RAILROAD GRADE CROSSING

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Report to the Legislature
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Executive Summary

Chapter 12, Statutes of 2015 (Assembly Bill 95), is the transportation budget trailer bill. Section 17 of this legislation requires the California Department of Transportation (Caltrans) to examine railroad grade crossings with a high risk of accidents on state-supported intercity rail passenger corridors. The grade crossing examination is required to consider improvements to safety, reductions to greenhouse gas (GHG) emissions, and improvements to intercity rail passenger service levels. This legislation requires Caltrans to prepare and submit a report on the results of its examination to the Legislature. Section 17 of Chapter 12 states that:

> "The Department of Transportation shall prepare a report examining improvements to safety, reduction of greenhouse gas emissions, and improvements to intercity rail passenger service levels that could be achieved through investments in improvements to grade level crossings or construction of grade separation projects at key intersections along State-sponsored intercity rail routes. For purposes of this report, "key intersections" means intersections identified in the Federal Railroad Administration's Web Accident Prediction System with a predicted collision risk of 0.15 or greater. The report shall be provided to the Legislature on or before April 1, 2016, in the manner provided in Section 9795 of the Government Code."

The Railroad Grade Crossing Evaluation Report (Report) was prepared to comply with the California State Legislature's request to examine selected grade crossings on State-supported intercity passenger rail corridors for:

- Improvements to safety
- Reduction in GHG emissions
- Improvements to intercity rail passenger service levels

This Report examines the effect of constructing at-grade safety improvements and the construction of grade separations at highway-railroad grade crossings which includes any surface street. These improvements can provide the following benefits:

- More efficient flow of trains
- Reduction in delays of trains
- Increased transportation choices when more trains operate in the corridor
- Increased transportation choices when trains operate at faster speeds
- Reduced emissions from motor vehicles associated with crossing delays
- Enhanced safety and traffic flow on surface streets

A discussion of the findings of the examination of each grade crossing is included in Section 4, Crossing Details and Evaluation.

- Reduction to GHG emissions by construction of a grade separation
- Improvement to rail passenger service levels by installation of at-grade safety improvements or construction of a grade separation
- Approximate cost to construct a grade separation

The table below summarizes each grade crossing by Accident Prediction Value, Approximate Cost of improvement Service Level, and GHG Reduction in metric tons with a Grade Separation.

Grade Crossing Summary					
Existing Road Crossing (City/County)	**FRA Accident Prediction Value (2014)**	**At – Grade Improvement Cost (In Millions)**	**Grade Separation Cost (Approximation In Millions)**	**Service Level [3] Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Rosecrans /Marquardt 027656A (Santa Fe Springs/Los Angeles County)	0.29[1]	N/A	$ 120	Significant	5,059 / 4,882
Grand Ave/Santa Ana 026741L (Santa Ana/Orange County)	0.28	$ 1	$ 90	Average	720 / 694
Hesperian Blvd. 749745L (San Leandro/Alameda County)	0.28	N/A	$ 90	Average	223 / 215
Grand Ave/Carlsbad 026820X (Carlsbad/San Diego County)	0.25	$ 1	$ 86	Average	275 / 266
La Palma Ave 026642N (Anaheim/Orange County)	0.24	$ 1	$ 86	Average	716 / 691
Ferry St. 751734Y (Martinez/Contra Costa County)	0.23 [1]	N/A	$ 25	Average	216 / 208
Cutting Blvd. 751678U (Richmond/Contra Costa County)	0.21 [1]	N/A	$ 83	Average	2,361 / 2,278
Vineland Ave. 746006D (Near Burbank/Los Angeles County)	0.18	$ 1	$ 86	Average	769 / 742

[1] Currently Under Contract or Study

[2] California High Speed Rail Funded Project

[3] Service Improvement are Considered Minimal at Spot Locations. Refer to Discussion in Report

