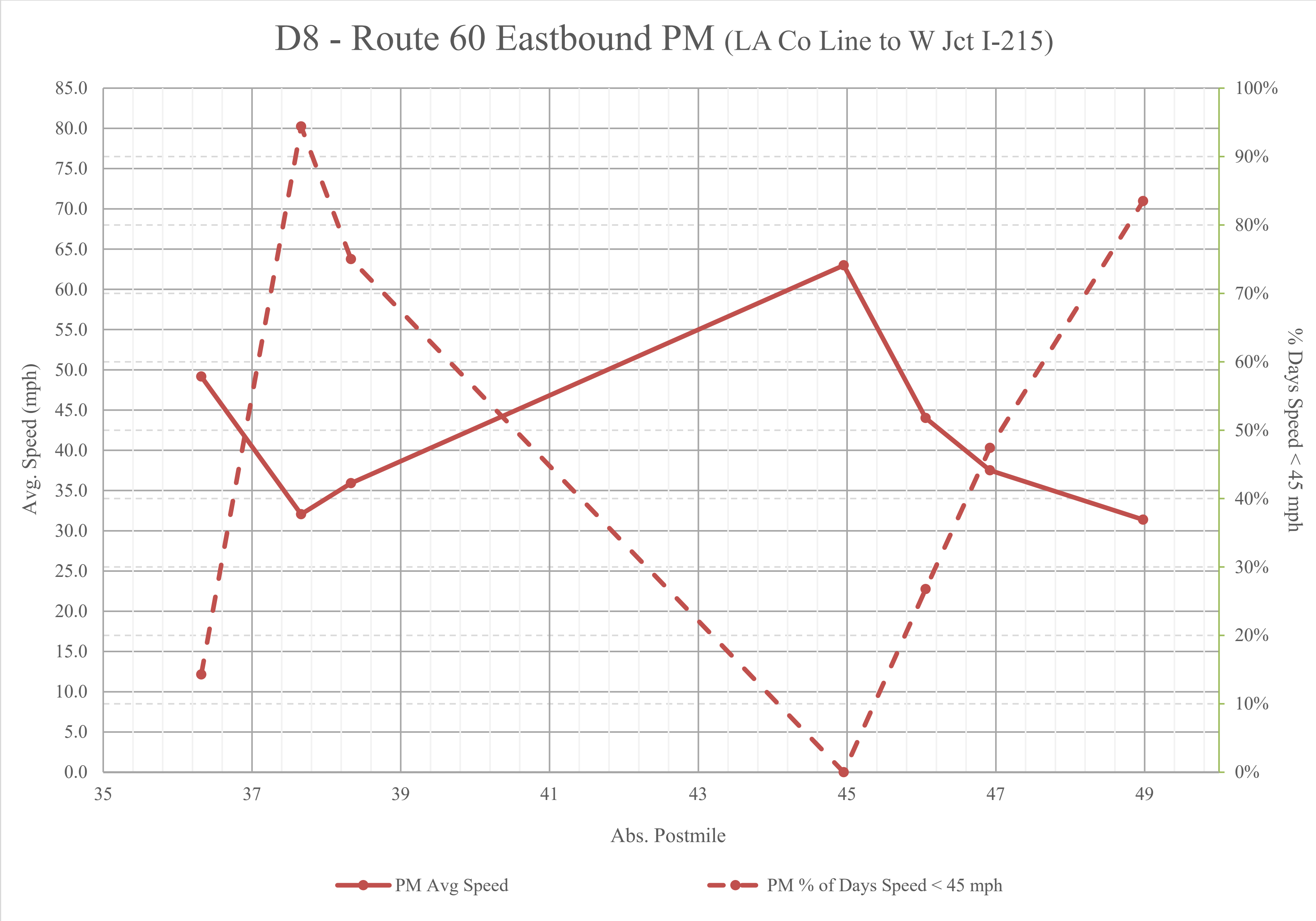


FIGURE 8.10 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 60, AM

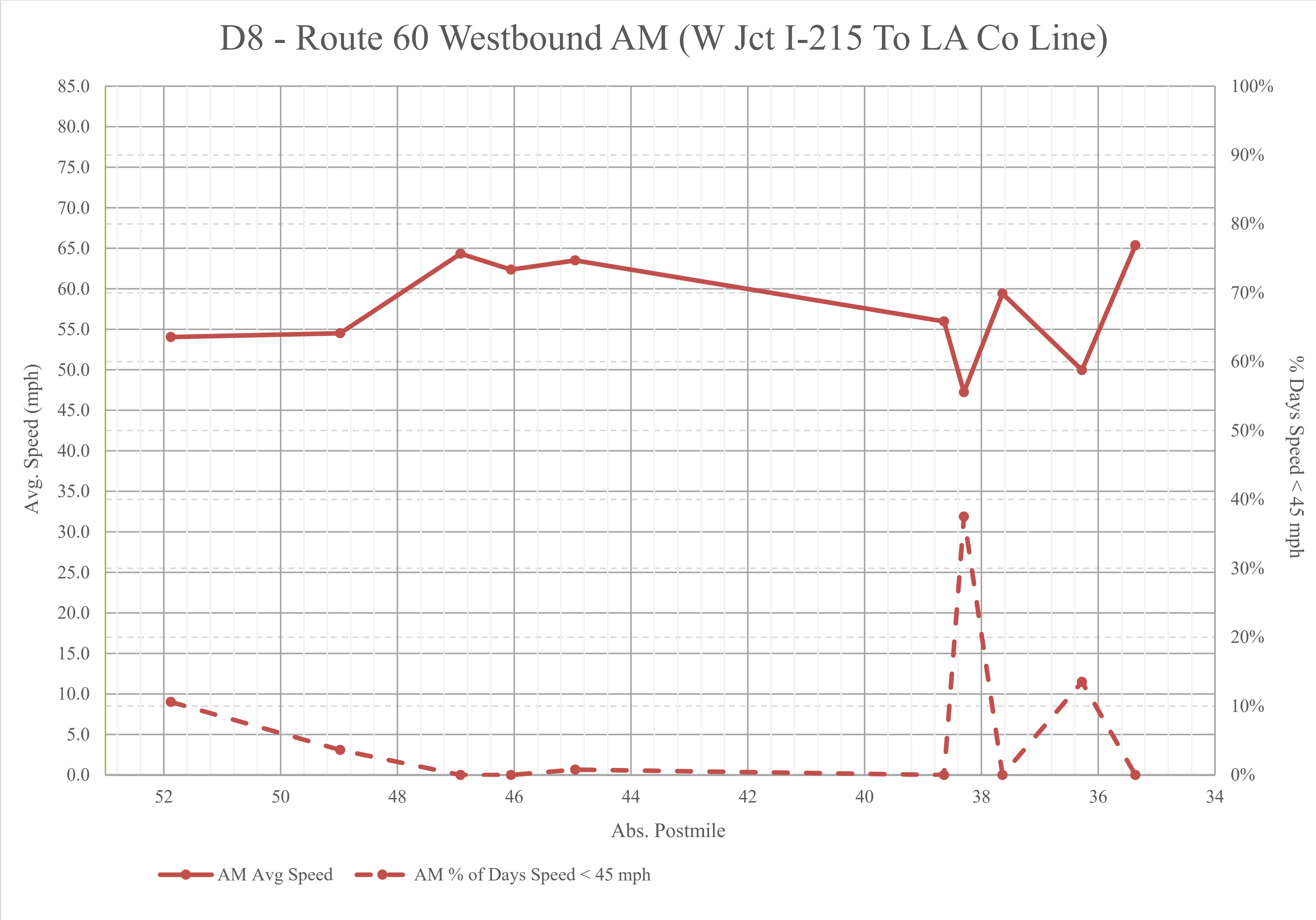


FIGURE 8.11 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 60, PM

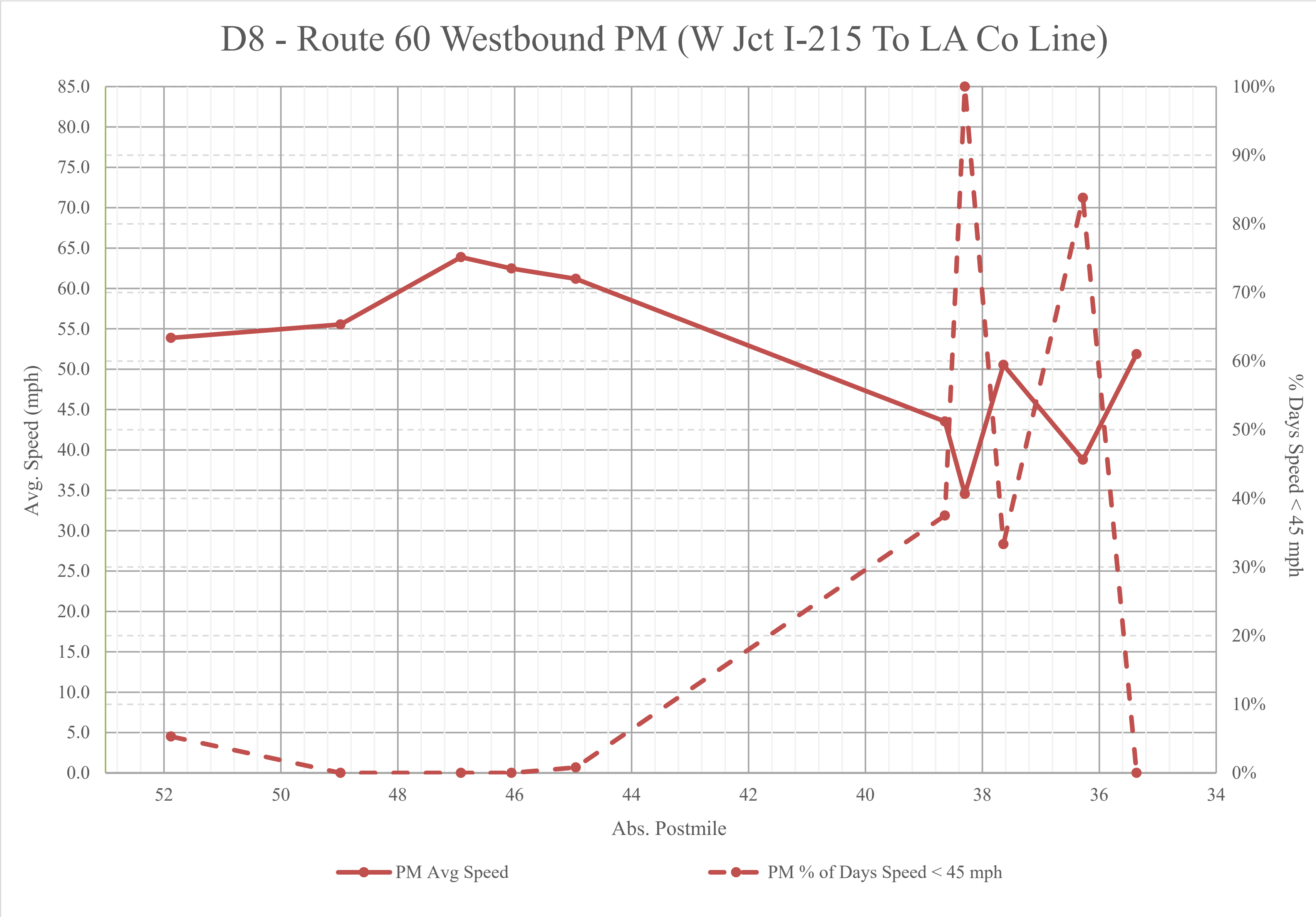


FIGURE 8.12 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 60, PM

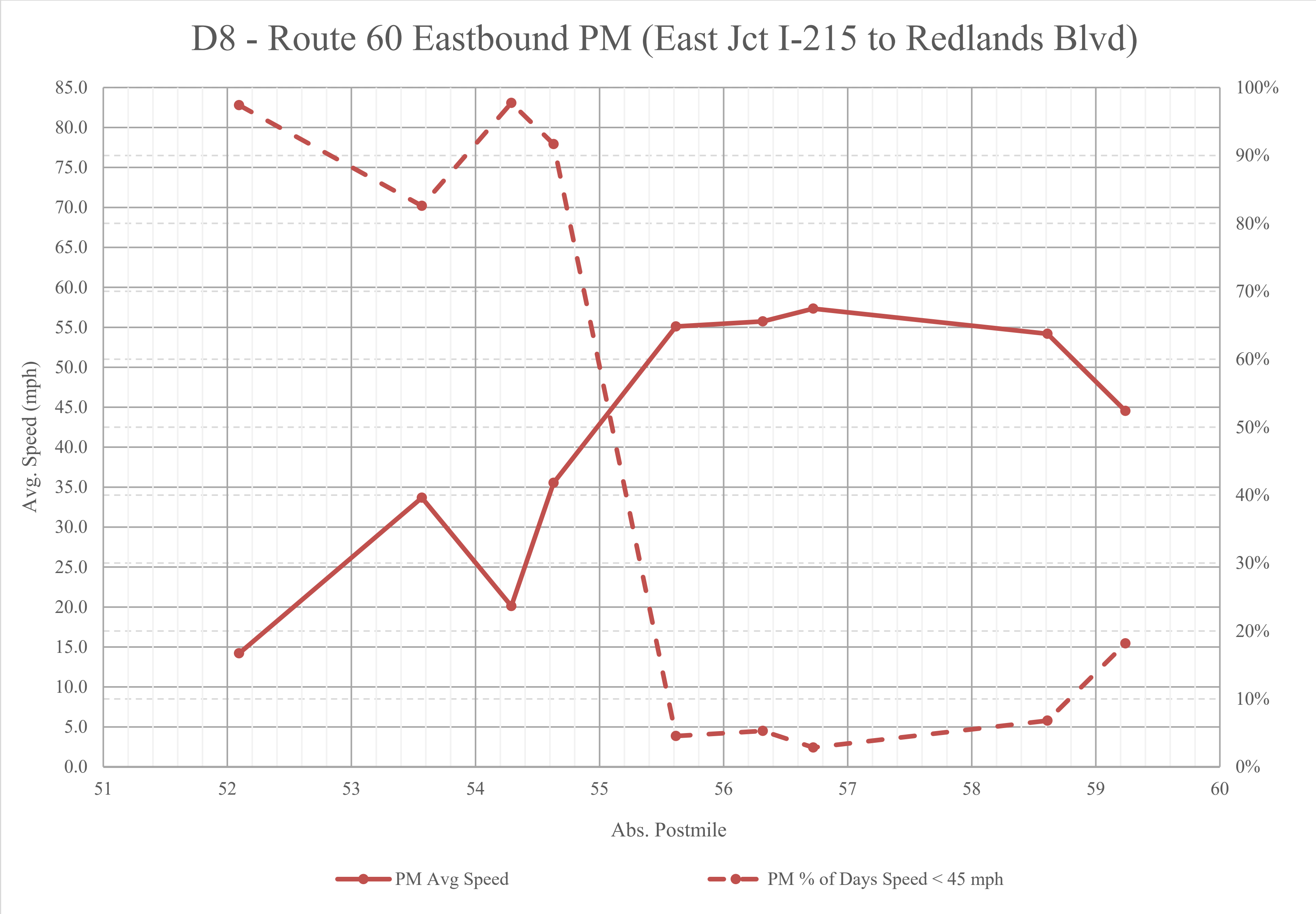


FIGURE 8.13 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 60, AM

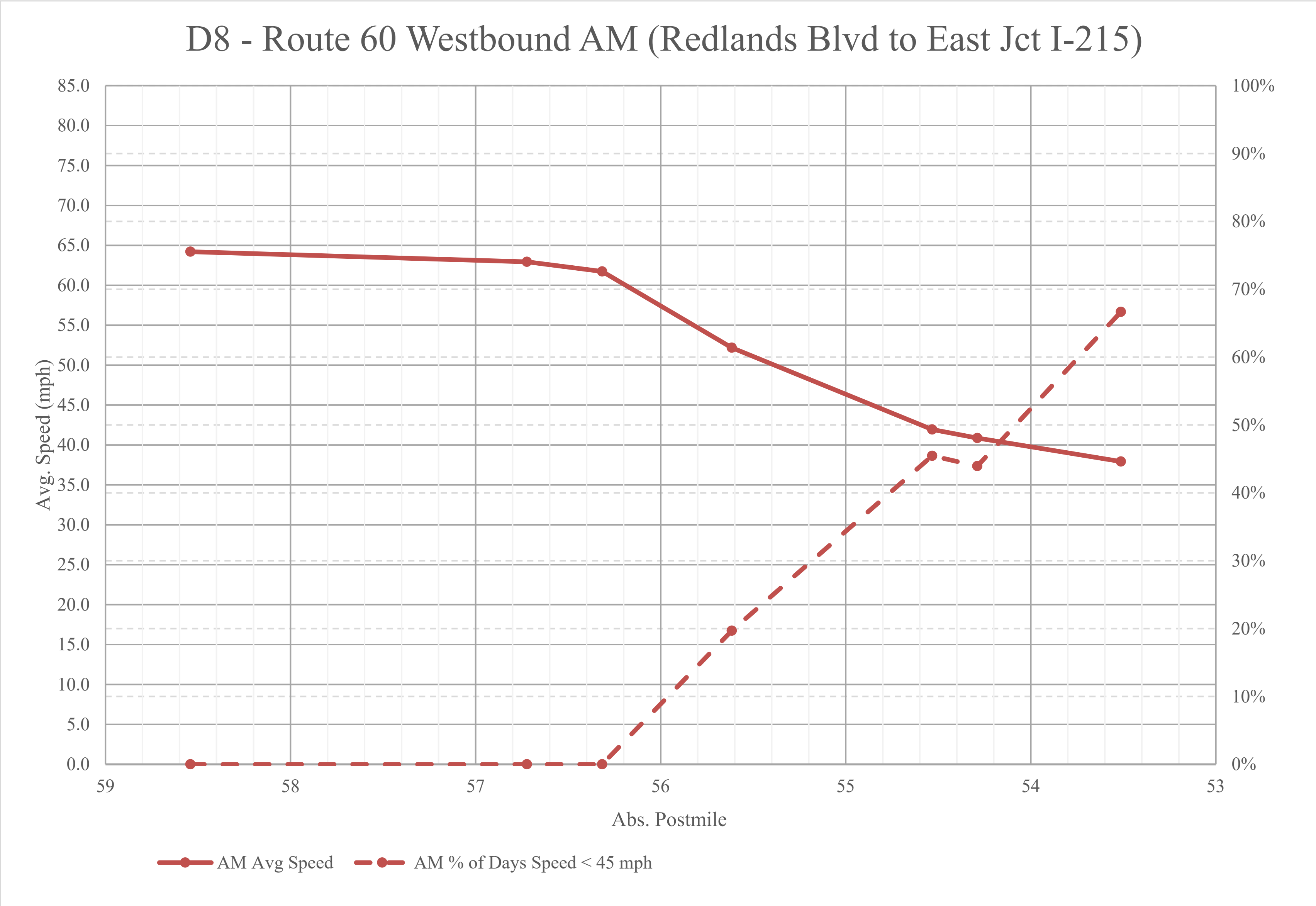


FIGURE 8.14 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 60, PM

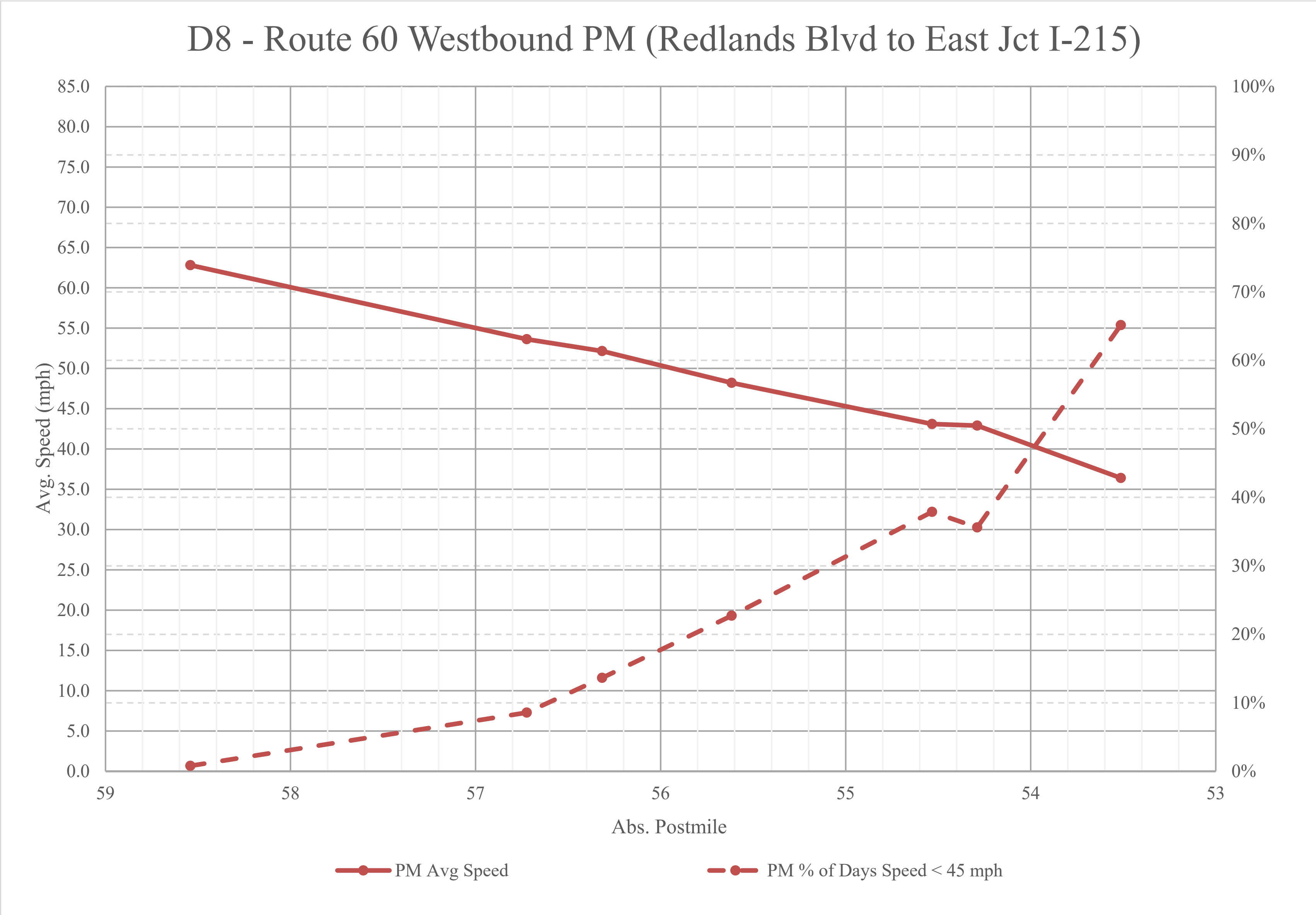


FIGURE 8.15 SPEED AND DEGRADATION PROFILE – NORTHBOUND ROUTE 71, PM

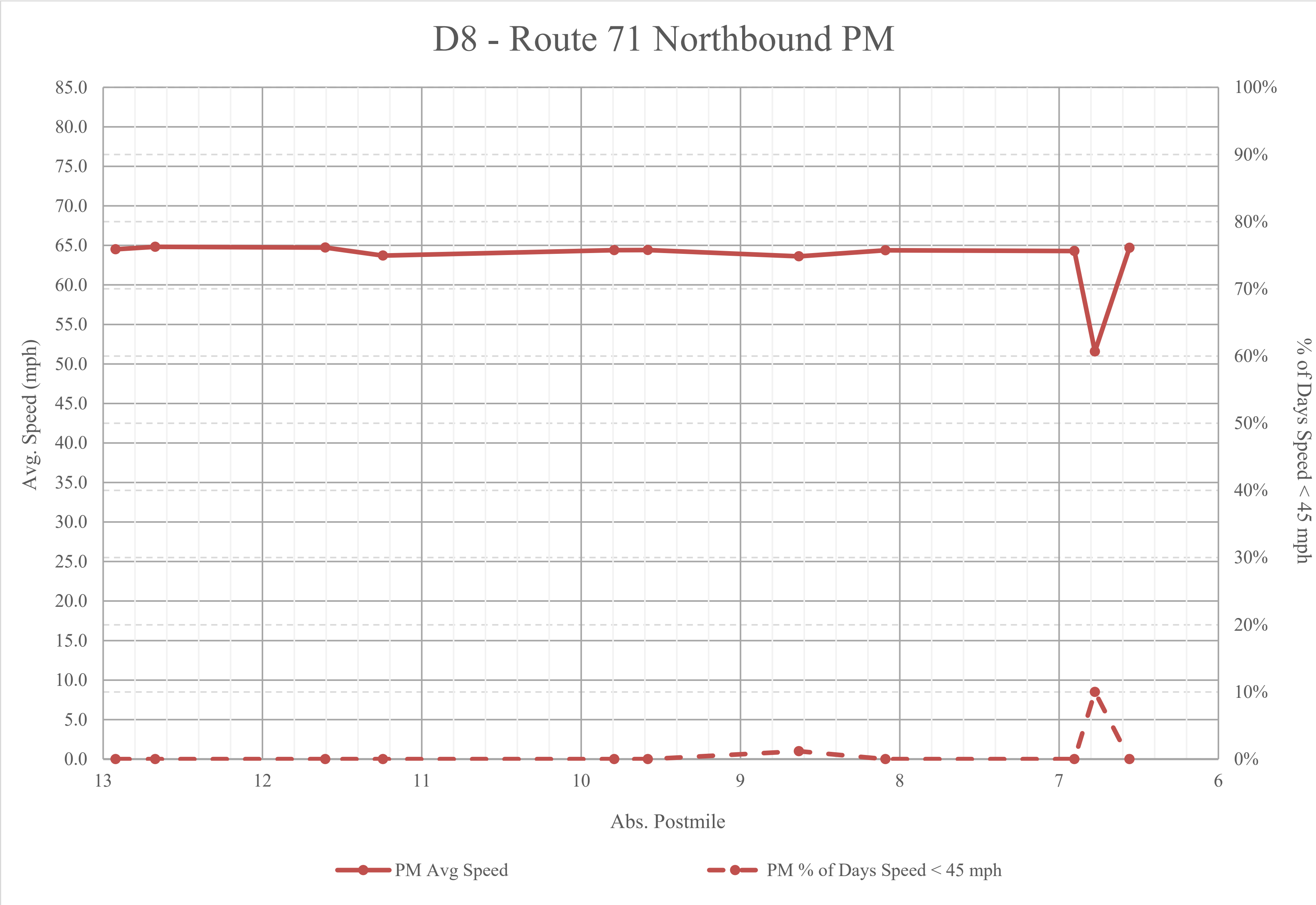


FIGURE 8.16 SPEED AND DEGRADATION PROFILE – SOUTHBOUND ROUTE 71, AM

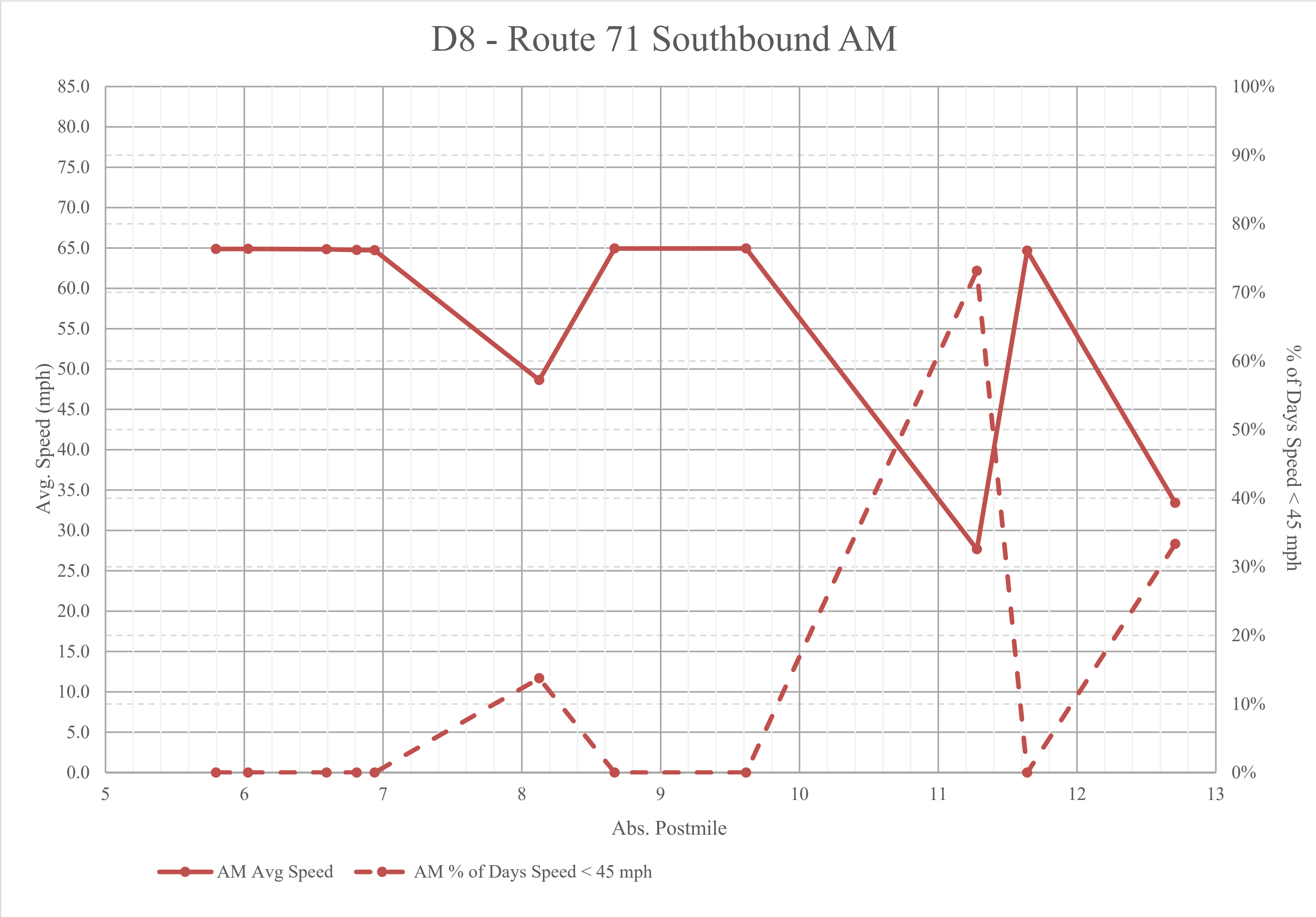


FIGURE 8.17 SPEED AND DEGRADATION PROFILE – SOUTHBOUND ROUTE 71, PM

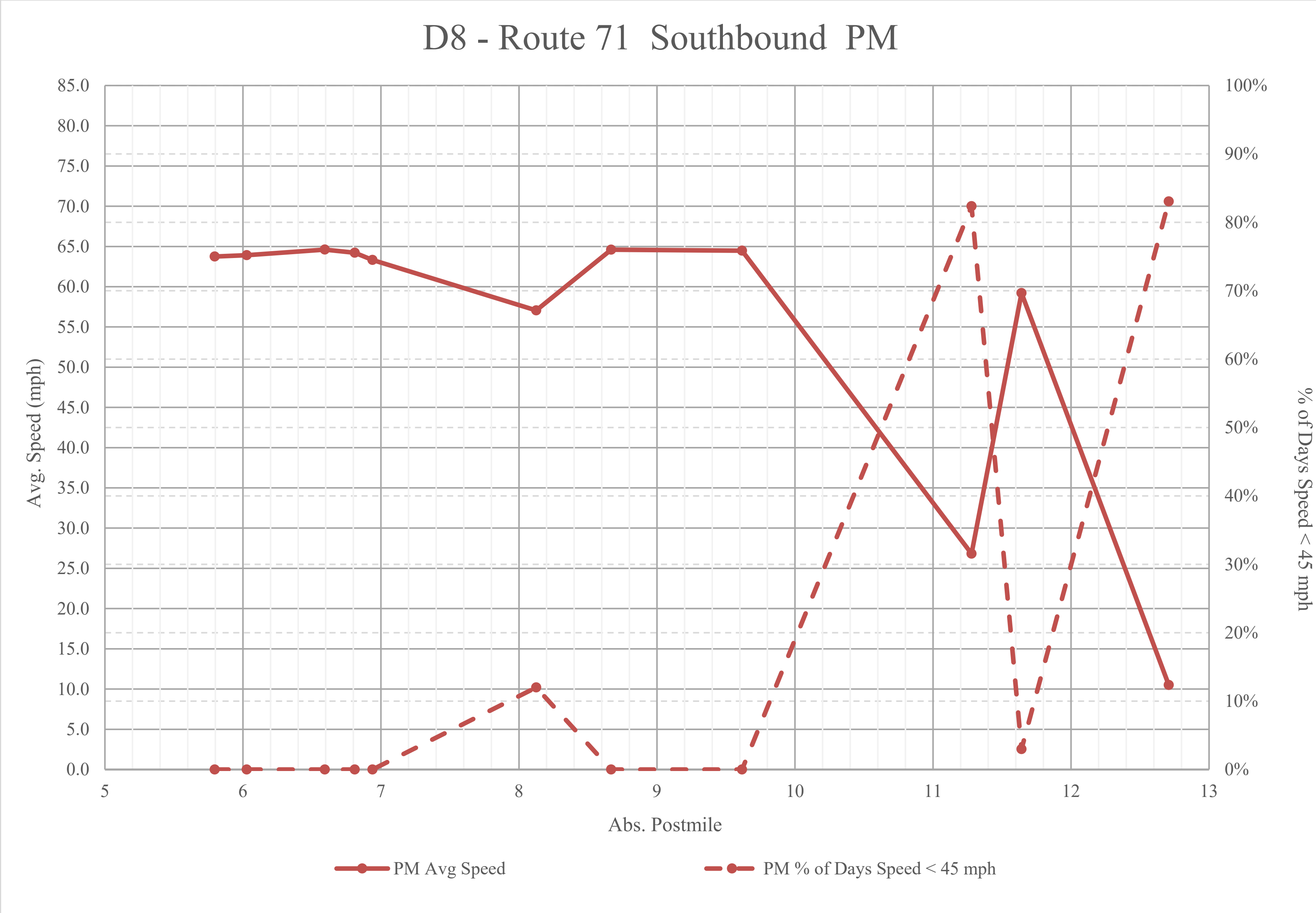


FIGURE 8.18 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 91 (HOT), AM

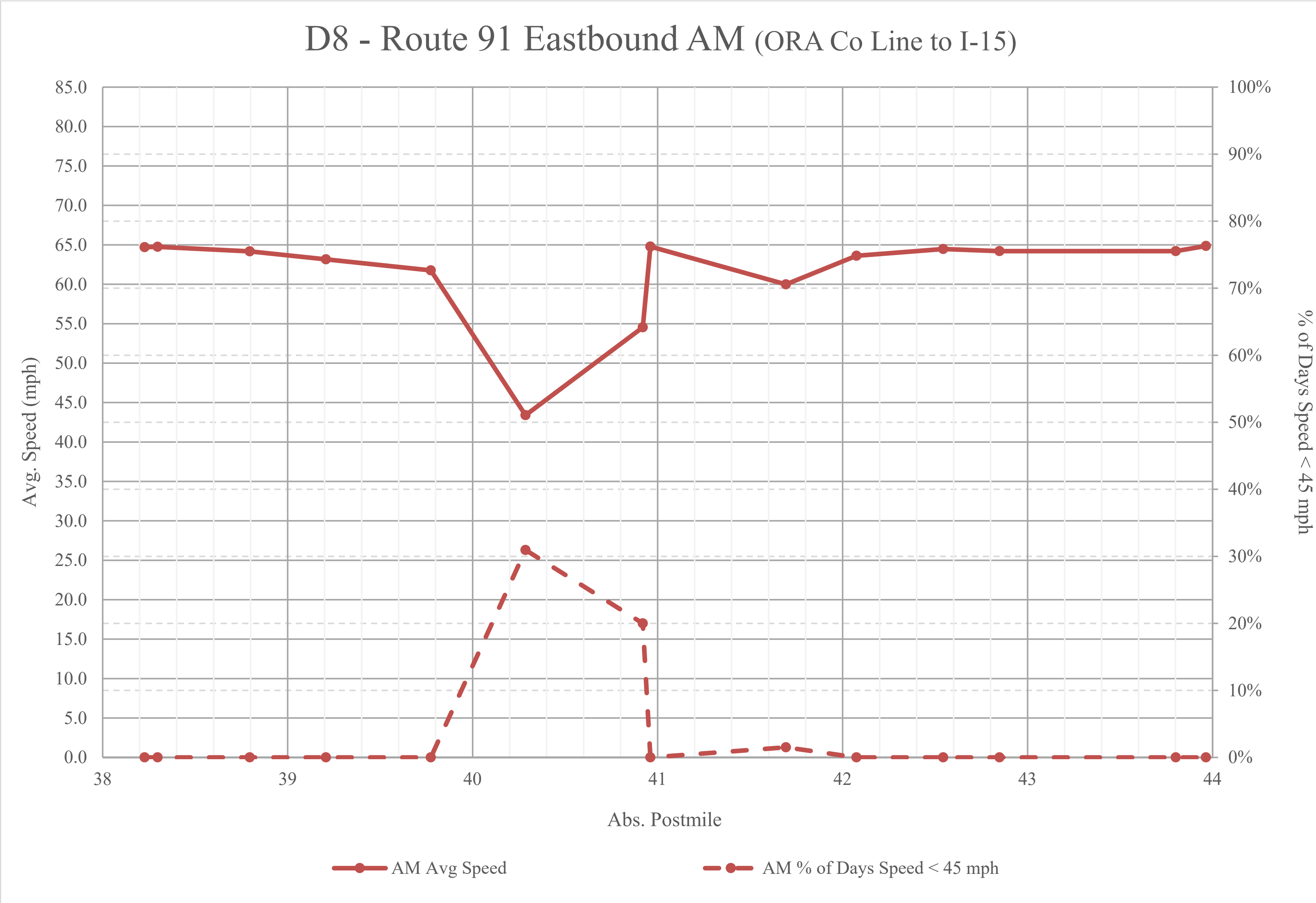


FIGURE 8.19 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 91 (HOT), PM

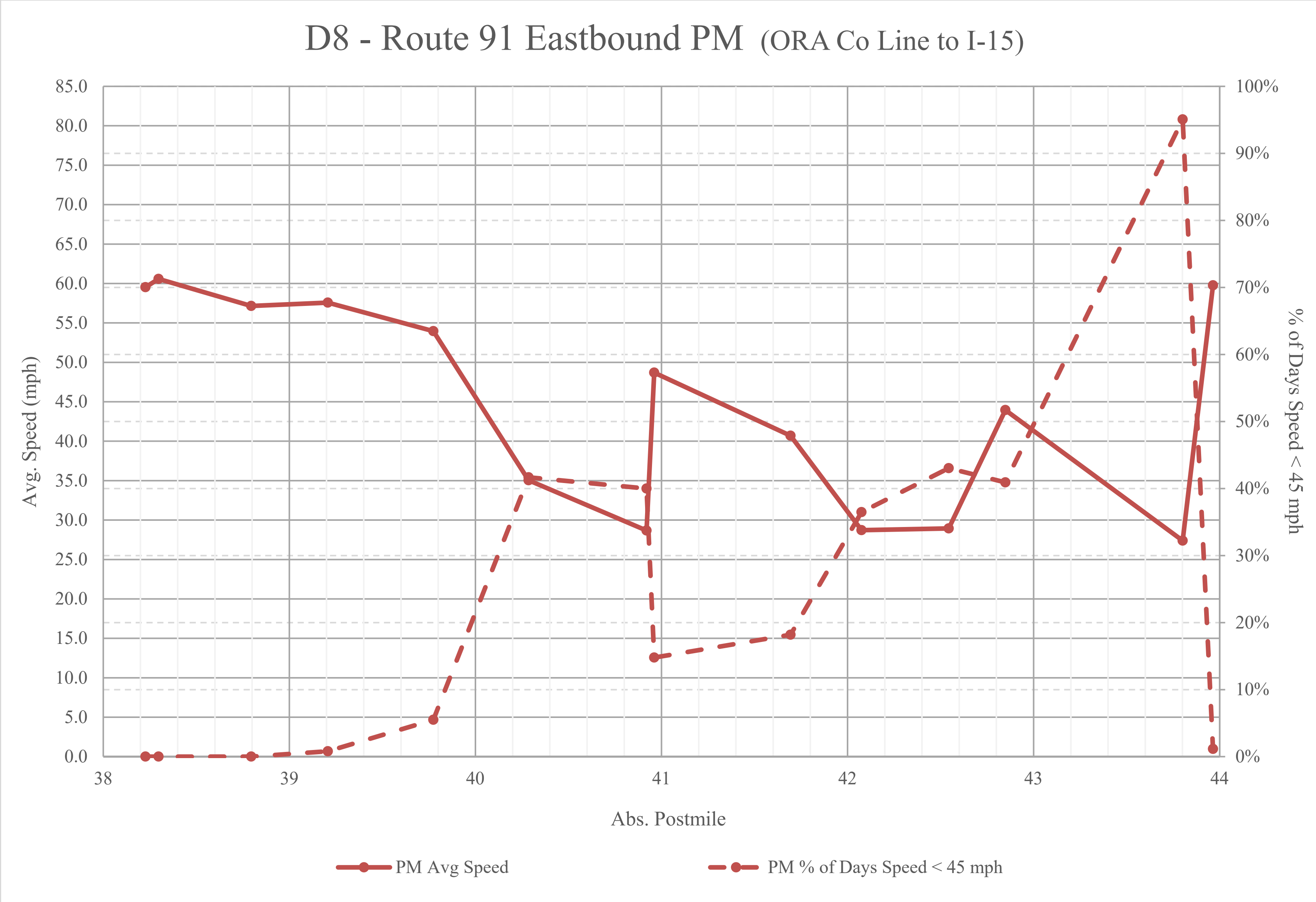


FIGURE 8.20 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 91 (HOT), AM

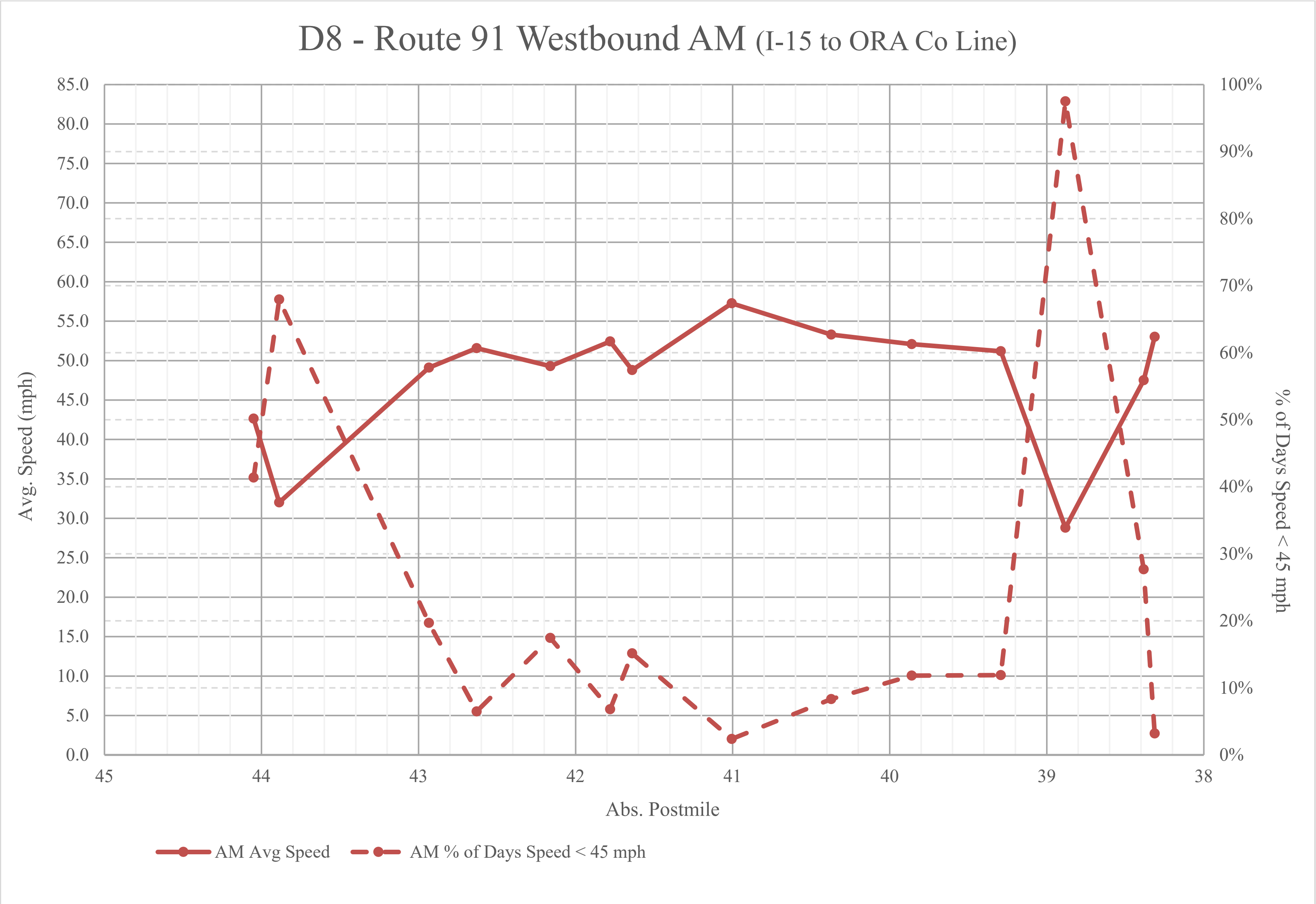


FIGURE 8.21 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 91 (HOV), AM

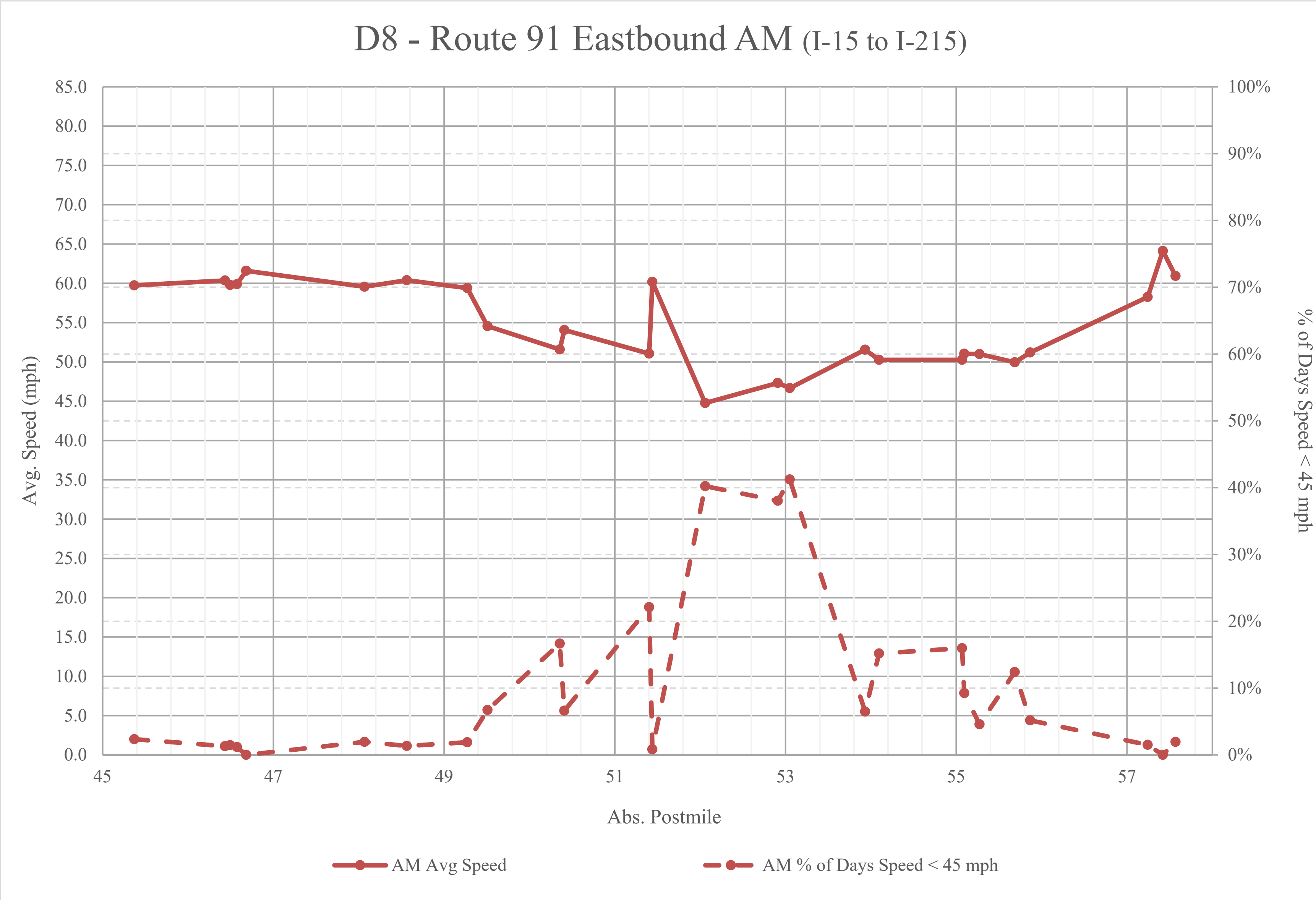


FIGURE 8.22 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 91 (HOV), PM

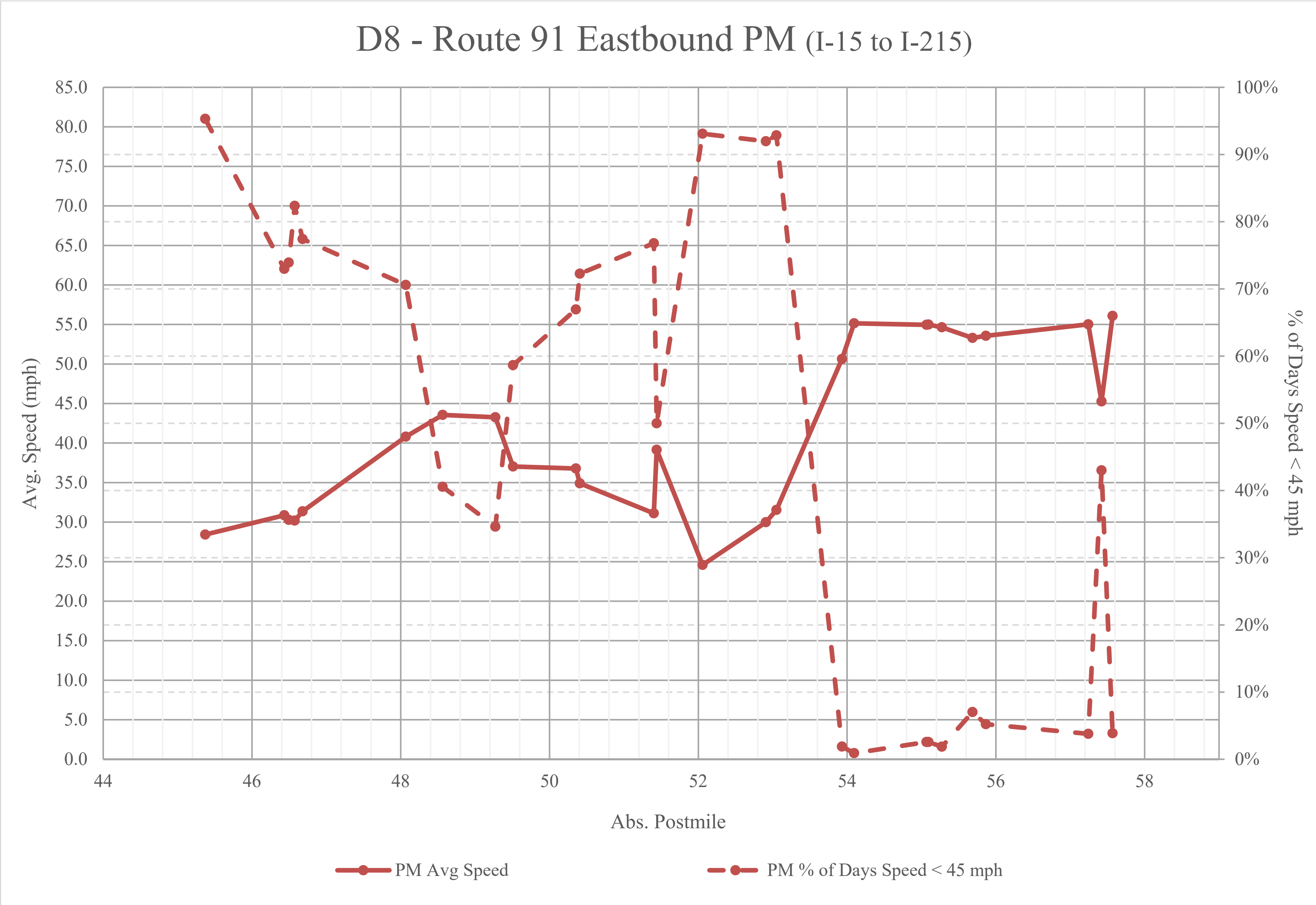


FIGURE 8.23 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 91 (HOV), AM

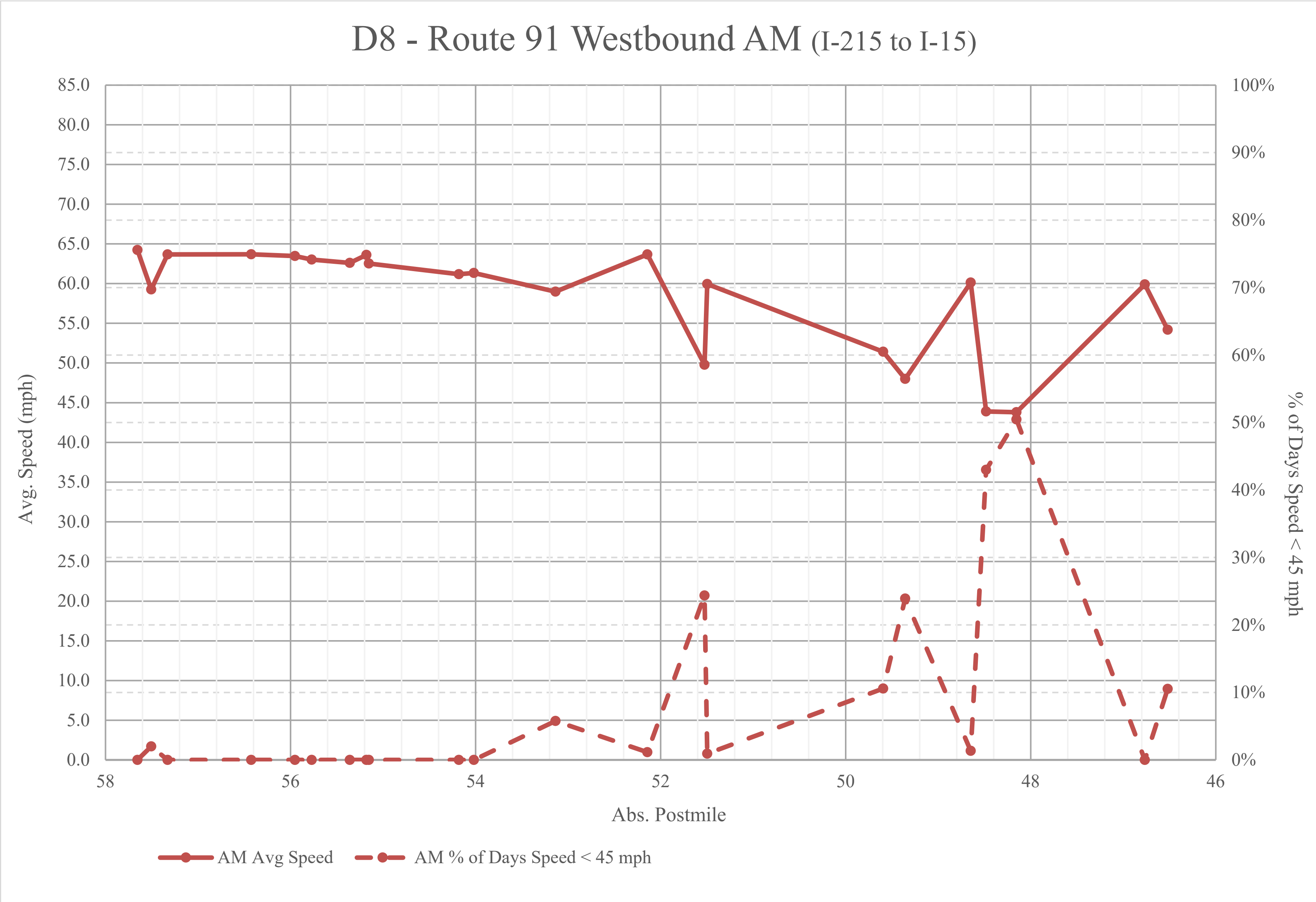


FIGURE 8.24 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 91 (HOV), PM

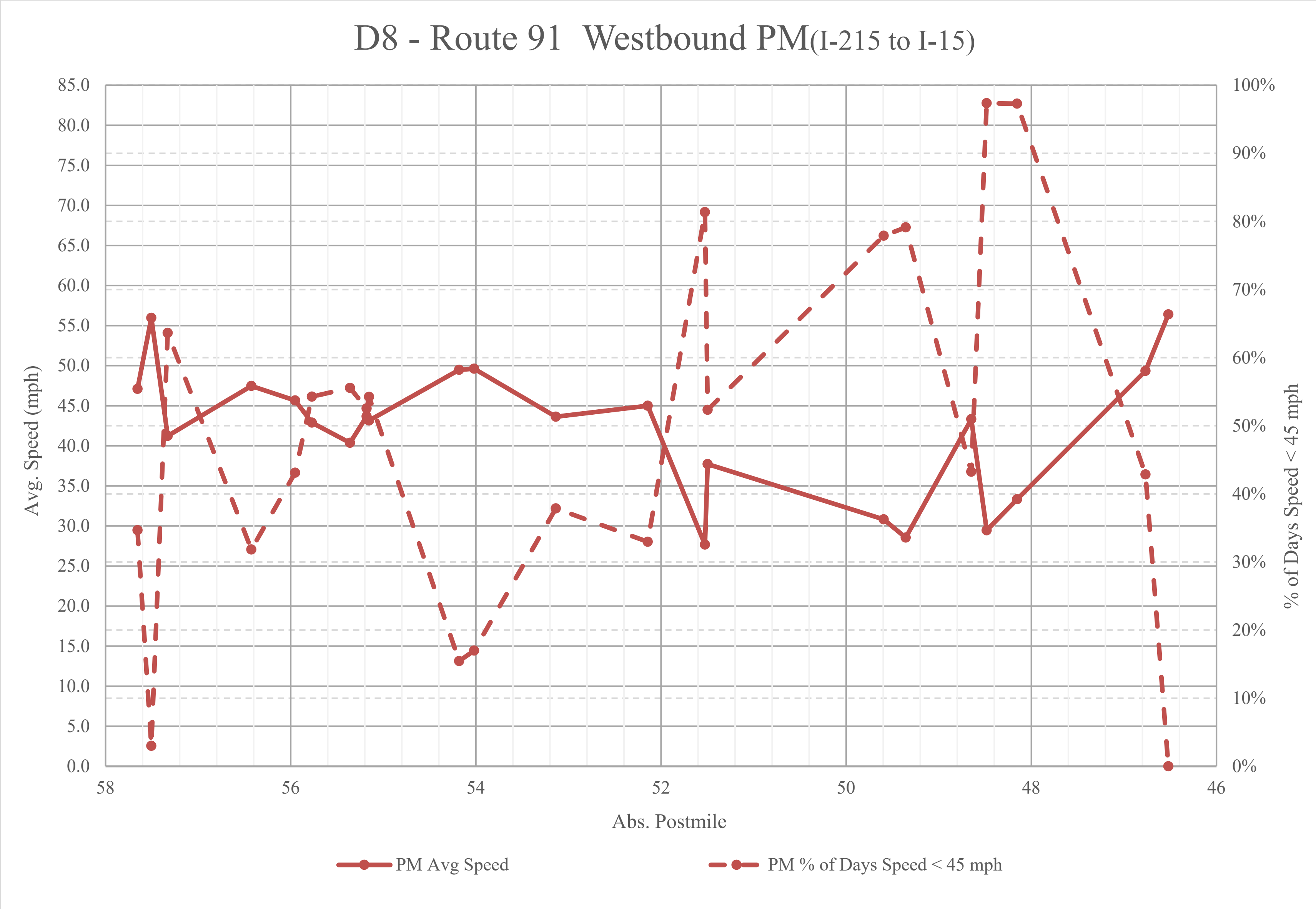


FIGURE 8.25 SPEED AND DEGRADATION PROFILE – EASTBOUND ROUTE 210, PM

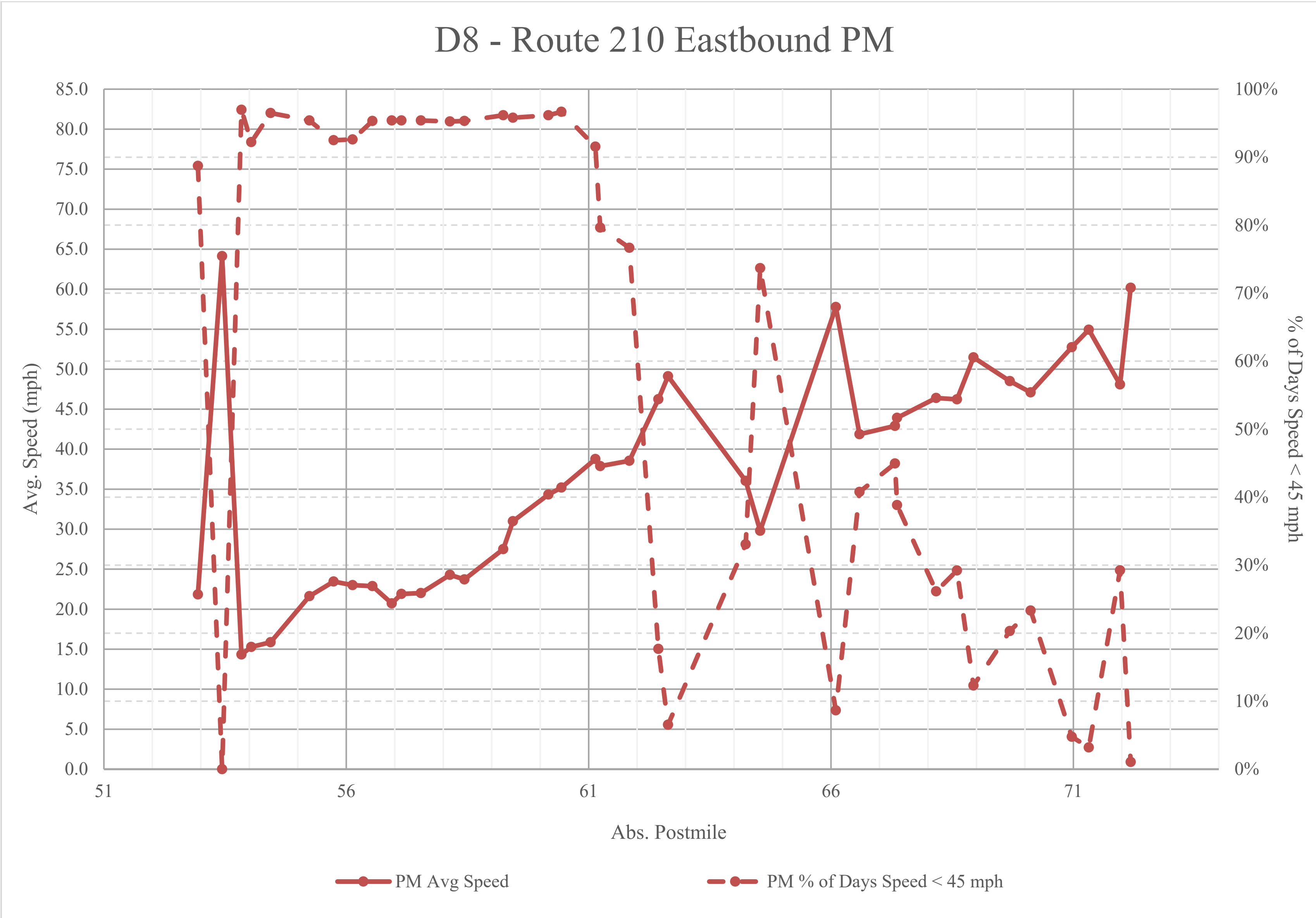


FIGURE 8.26 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 210, AM

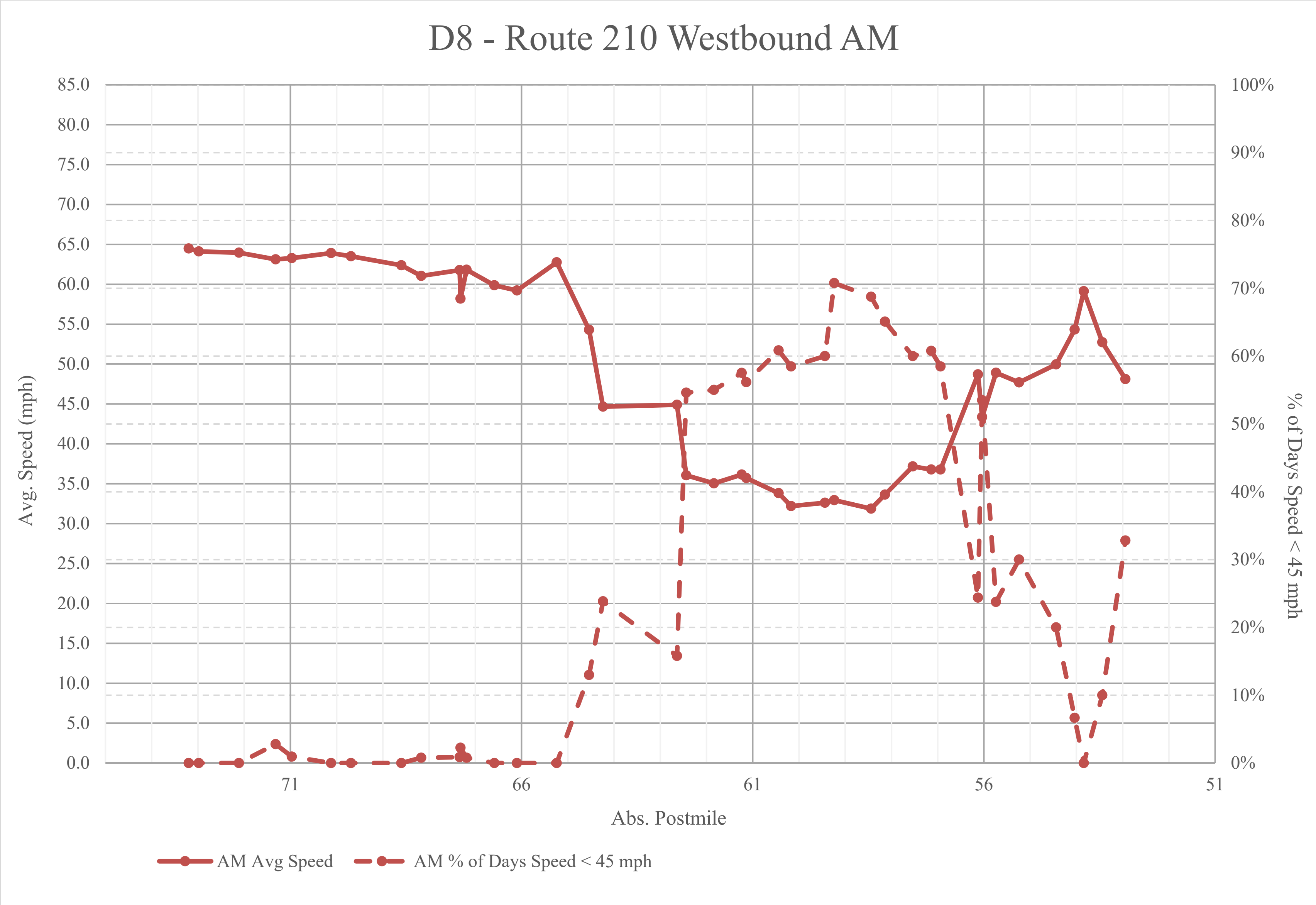


FIGURE 8.27 SPEED AND DEGRADATION PROFILE – WESTBOUND ROUTE 210, PM

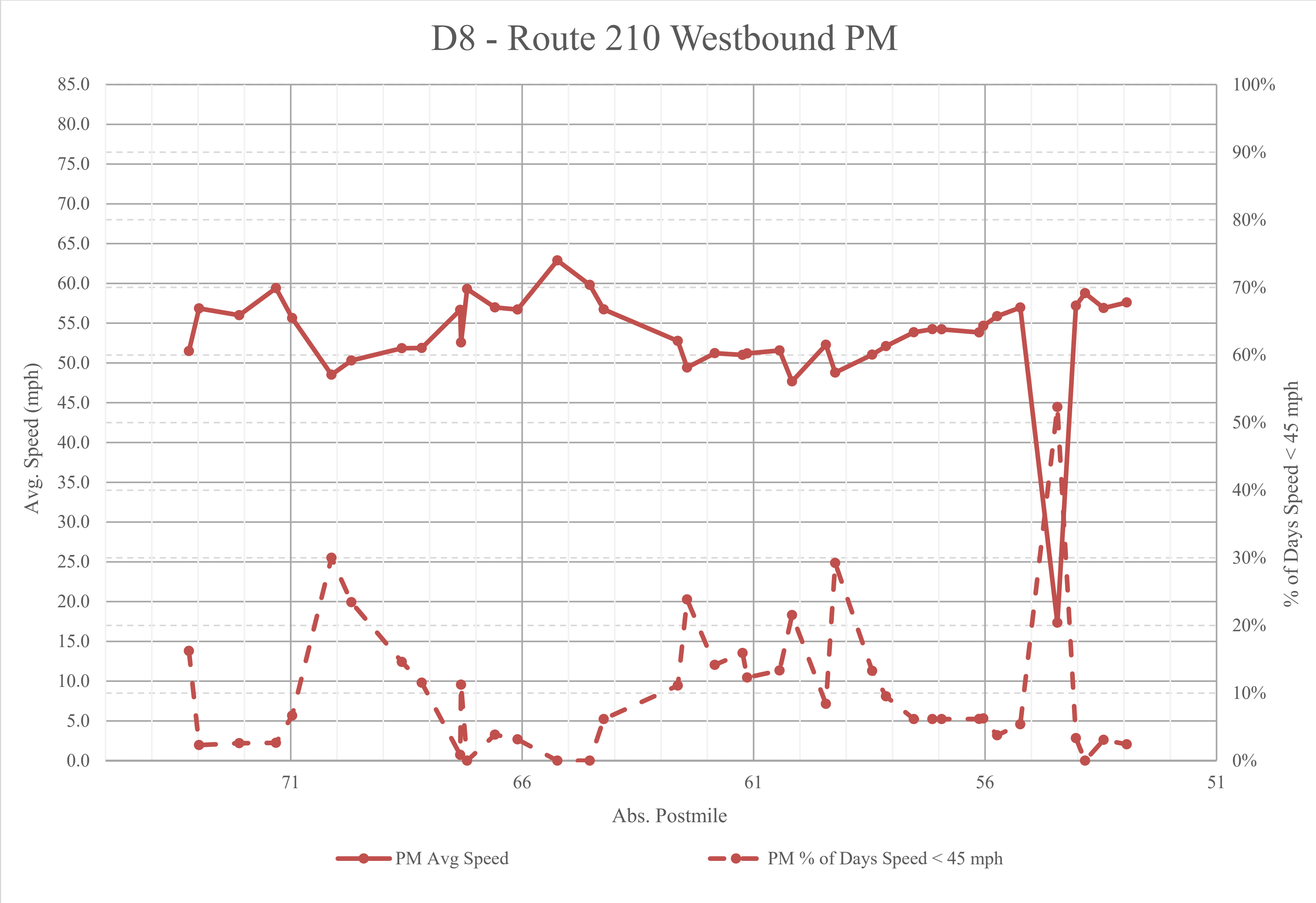


FIGURE 8.28 SPEED AND DEGRADATION PROFILE – NORTHBOUND ROUTE 215, AM

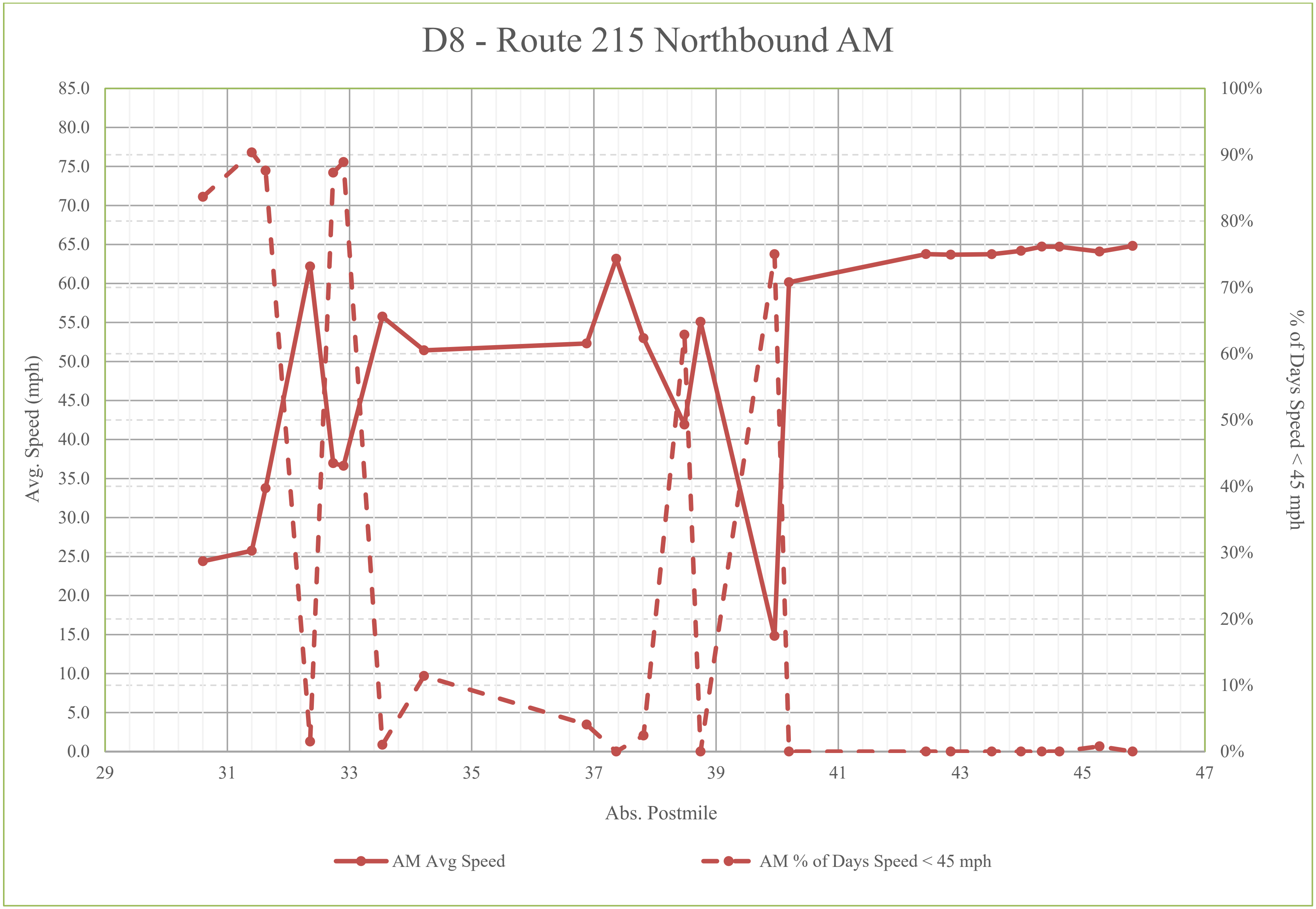


FIGURE 8.29 SPEED AND DEGRADATION PROFILE – NORTHBOUND ROUTE 215, PM

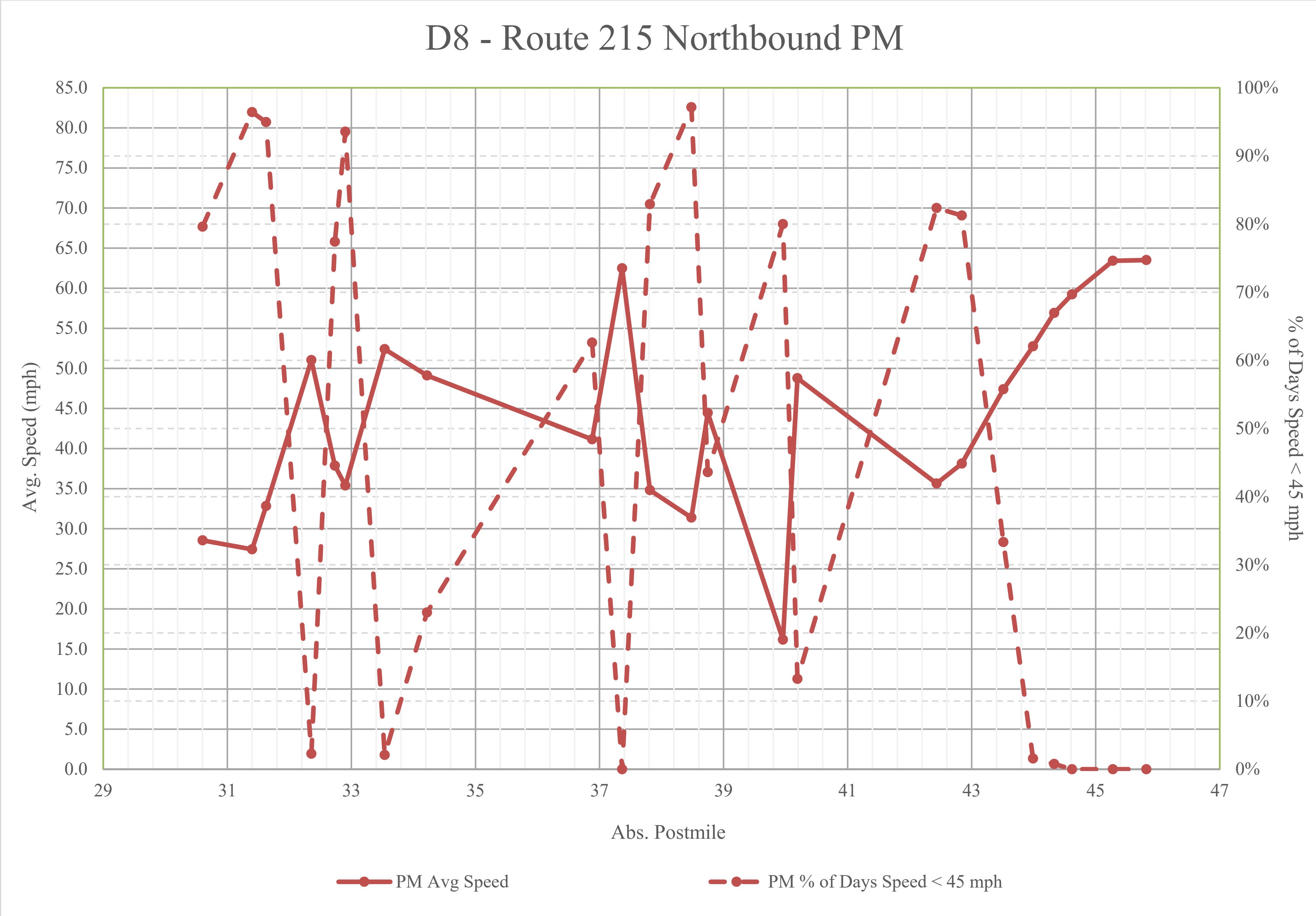


FIGURE 8.30 SPEED AND DEGRADATION PROFILE – SOUTHBOUND ROUTE 215, AM

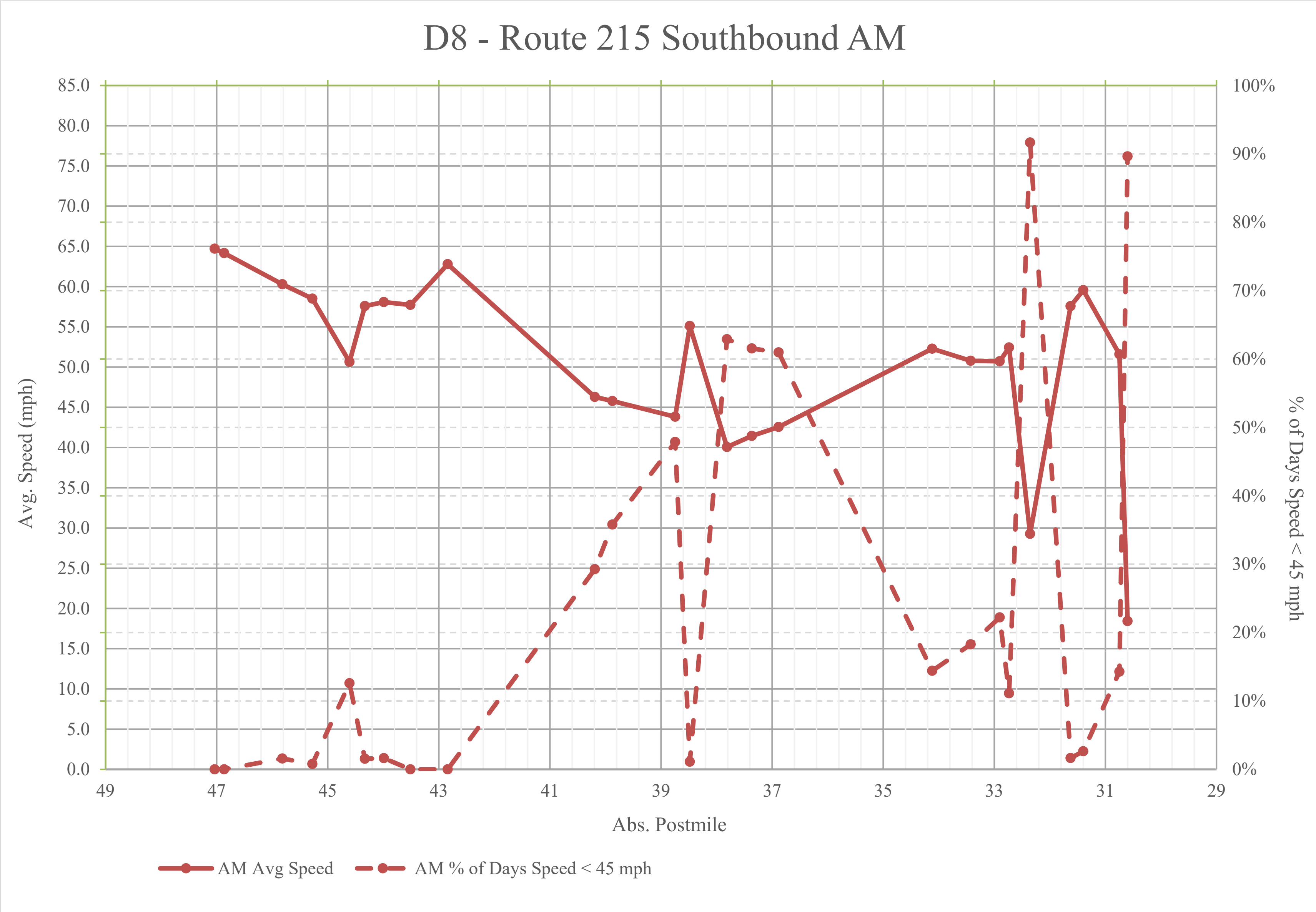


FIGURE 8.31 SPEED AND DEGRADATION PROFILE – SOUTHBOUND ROUTE 215, PM

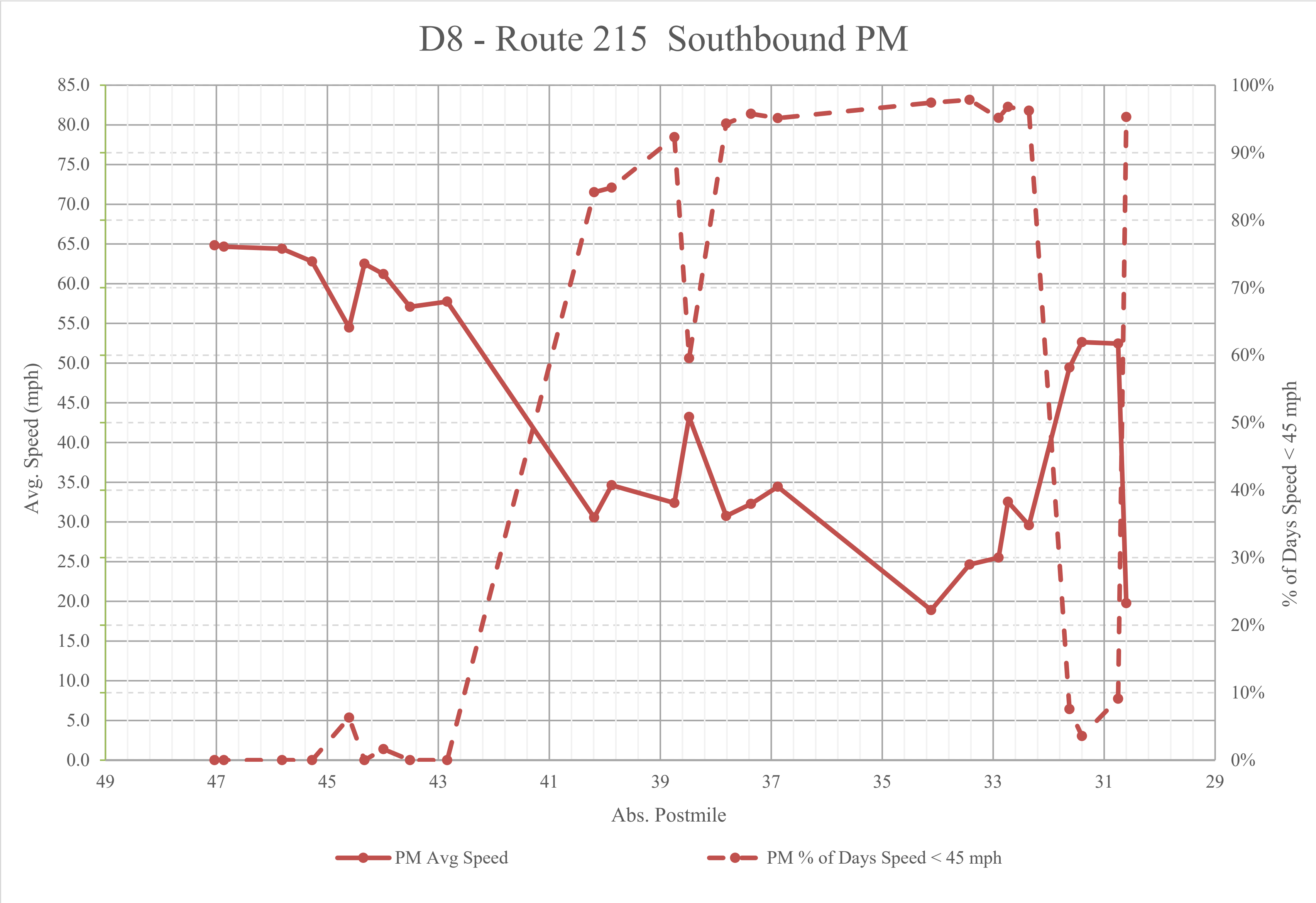


FIGURE 11.1 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 5, PM

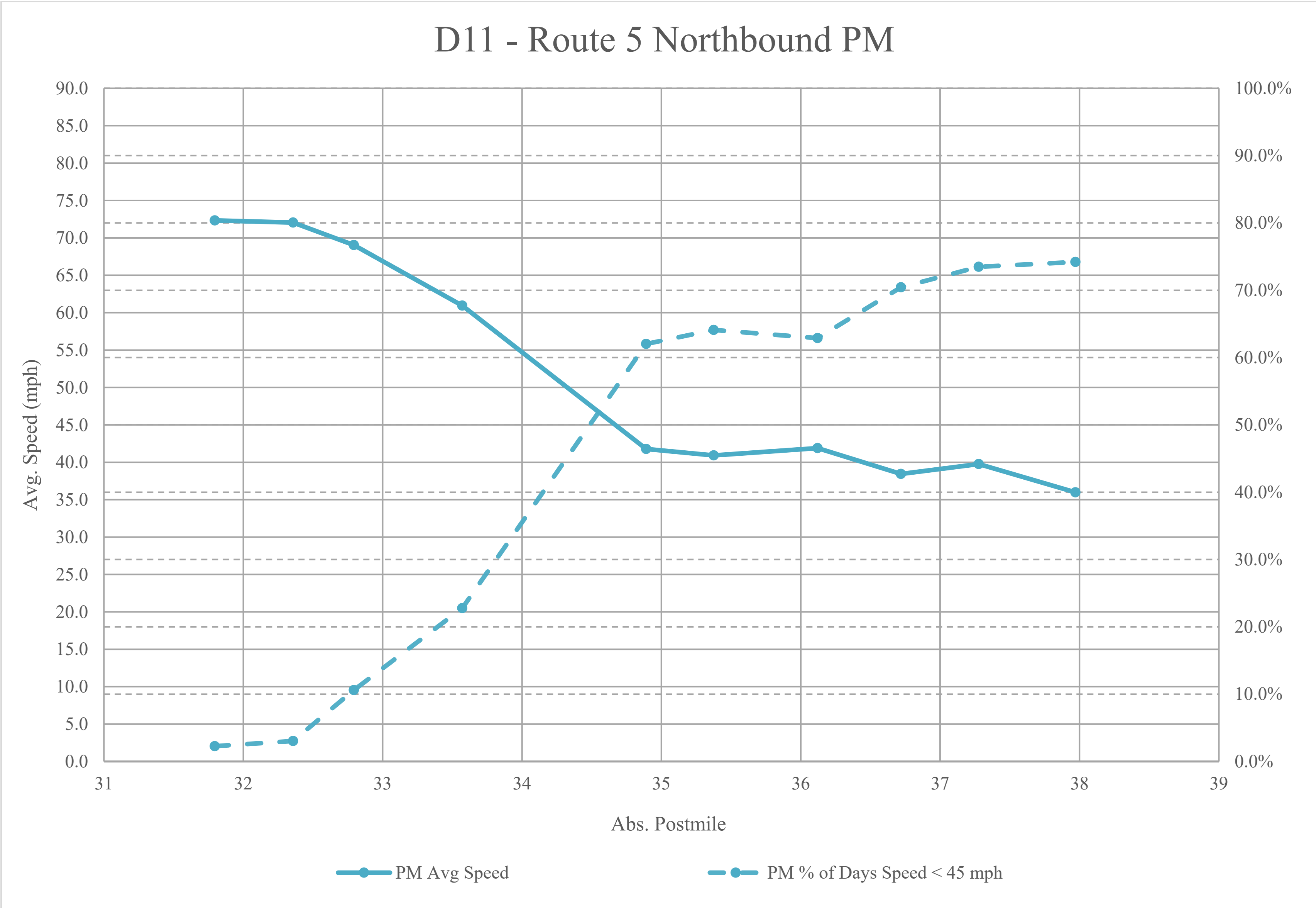


FIGURE 11.2 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 15, PM

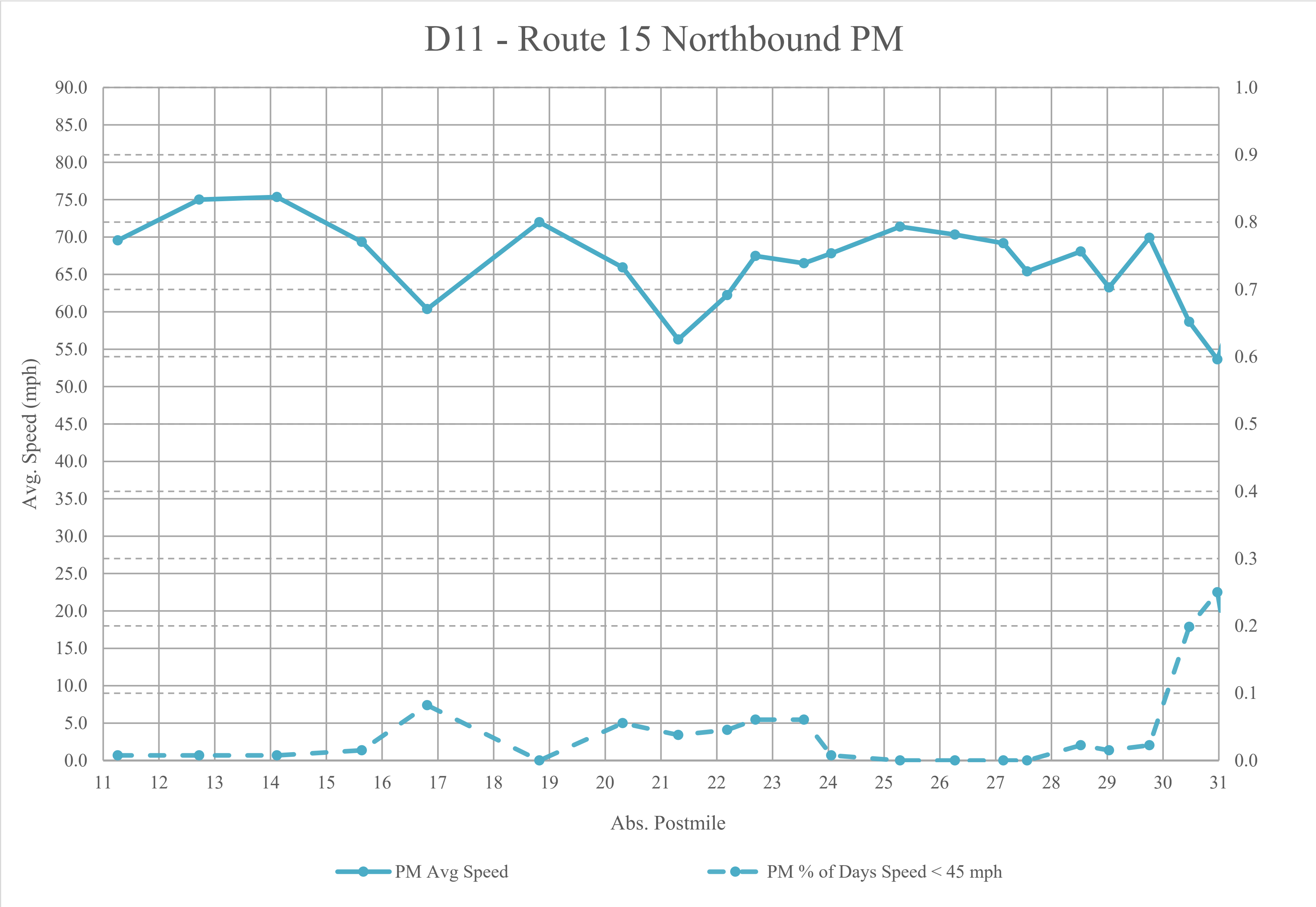


FIGURE 11.3 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 15, PM

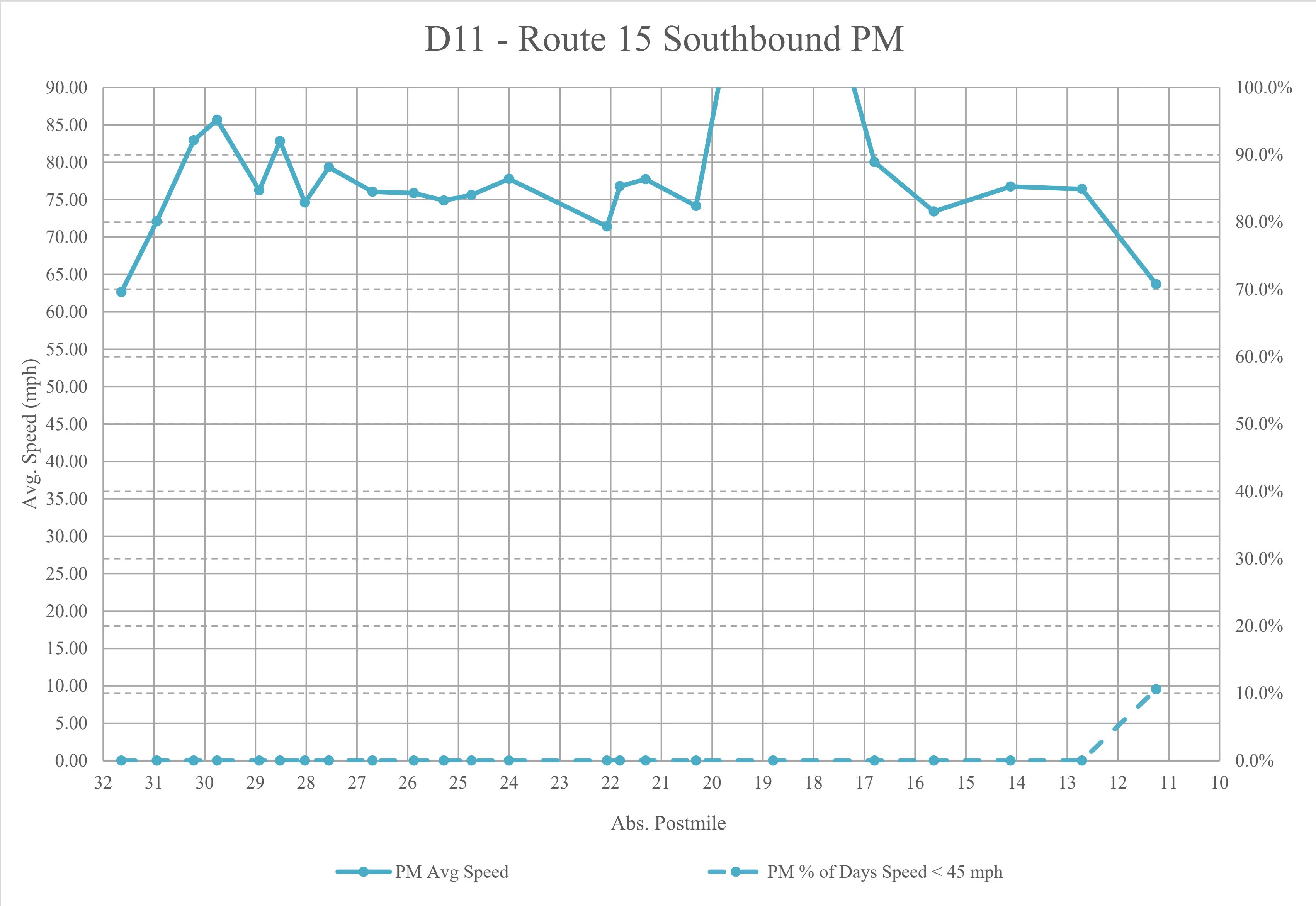


FIGURE 11.4 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 805 (a) AM

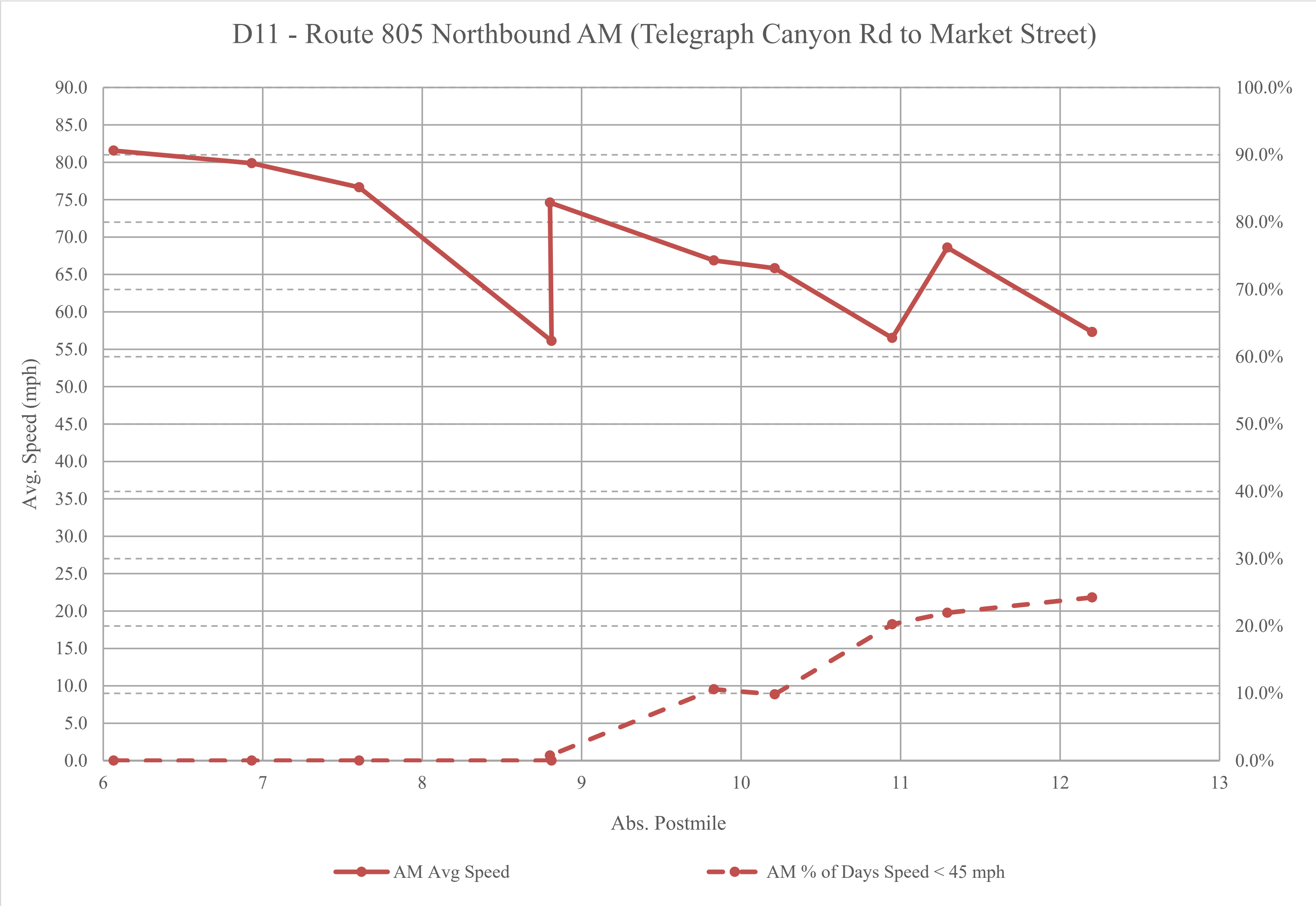


FIGURE 11.5 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 805 (b), AM

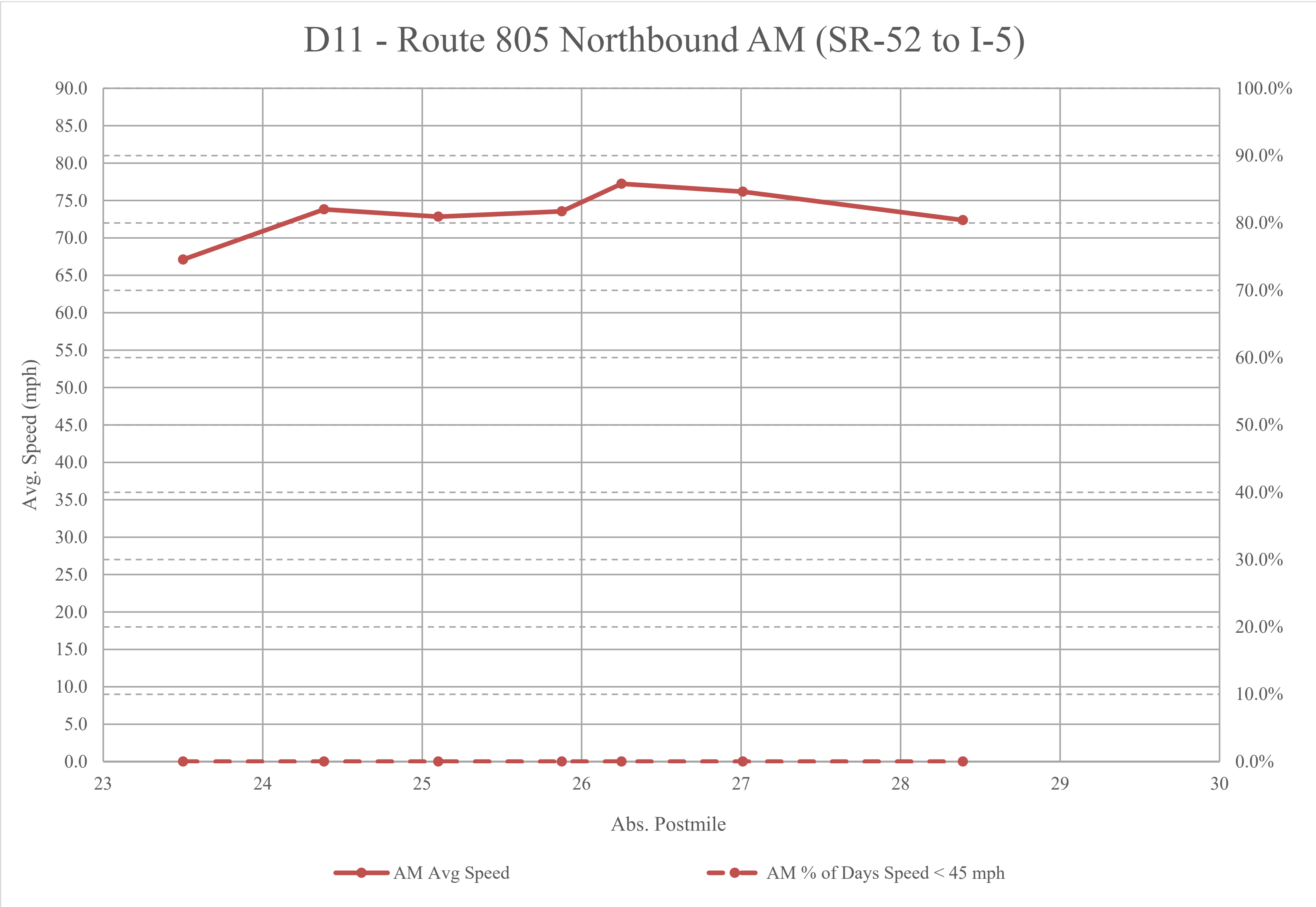


FIGURE 11.6 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 805 (a), AM

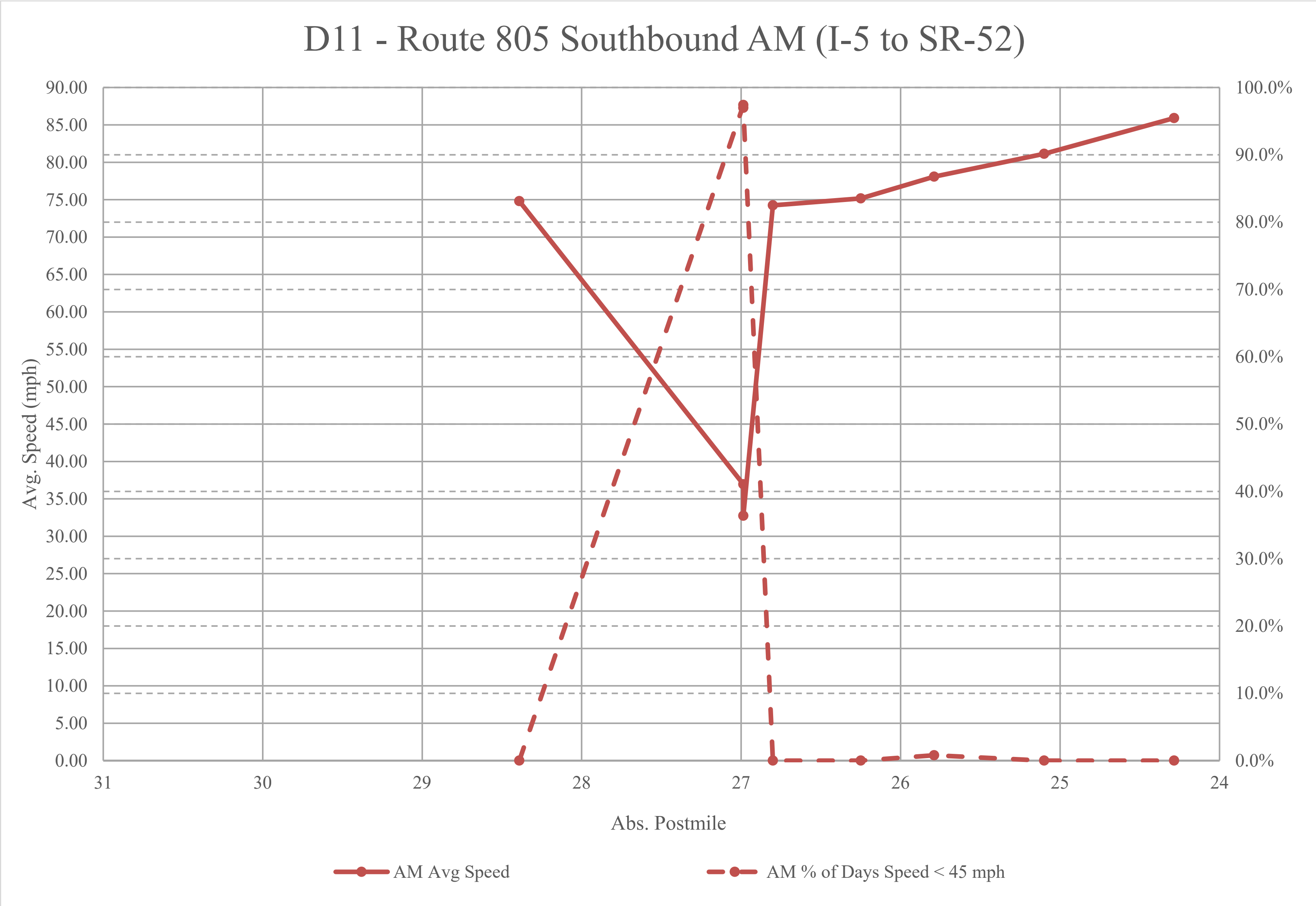


FIGURE 11.7 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 805 (b), AM

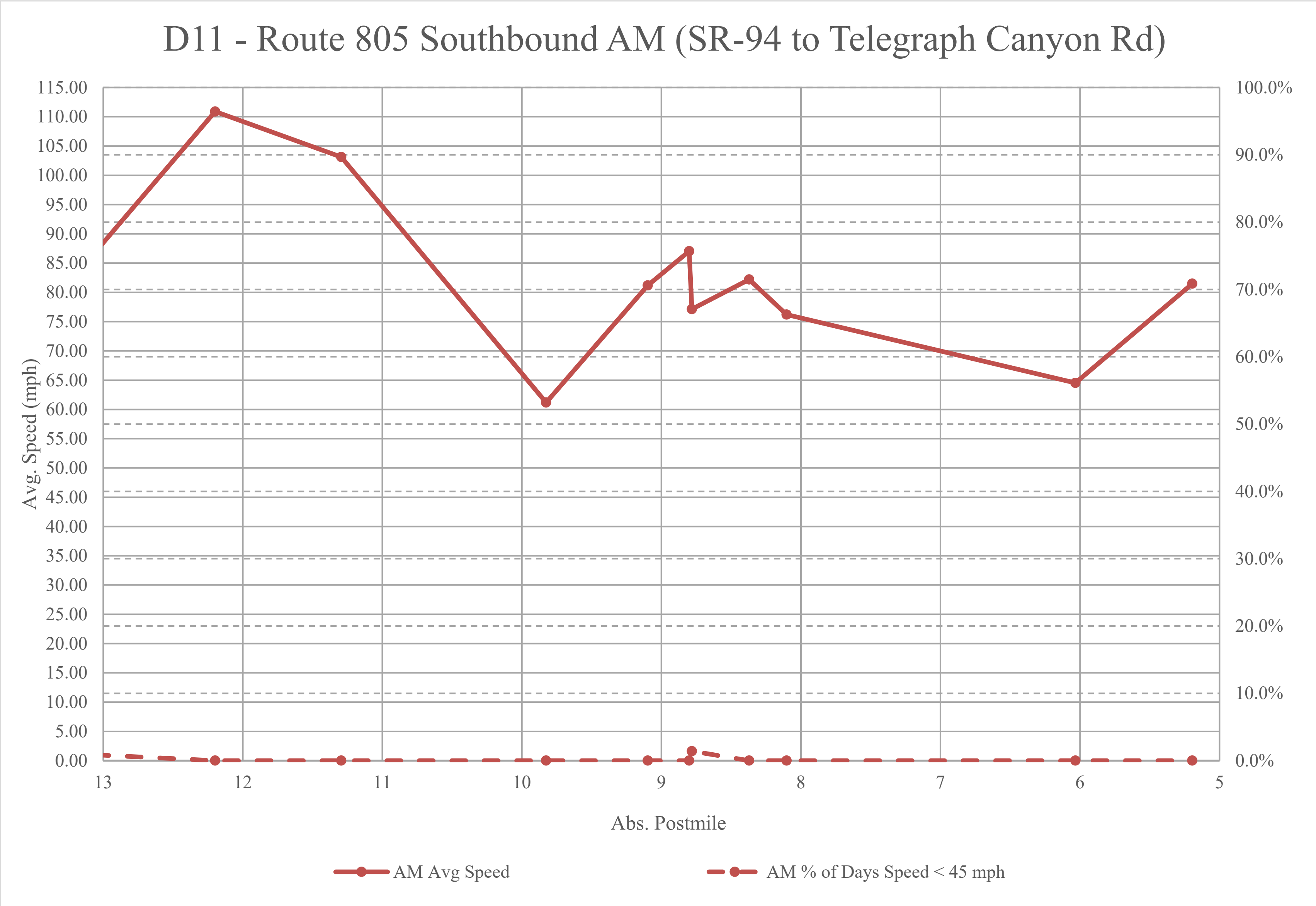


FIGURE 11.8 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 805 (a), PM