Grade Crossing Summary					
Existing Road Crossing (City/County)	**FRA Accident Accident Prediction Value (2014)**	**At – Grade Improvement Cost (In Millions)**	**Grade Separation Cost (In Millions)**	**Service Level [3] Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Los Nietos Rd 027650J (Santa Fe Springs/Los Angeles County)	0.18	$ 1	$ 106	Average	1,834 / 1770
7th St 028424N (Hanford/Kings County)	0.18	$ 1	$ 86	Average	277 / 267
Washington St 026857M (San Diego/San Diego County)	0.17	$ 1	$ 77	Average	5,042 / 4,866
Mission Ave 027062B (Oceanside/San Diego County)	0.17 [1]	N/A	$ 90	Average	170 / 164
Grape St 026867T (San Diego/San Diego County)	0.17	N/A	$ 320	Average	1,314 / 1,268
Hawthorn St 026866L (San Diego/San Diego County)	0.17	N/A	$ 320	Average	1,237 / 1,194
Kansas Ave 028400A (Near Guernsey/Kings County)	0.16	N/A	$ 19	Average	297 / 287
11th Ave 028427J (Hanford/Kings County)	0.16	$ 1	$ 130	Average	565 / 545
Bellevue Ave 028688J (Atwater/Merced County)	0.16	$ 1	$ 66	Average	107 103
Church Ave 028512Y (Fresno/Fresno County)	0.15	N/A	CAHSR [2]	Average	772 / 745

[1] Currently Under Contract or Study

[2] California High Speed Rail Funded Project

[3] Service Improvement are Considered Average at Spot Location Refer to Discussion in Report

This Report examined 18 highway-railroad grade crossings on State-supported intercity rail passenger corridors: Pacific Surfliner, San Joaquin, and the Capitol. These 18 crossings were identified as the most accident prone crossings on the corridors, with a predicted collision risk of 0.15 or greater, using the FRA's Web Accident Prediction System

GHG emissions can be reduced by the construction of grade separations. This decreases emissions by reducing idling time while vehicles wait for trains to pass through the crossing. Reduction in annual metric tons of carbon dioxide by constructing grade separations at the crossings examined, ranged from a low of 107 for Bellevue Avenue in Atwater, to a high of 5,059 at Rosecrans/Marquardt in Santa Fe Springs.

Safety can be improved by installation of at-grade safety improvements and the construction of grade separations. Installation of quad gates and pedestrian gates, with fencing, at the 18 crossings that were examined, can minimize crossing accidents. The construction of grade separations eliminates at-grade crossing accidents.

Service levels can minimally be increased by increasing the speed of trains by installing quad gates at the crossings or by constructing a grade separation. Increased speeds provide the opportunity for faster travel times and increased train frequency. To significantly improve service levels a corridor level improvements study would have to be conducted to consider overall strategies. However one crossing was considered to have a significant service level improvement. This was the Rosecrans/Marquardt crossing in Santa Fe Springs. Construction of a grade separation at this location would allow the completion of a third main line through the crossing, providing an opportunity to increase train speed and frequency of service.

The Planning Level evaluation was limited in the scope of evaluation by data that was readily available. Further analysis may be needed to collect additional information about the crossings. This information would provide for a more in-depth evaluation of the benefits of improving these crossings. The evaluations should include traffic studies and an interdisciplinary safety study of the grade crossing and of nearby streets. Corridor evaluations should also be considered to identify potential service level increases.

1. Introduction

Section 17 of Assembly Bill 95, Statutes of 2015, mandated that Caltrans prepare a report examining grade crossings on State-supported rail passenger routes with a high accident history.

The purpose of this Report is to comply with the legislative mandate and examine grade crossings on State-supported intercity passenger rail corridors at intersections identified in the Federal Railroad Administration's (FRA) Web Accident Prediction System with a predicted collision risk of 0.15 or greater. Caltrans staff identified 18 grade crossings that met this criterion. The FRA's Web Accident Prediction System predicted annual accident rate for these crossings ranged from a low of 0.15 to a high of 0.28.

The examination considered improvements to safety, reductions in GHG emissions, and improvements to intercity rail passenger service levels that could be made by grade separating highway-railroad crossings and by making at-grade improvements at the crossings. The potential cost to construct grade separations is included as part of the discussion of each crossing.

The alternatives examined in this study were specifically chosen for their capacity to improve safety, reduce GHG emissions, and improve intercity rail passenger service levels. The alternatives were not examined based on funding considerations.

Improvements to safety: Safety at highway-railroad grade crossings can be improved with the construction of at-grade improvements, such as the installation of quad gates, or by constructing a grade separation. Quad gates are constructed by installing a second pair of gates on both sides of the tracks where the car exits the crossing after passing over the tracks. Quad gates were considered for all locations. This minimizes the opportunity for approaching vehicles to drive around the lowered gate arms. Construction of a grade separation eliminates most at-grade crossing accidents.