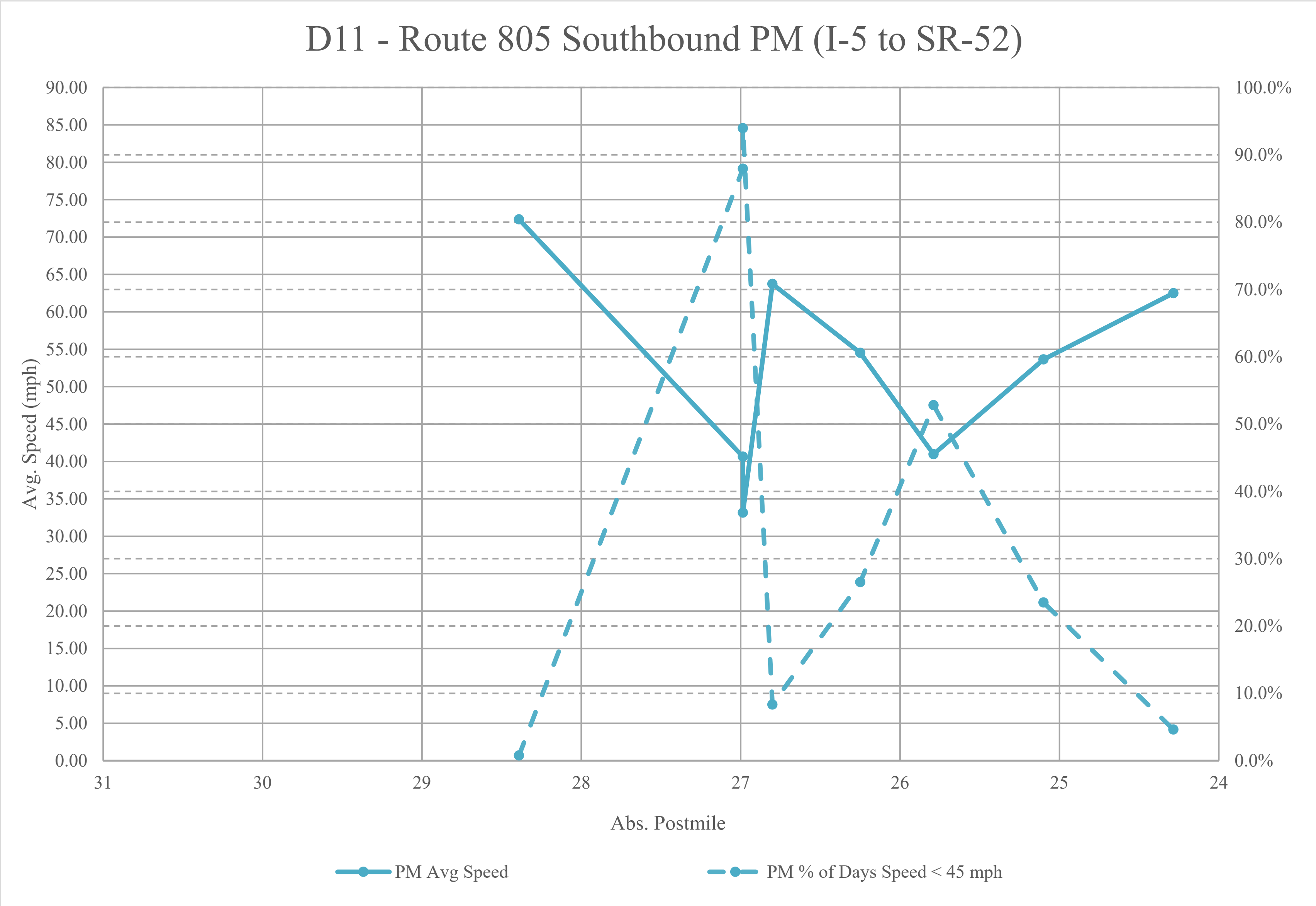


FIGURE 11.9 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 805 (b), PM

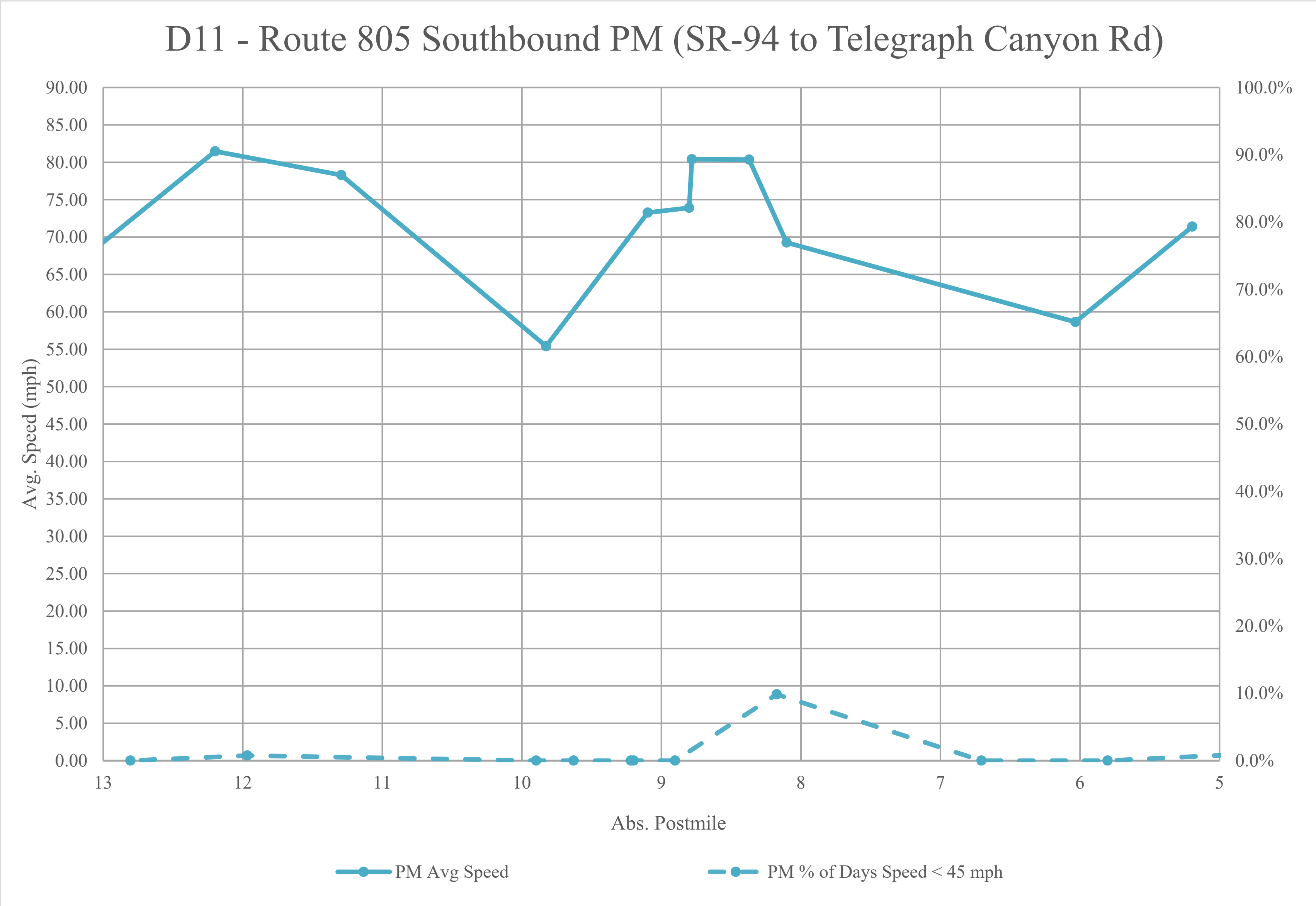


FIGURE 12.1 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 5, AM

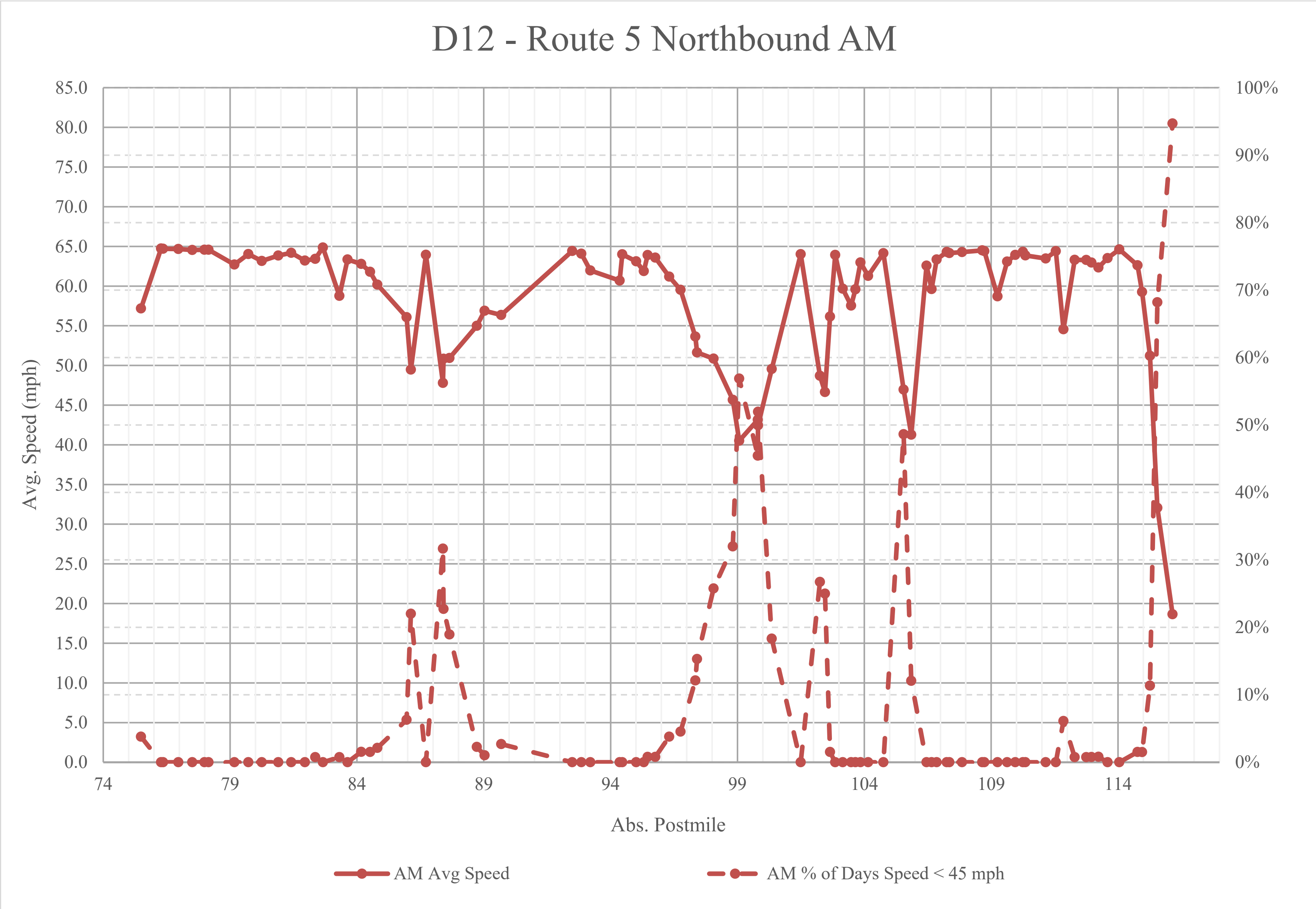


FIGURE 12.2 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 5, PM

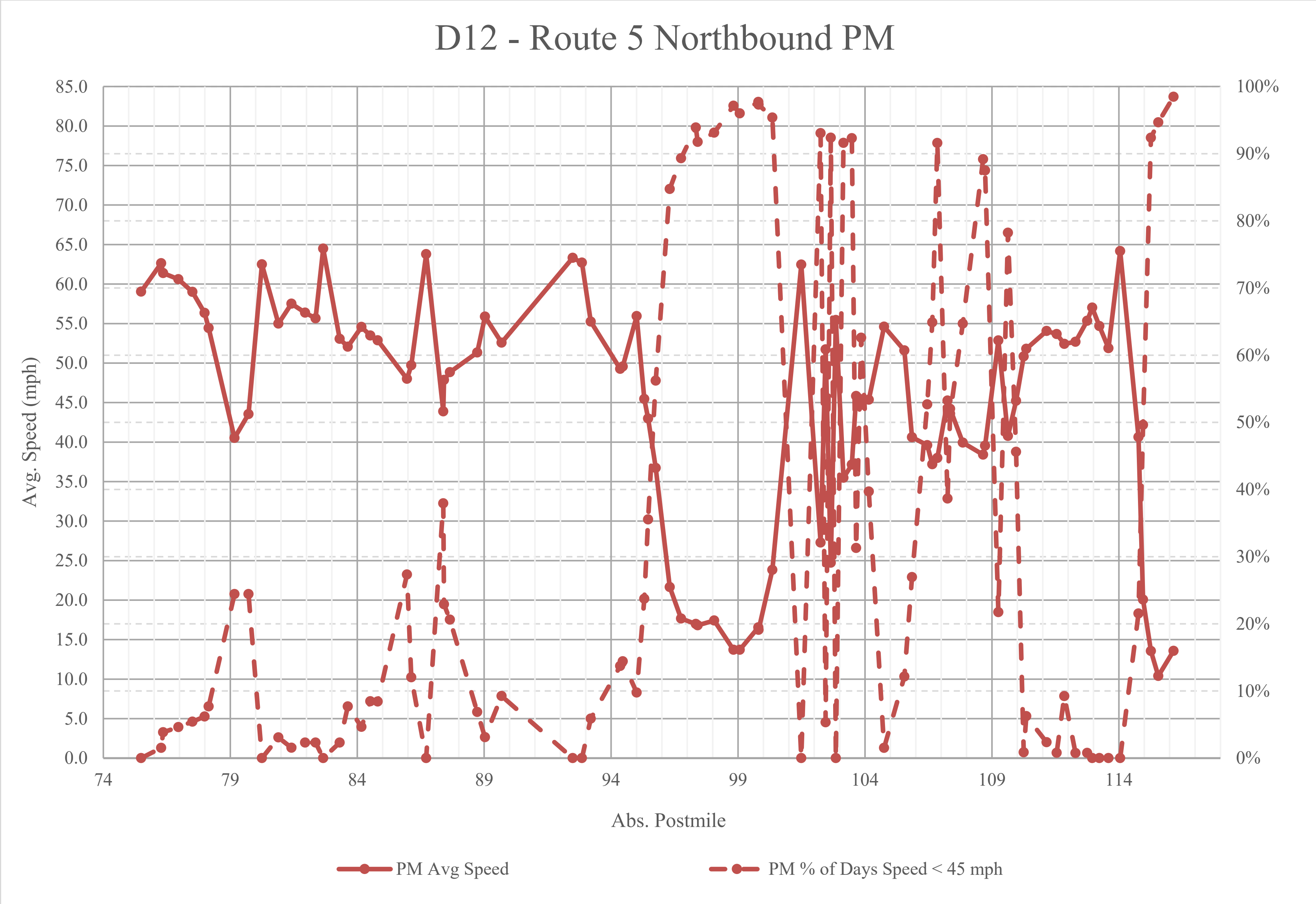


FIGURE 12.3 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 5, AM

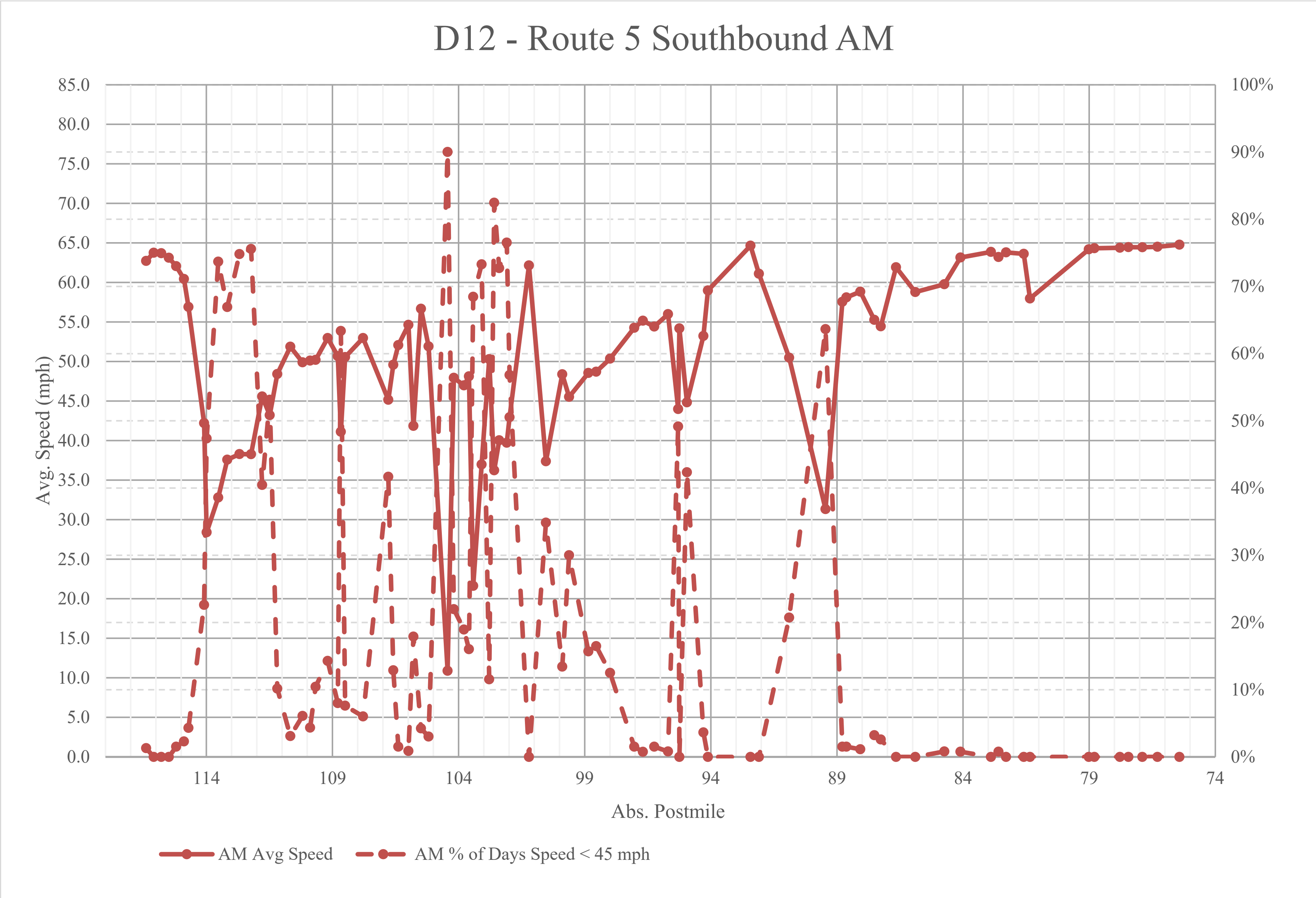


FIGURE 12.4 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 5, PM

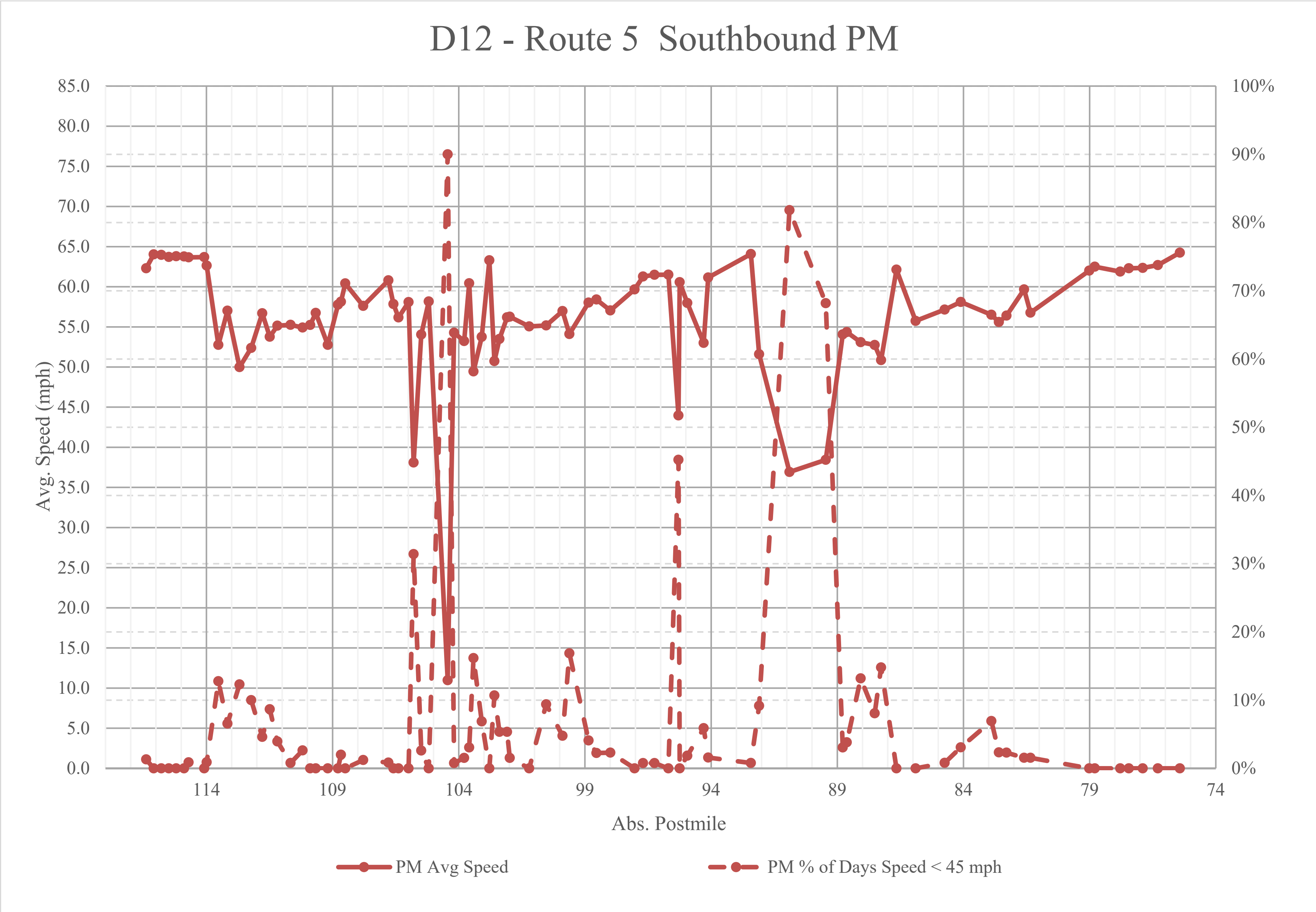


FIGURE 12.5 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 22, AM

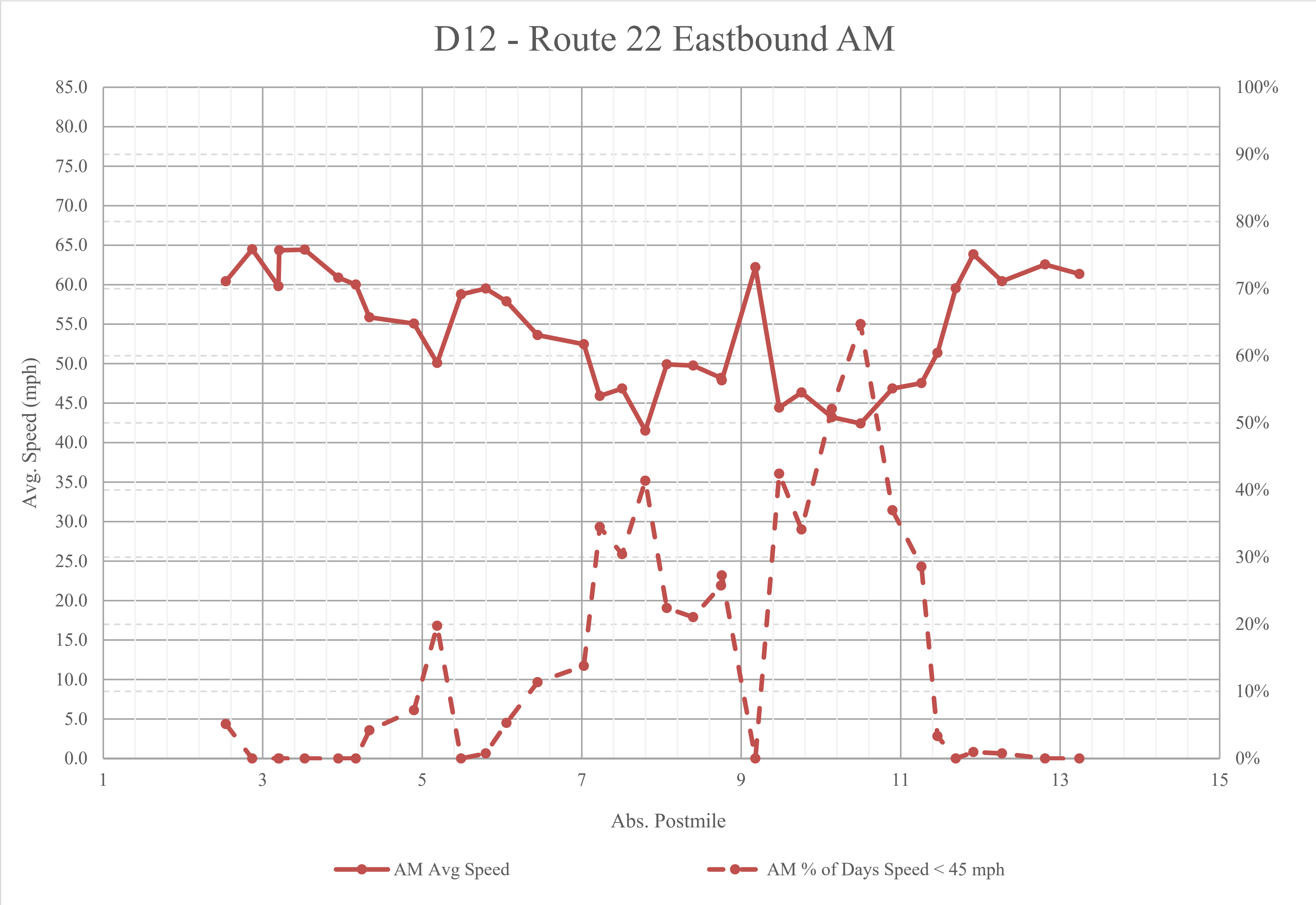


FIGURE 12.6 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 22, PM

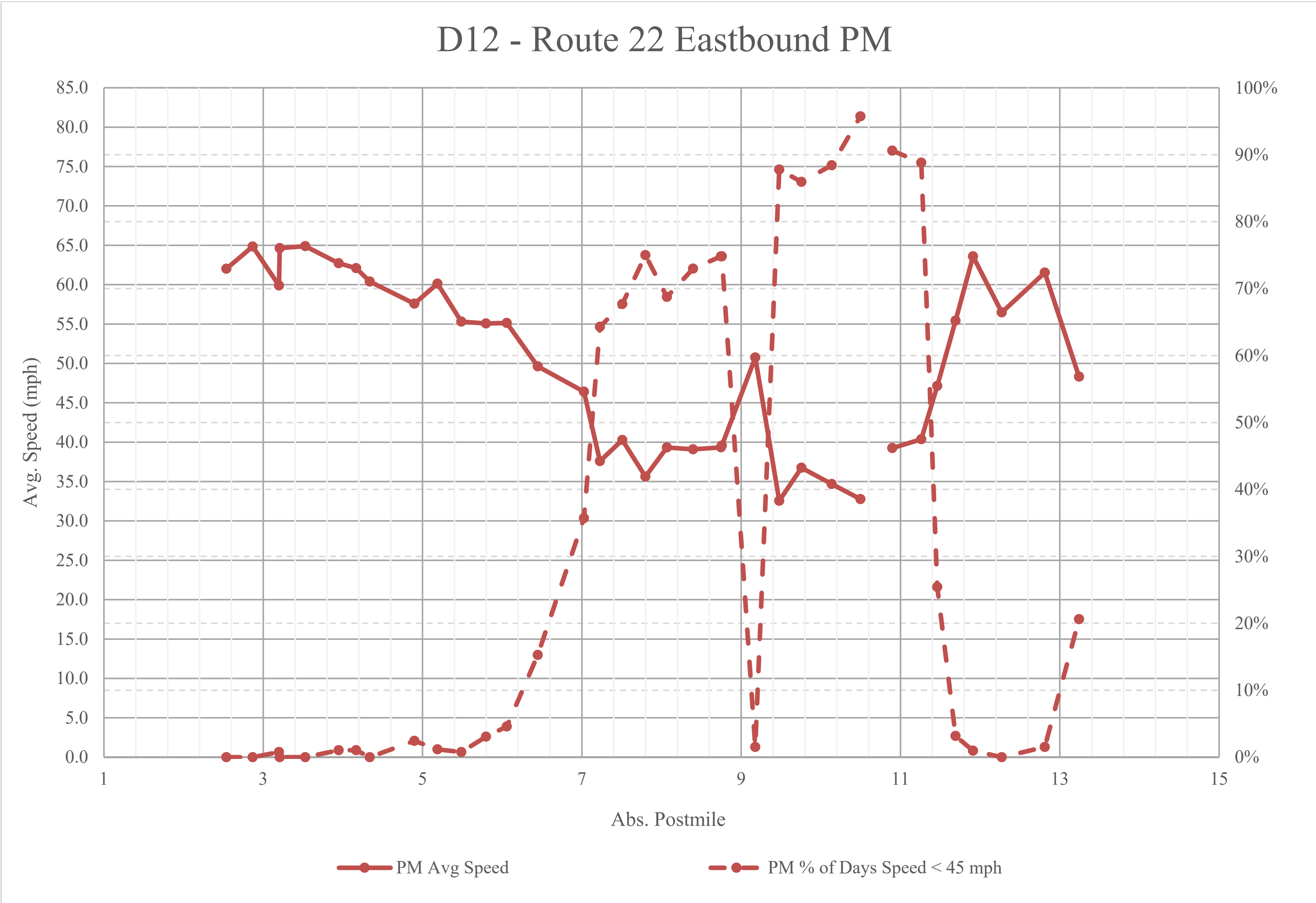


FIGURE 12.7 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 22, AM

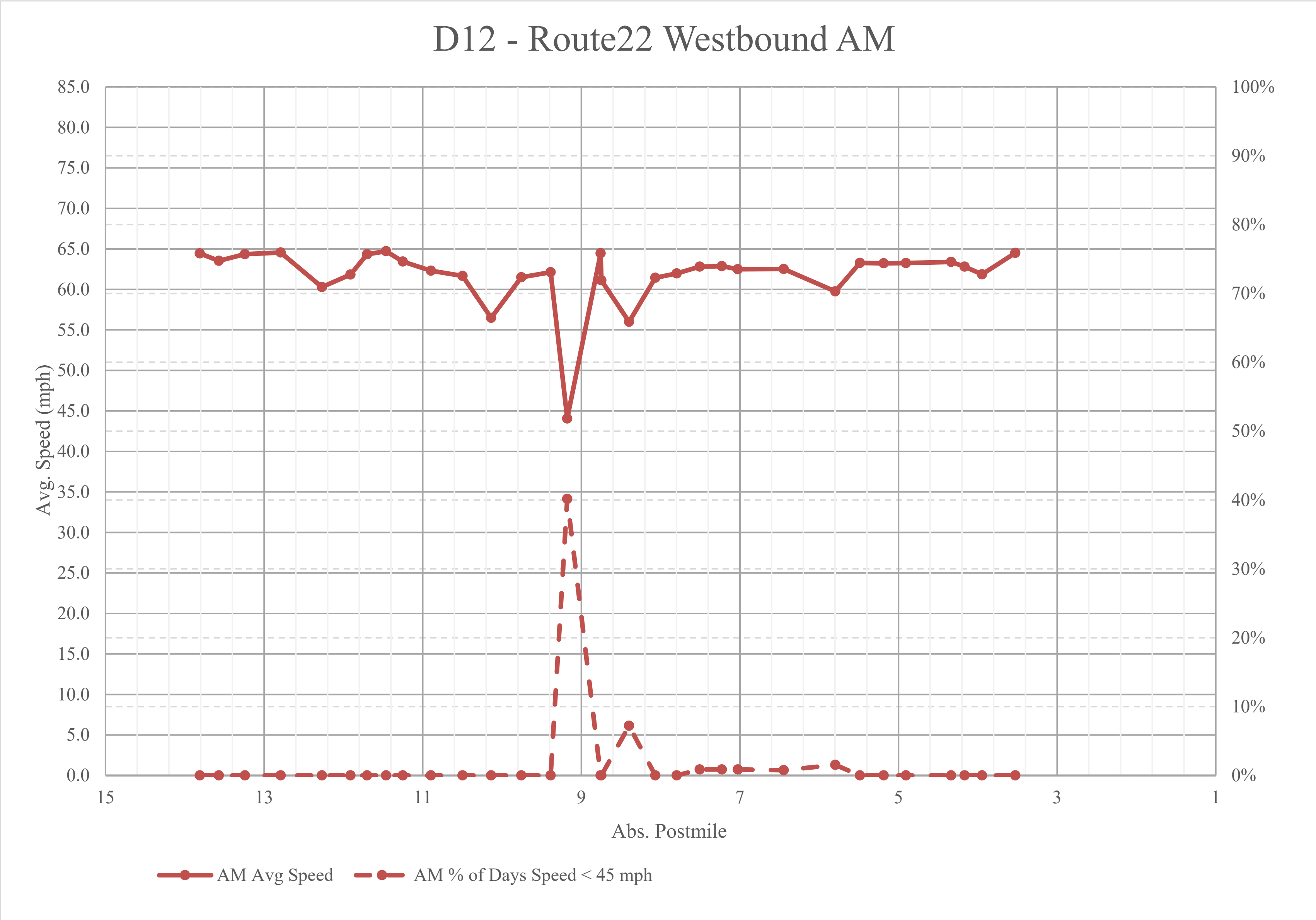


FIGURE 12.8 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 22, PM

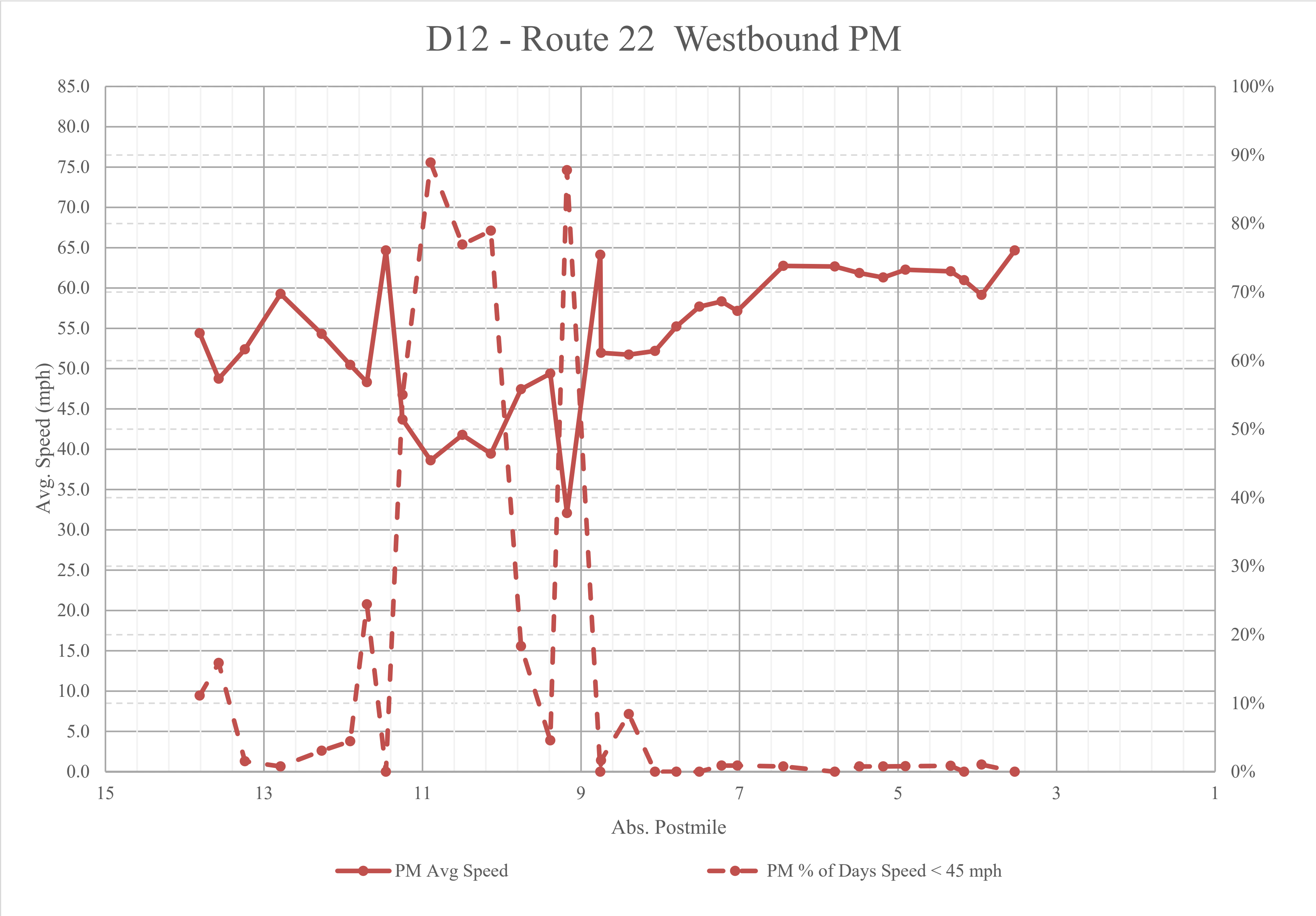


FIGURE 12.9 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 55, AM

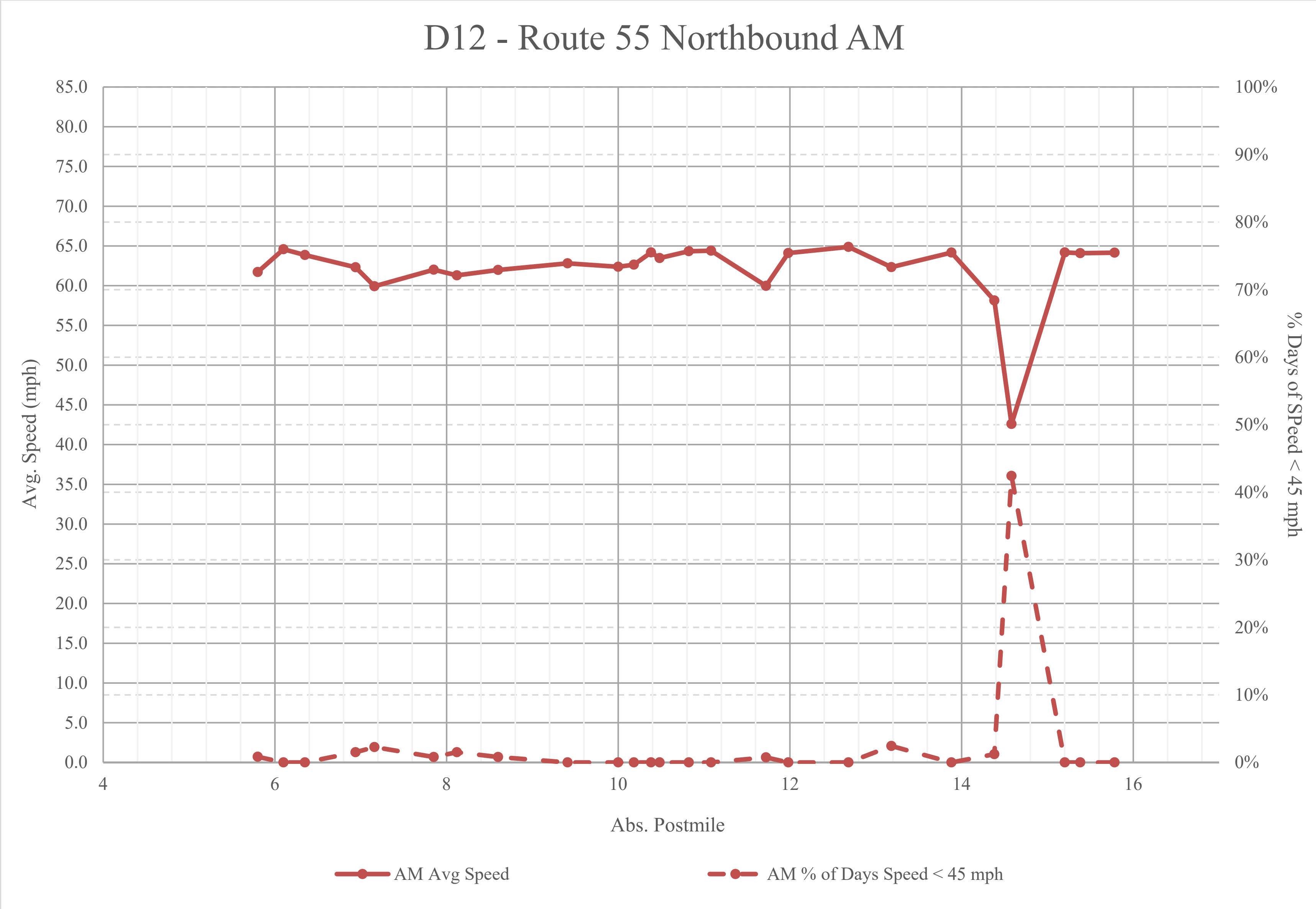


FIGURE 12.10 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 55, PM

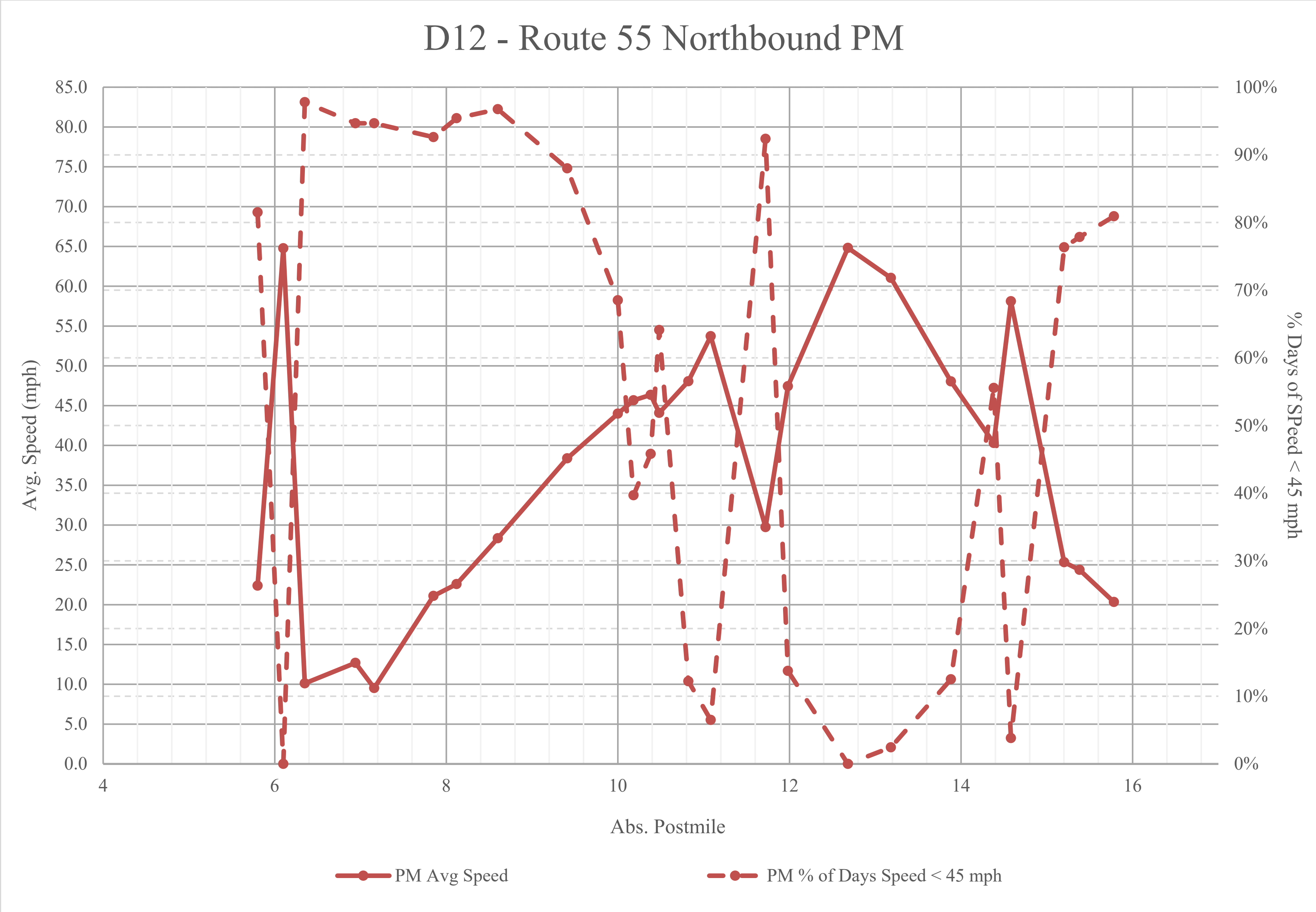


FIGURE 12.11 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 55, AM

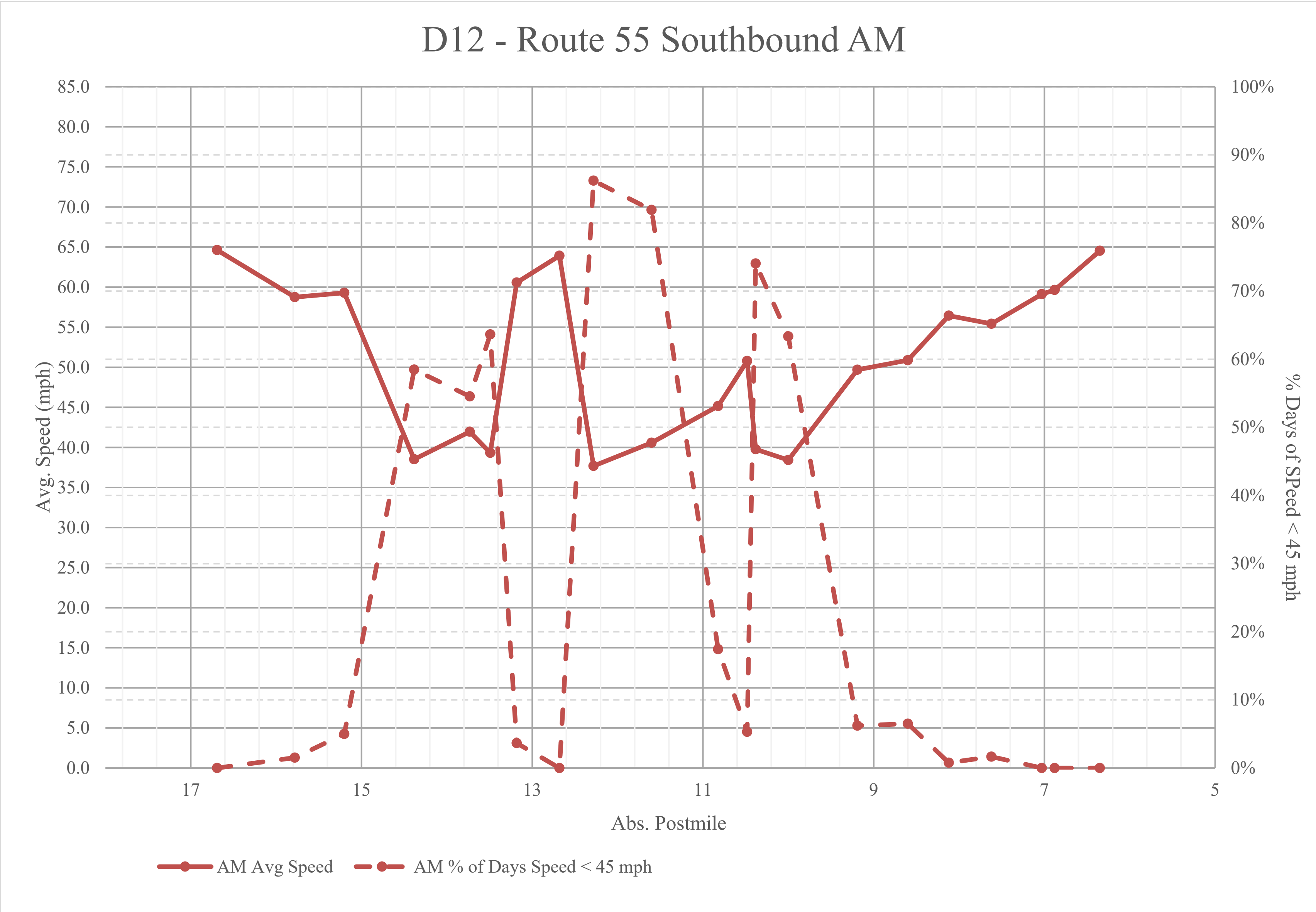


FIGURE 12.12 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 57, AM

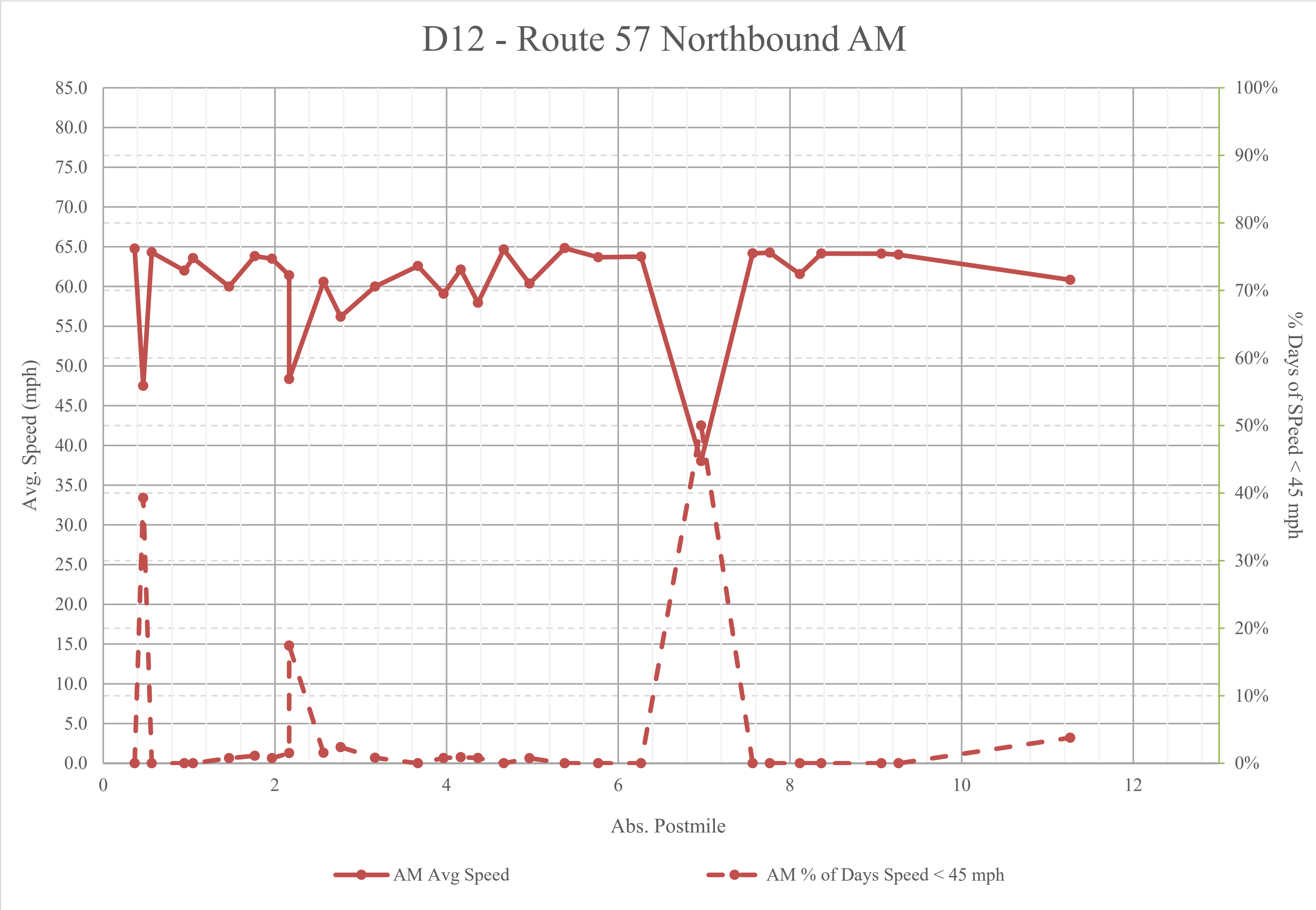


FIGURE 12.13 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 57, PM

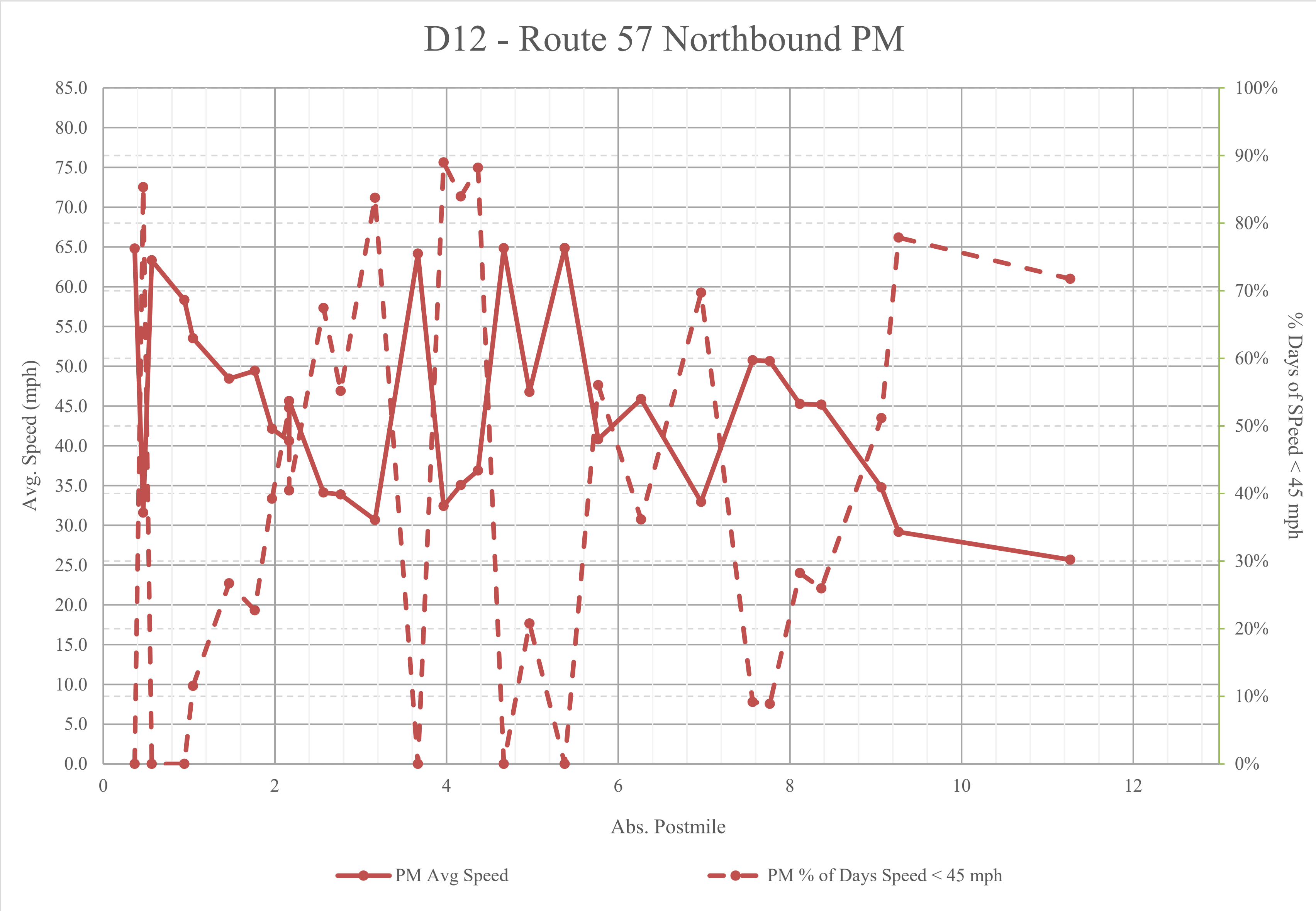


FIGURE 12.14 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 57, AM

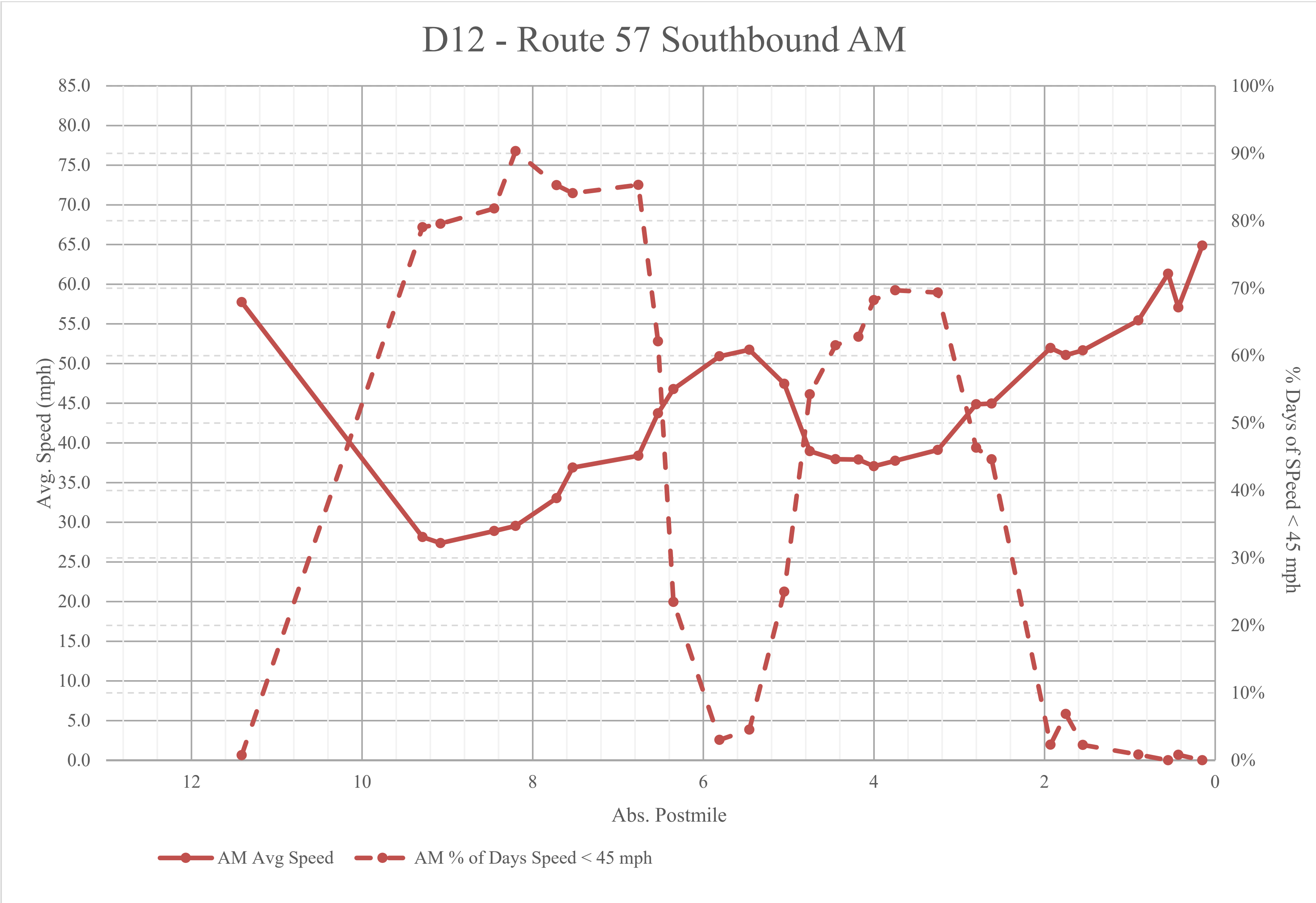


FIGURE 12.15 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 57, PM

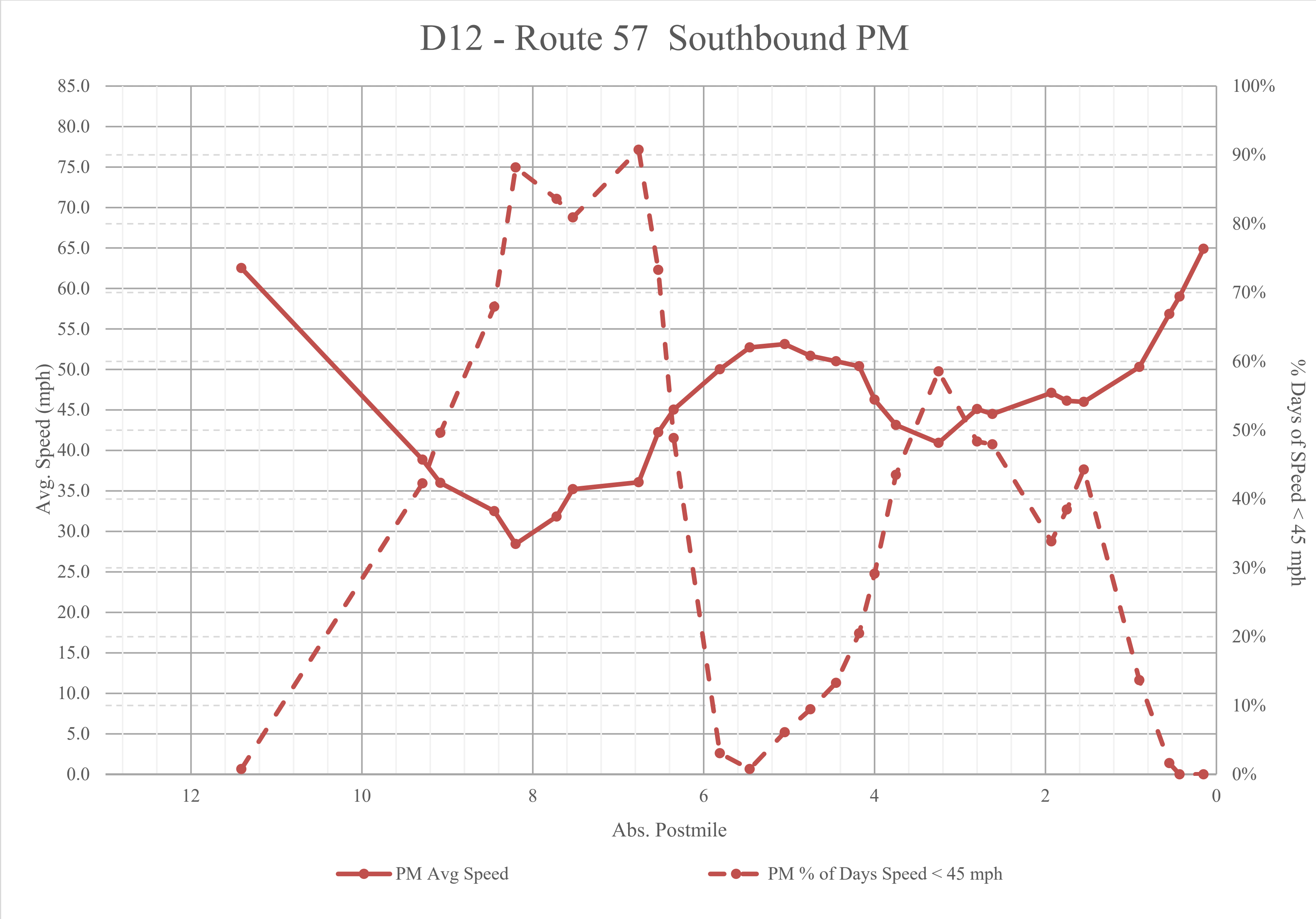


FIGURE 12.16 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 91, AM

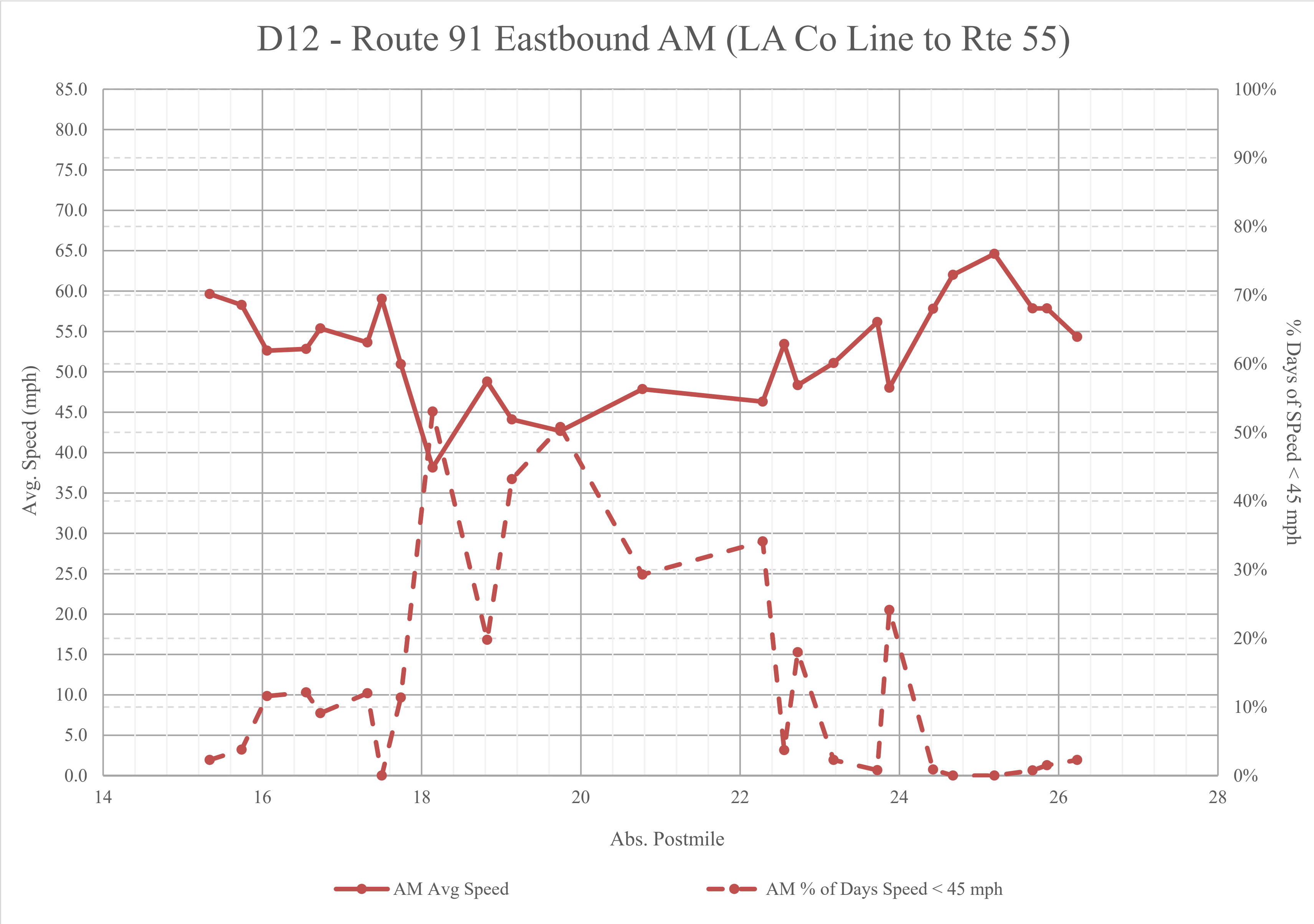


FIGURE 12.17 SPEED AND DEGRADATION PROFILE - EASTBOUND ROUTE 91, PM

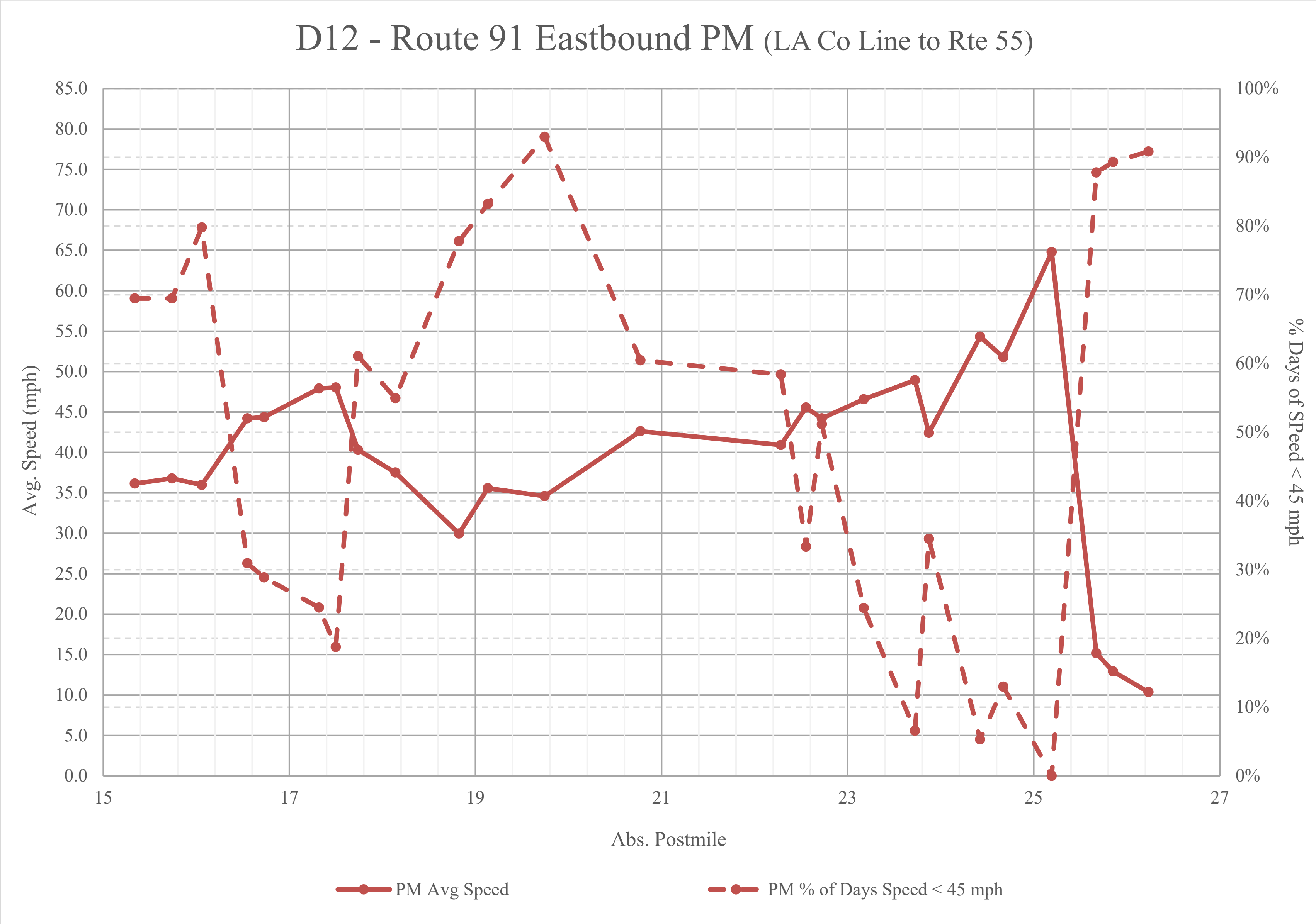


FIGURE 12.18 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 91, AM

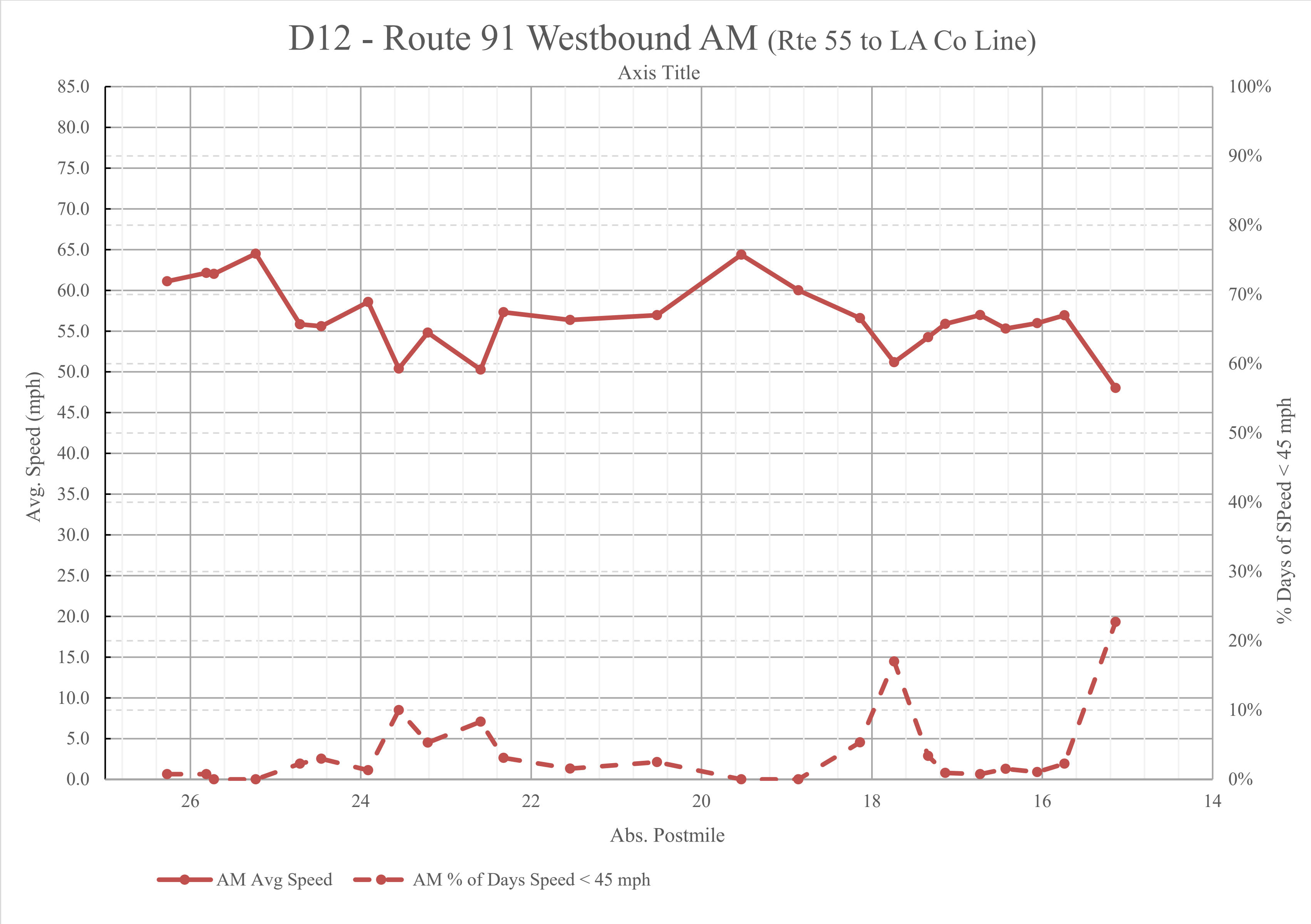


FIGURE 12.19 SPEED AND DEGRADATION PROFILE - WESTBOUND ROUTE 91, PM

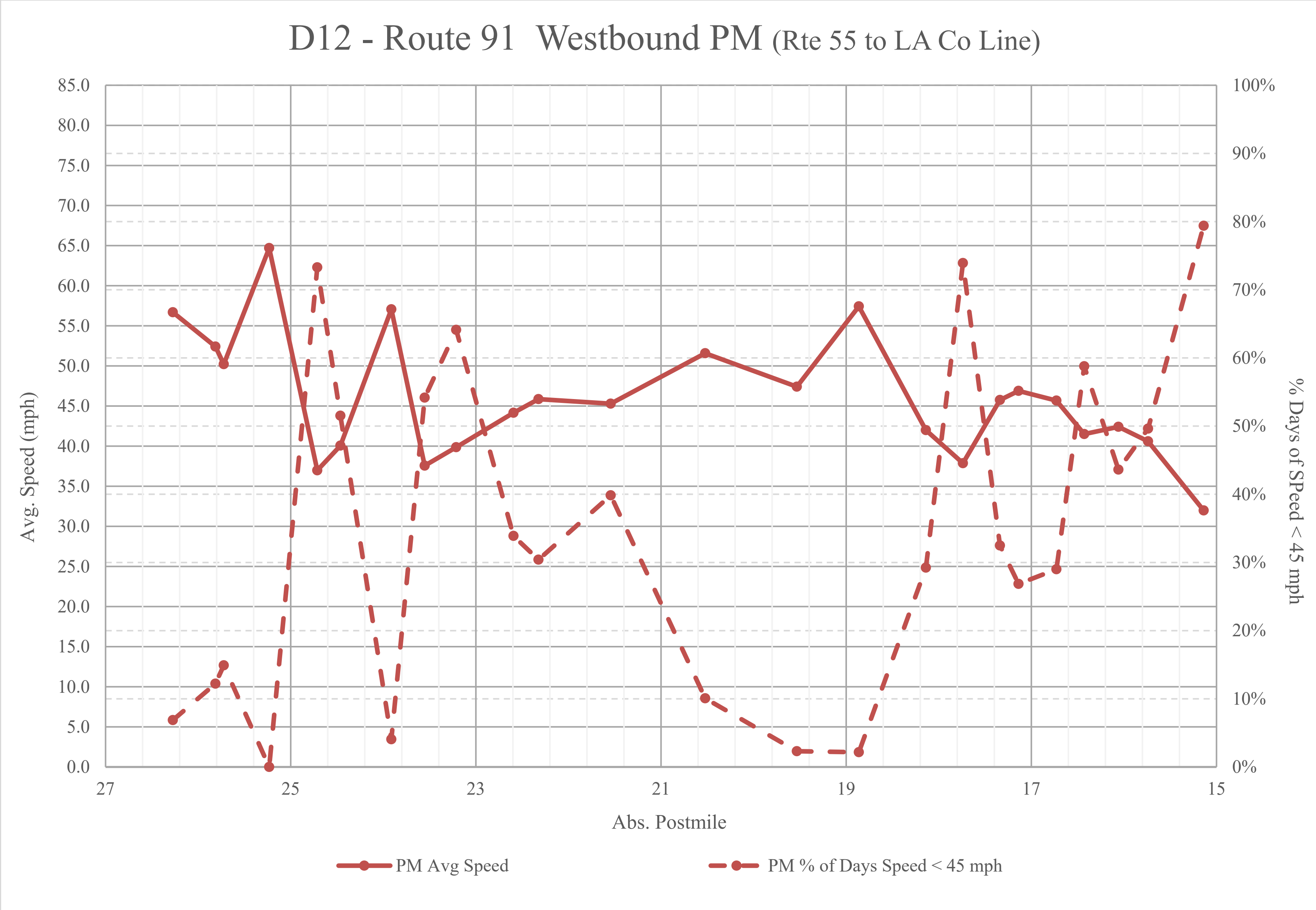


FIGURE 12.20 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 405, AM

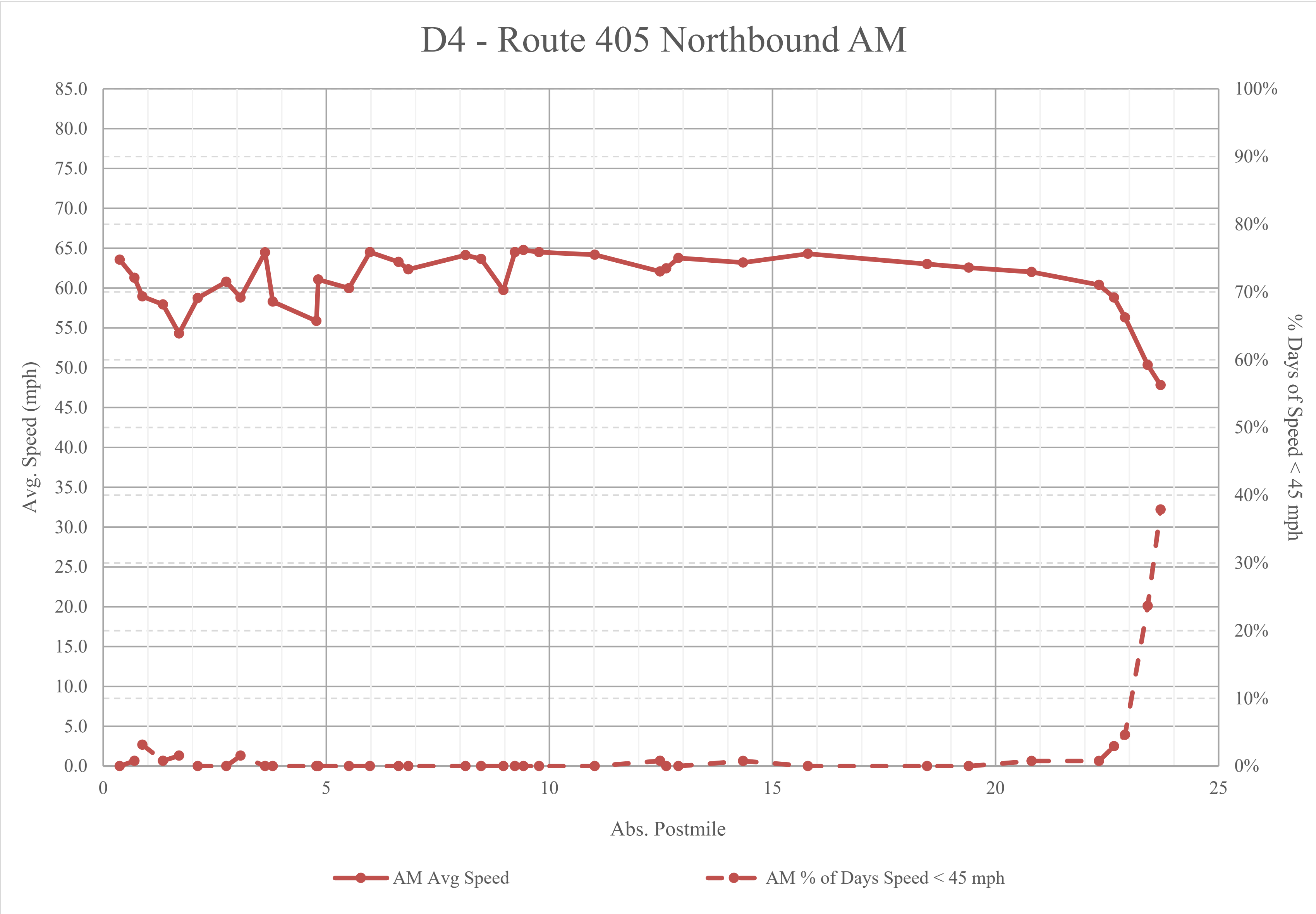


FIGURE 12.21 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 405, PM

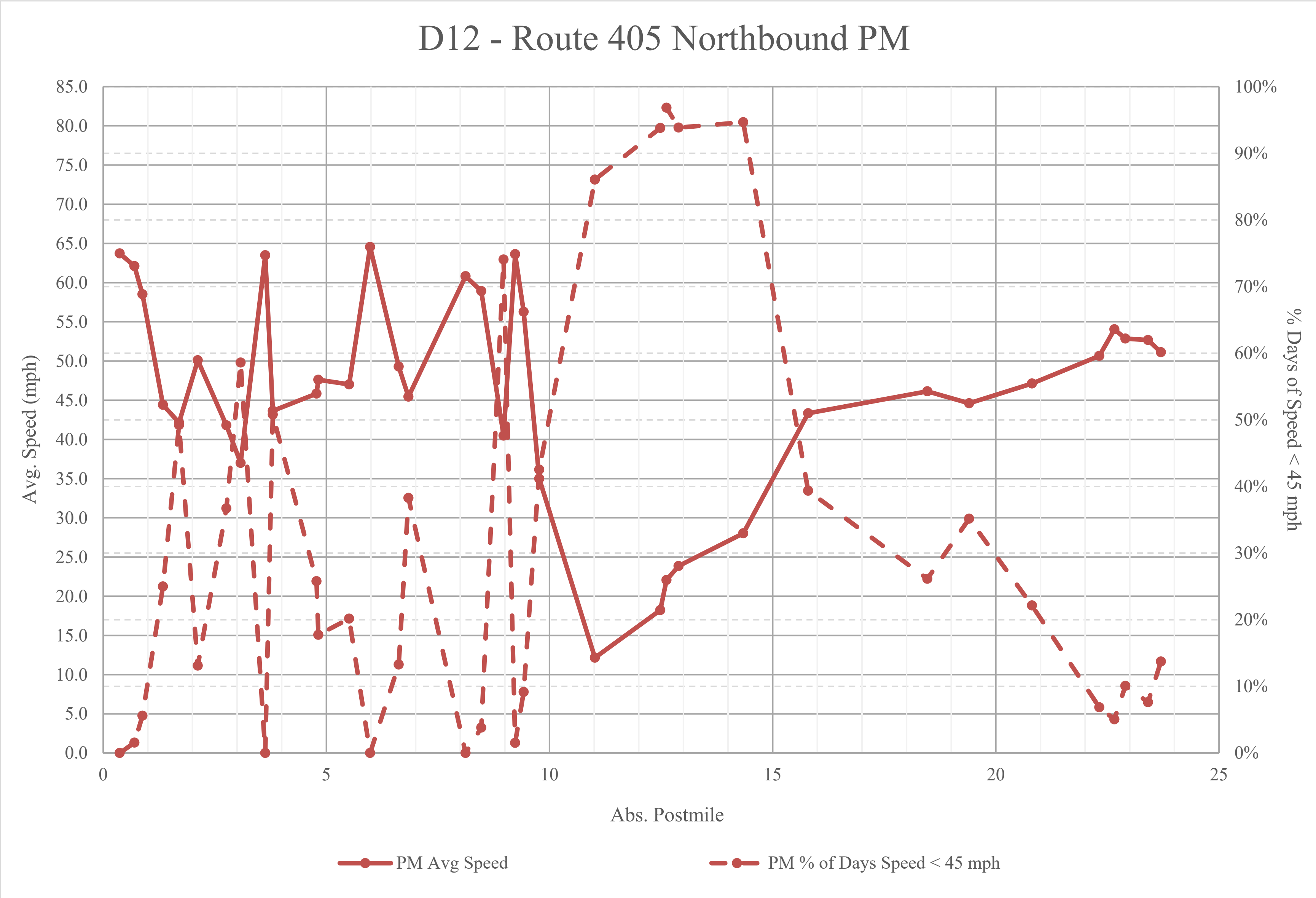


FIGURE 12.22 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 405, AM

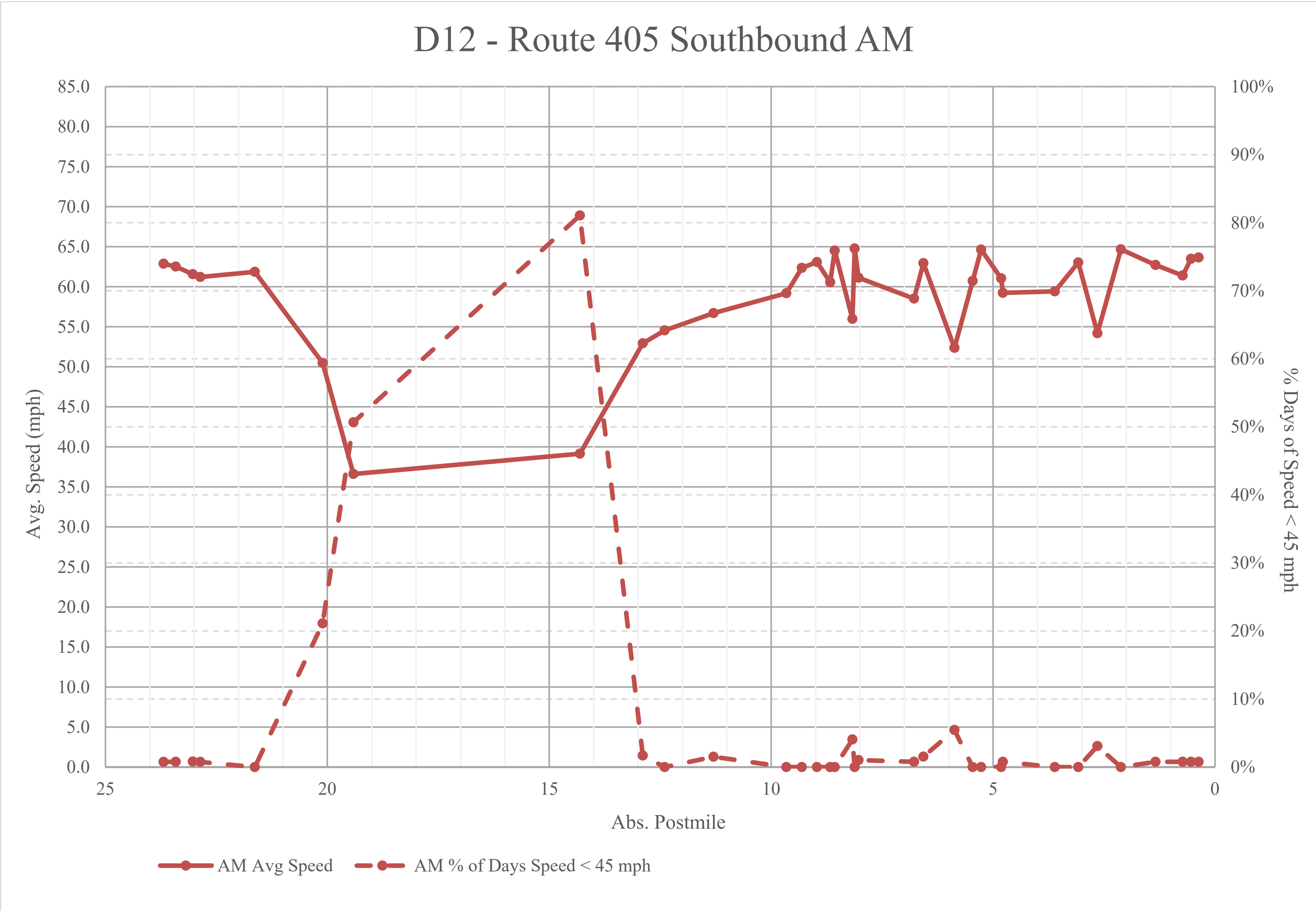


FIGURE 12.23 SPEED AND DEGRADATION PROFILE - SOUTHBOUND ROUTE 405, PM

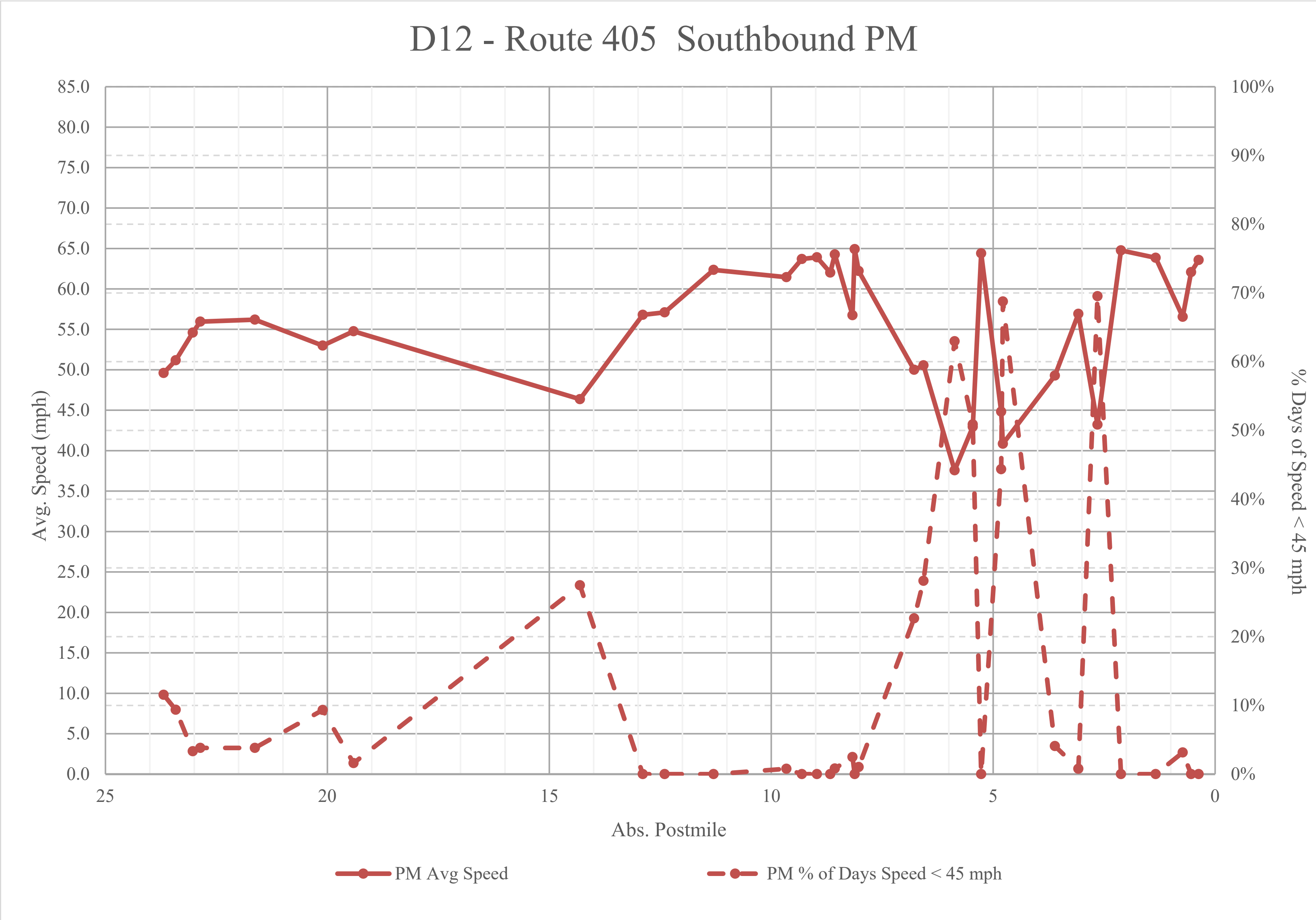
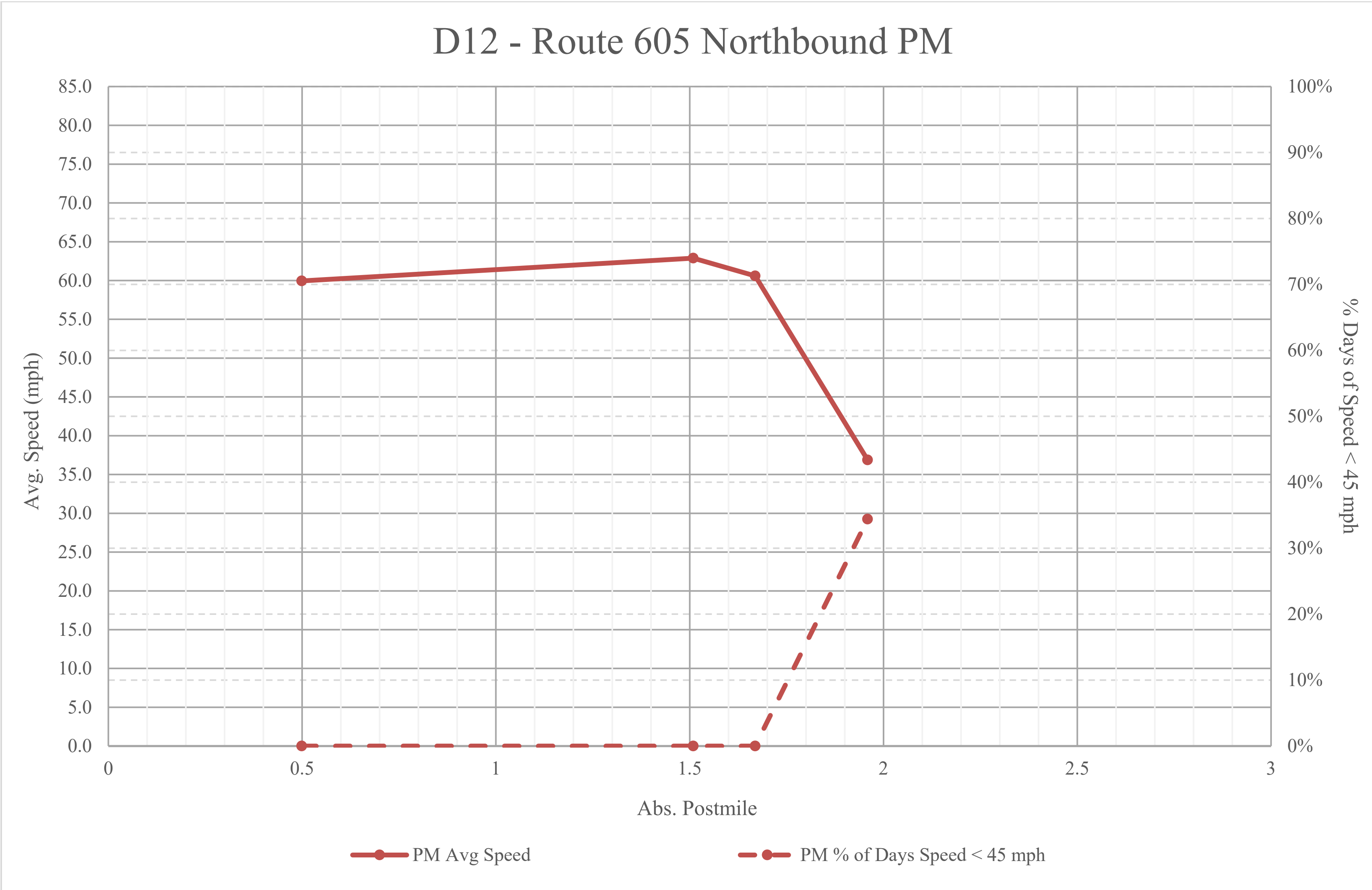


FIGURE 12.24 SPEED AND DEGRADATION PROFILE - NORTHBOUND ROUTE 605, PM



8. APPENDIX C

THIS APPENDIX C CONTAINS INFORMATION FROM DISTRICT 7.

Future Approach Strategies to HOV/HOT Degradation

District 7's HOV lane operations have been negatively impacted by the single occupant vehicle motorists utilizing the Clean Air Vehicle (CAV) Decal program. To continue towards the reduction of greenhouse gases (GHGs) by promoting motorists to switch over from gas combustion engine vehicles to electric vehicles the CAV decal program continues but is set to expire in 2025.

District 7 is still actively mitigating congestion while implementing Caltrans' Strategic Goals of addressing the reduction of greenhouse gases (GHGs), safety, and equity. The following alternative approaches, which have been studied and supported by FHWA, will help address the HOV/HOT degradation and should be considered as remediation strategies.

In the future, District 7 will propose a proactive approach with active traffic management which implements speed harmonization along the corridors, by using overhead digital speed signs. District 7 with other districts provided data supporting how the friction factor impacts the HOV lane vehicles to experience lower speeds, increased congestion by potential buffer jumpers from the general-purpose lanes and hindering egress into the congested general-purpose lanes. Other states are implementing speed harmonization such as Colorado, the link provided below. District 7 would benefit greatly from the implementation of the mentioned concept. For instance, I-405 Northbound near the merge with I-5, the NB I-405 experiences the end of the HOV lane, an outside lane drop with the confinement of a tunnel. Another location would be for the Southbound directions for both the I-5 and LA-14 where both freeway volumes merge into the I-5, vehicles' upstream speeds are too great for the downstream vehicle flow to adjust hence a congested bottleneck. (https://slate.com/human-interest/2011/10/rolling-speed-harmonization-how-colorado-fights-congestion-on-i-70.html)

Provided is a link from FHWA website supporting this concept: https://safety.fhwa.dot.gov/provencountermeasures/variable-speed-limits.cfm.
District 7 along with the support with FHWA corridors would benefit with a lower posted speeds which will also coincide with Caltrans Strategic Goals based on reducing GHG's, increasing safety and by addressing equity.

With further support according to the FHWA "while the laws of physics make it very clear that speed and crash severity are inextricably linked…there has been a good deal of controversy over the impact of speed on crash occurrence." Although there is controversy regarding whether higher speeds contribute to increased numbers of crashes, FHWA concluded, based on a 2004 study, that "the most recent and statistically robust research on speed and crash occurrence fairly definitively indicates that, all other factors being equal, increased speeds increase crash occurrence."

Addressing Caltrans Strategic Plan of Safety, Equity, and Reduction of GHGs, District 7 would benefit by implementing lower speed limits to a maximum speed of 55 mph which has the following positive effects:

- Vehicles at 55 mph emit lower GHGs.
- Increases equity.
- Increases safety.
- Produces fuel savings to motorists.
- Improves traffic patterns by reducing traffic bottlenecks by allowing downstream traffic to recover before more vehicle volumes contribute to congestion build-up.

District 7 is composed of new and old segments of freeways and while the urban sprawl is continuing outward, along with cities seeking more housing, lowering the speed limit along with active traffic management is a viable tool especially since building out of congestion is not an option. Express lanes have increased congestion and disseminated the carpoolers to single-occupant vehicles and negatively impacted the general-purpose lanes along the corridors. To address congestion, the HOV lanes have proven effective by reducing vehicles, therefore reducing GHGs with equity and reducing congestion in the general-purpose lanes as well. Active traffic management with a reduced speed limit to 55 mph as noted above, will have positive results toward Caltrans Strategic Goals of reduction of GHGs, increased safety, and equity which has been proven by FHWA's studies.

Interesting Facts/Key points (Go Slow To Go Fast, by Tom Vanderbilt: https://slate.com/human-interest/2011/10/rolling-speed-harmonization-how-colorado-fights-congestion-on-i-70.html):

- "One to key to explaining why is the merge zones. At the entrance to the Eisenhower Tunnel, CDOT notes, every minute of backup translates to eight minutes of recovery time. This is another law of traffic: It takes exponentially longer to get out of a traffic jam than to get into one. Rather than having drivers go full-tilt into a jam at the tunnel entrance, drivers approach more slowly; even though their speed may be temporarily reduced, the system is now processing vehicles faster. It's the famous rice-and-funnels effect popularized by former Washington transportation commissioner Doug MacDonald: The slower you pour the rice, the faster it gets through the bottleneck.", which substantiates the reduction of the static posted speed limit of 55 mph along with active traffic dynamic posted speed limits will allow more vehicles through the facility faster with less congestion and less production of pollution."

- "Colorado's program is an exercise in what's known as "active traffic management." Rather than just posting static speeds and fixed infrastructure, and letting drivers work things out for themselves (a more passive approach), the idea is to shape traffic algorithmically based on changing conditions—automatically slowing drivers ahead of a construction work zone, opening up a shoulder when peak congestion levels are hit. There is a bounty of studies from Europe showing that technologies like "variable speed limits," which generate specific speeds depending on traffic conditions, can, under the right conditions, help reduce crashes and even improve highway throughput (even as mean speeds are lowered)."
- "Traffic engineers know, for example, that a highway can move more vehicles per hour at 55 mph than at 85 mph."

Other references:

- Link to Georgia Institute of Technology: https://smartech.gatech.edu/bitstream/handle/1853/53098/TOTH-DISSERTATION-2014.pdf
- Guin, A., Hunter, M., and Guenslert, R. (2008). Analysis of Reduction in Effective Capacities of High-Occupancy Vehicle Lanes Related to Traffic Behavior. Transportation Research Record 2065: 47-53.

9. APPENDIX D

Table 4.4-1.(DISTRICT 7)

Table 4.4-1. The comparison of percentage of degraded days in the year 2019 and 2021. The percentage value for each facility represents an average on an HOV/HOT lane, calculated from individual PeMS' detection stations with 100% observation both in 2019 and 2021.

FACILITY	AVERAGE PERCENTAGE OF DEGRADED DAYS		PERCENTAGE INCREASE+/DECREASE-
	YEAR 2019	YEAR 2021	
5N-PM	48.1%	56.3%	8.2%
5S-AM	32.9%	26.3%	-6.6%
10E HOT_PM	16.6%	27.2%	10.6%
10E HOV-PM	82.8%	92.1%	9.3%
14N-PM	28.2%	38.4%	10.2%
14S-AM	46.2%	57.1%	10.9%
91E-PM	72.7%	56.7%	-16.0%
91W-AM	55.2%	35.5%	-16.8%
91W-PM	35.7%	37.8%	2.1%
105E-PM	59.6%	54.1%	-5.6%
110N HOT-AM	37.6%	48.1%	10.5%
110N HOT-PM	16.3%	60.6%	44.4%
118E-PM	32.8%	24.2%	-6.7%
134E-PM	54.0%	42.7%	-11.3%
405N-AM	42.4%	32.1%	-10.3%
405N-PM	40.6%	41.1%	0.5%
405S-AM	19.4%	20.6%	1.0%
405S-PM	54.5%	56.9%	2.4%
605N-PM	52.4%	44.1%	-11.0%
605S-AM	32.5%	22.6%	-11.8%
605S-PM	39.3%	38.3%	-3.3%