Reduction of GHG emissions: GHG emissions, primarily carbon dioxide, are generated from the combustion of petroleum-based products, like gasoline and diesel fuel, in internal combustion engines. One method to reduce GHG emissions is to reduce the idling time of vehicles waiting for a train to pass through a grade crossing by constructing a highway-railroad grade separation. Improvements to rail passenger service (increasing train frequencies or train speed) can also lead to a reduction in GHG emissions. Service improvements make the train more competitive with the automobile. As individuals switch to the train, this reduces the number of automobiles idling at the rail crossing and therefore reduces GHG emissions.

The potential GHG emissions reductions by incorporating a grade separated passenger and freight train crossing at each of the eighteen crossings was analyzed. Available traffic data from Caltrans, Federal Highway Administration (FHWA), and local agencies, in addition to available forecasted traffic data, to model anticipated GHG reductions from vehicles that would no longer be idling as trains pass through these intersections. Idling emissions rates from the United States Environmental Protection Agency (US EPA) approved EMFAC2011 model available on the California Air Resources Board (CARB) website at http://www.arb.ca.gov/msei/categories.htm was used in the analysis. Emissions rates for light duty vehicles (LDV) traveling at 5 miles per hour, obtained by the US EPA approved EMFAC2011–LDV model available on the CARB website at http://www.arb.ca.gov/msei/categories.htm, was multiplied by five to convert emissions in grams/miles (running emissions) to miles/hours (idling emissions). Idling emissions were calculated from air basin-specific data for the 21 vehicle classes specified in the model that are appropriate to the location of each of the 18 proposed grade crossing separations, except for emissions from diesel medium-heavy and heavy-heavy trucks and busses. Idling emissions from these vehicle classes were calculated from the EMFAC2011-HD model data also available on the CARB's website.

Improvements to intercity rail passenger service levels: Improvements to intercity rail passenger service can be made by increasing the capacity of the system to allow more trains to operate in a corridor, by increasing the speed of the trains and by reducing delays. At-grade safety improvements can reduce crashes that cause delays. At-grade improvements may improve train speeds by reducing conflicts, thus increasing train performance. Building a grade separation can provide additional right of way to add passenger train capacity by constructing additional tracks in the rail corridor. Grade separations eliminate train and vehicular delays that would be caused by accidents at the at-grade crossing. *Generally, improvements must be made along a corridor to reap the most benefit to service levels.*

The alternatives and benefits for each crossing examined are discussed in detail in Section 4, Crossing Details and Examination.

2. Assumptions

For purposes of this examination the following assumptions were made:

- The information included in the FRA's Office of Safety Analysis web site inventory for the grade crossings being examined was accurate and up-to-date, with the exception of the number of passenger trains passing through the crossing
- Current timetables can be used to determine the number of passenger trains traveling through a grade crossing
- Grade crossing gate arms are in the down position 30 seconds before a train arrives at the crossing and that crossing gate arms are in the raised position 10 seconds after the train passes through the crossing
- Passenger trains are 700 feet long
- Freight trains are 5,000 feet long
- Freight train speed is 15 miles per hour less than the maximum train speed cited in the FRA's inventory for the grade crossing being examined
- The frequency of both passenger and freight trains through a crossing is evenly distributed between 5 a.m. and 11 p.m.
- The approximate cost to construct improvements at the 18 crossings being evaluated was made by comparing the recent cost to make similar improvements at other crossings within the State. (Note: Additional engineering studies would be required to determine the site specific costs for improvements at each of the grade crossings examined in this Report). An order of magnitude estimate is provided for each grade crossing.

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3. Methodology

3.1 Data Acquisition

Information used to examine the grade crossings were extracted from the FRA's Office of Safety Analysis grade crossing inventory. This included, but was not limited to, information about the design of the crossing, train speed limits, vehicular traffic counts, and grade crossing accident data.

Grade crossings included in the FRA's Web Accident Prediction System with a predicted collision risk of 1.15 or greater, and that were located on State-supported passenger rail corridors were considered. A total of 18 crossings were identified for examination.

Additional information was gathered that was used in the examination of the grade crossings. This information included:

- Current and planned improvements to the grade crossing being examined
- Current and planned improvements to grade crossings in proximity to the crossing being examined
- Current and planned track and signal improvements at or near the crossing being examined

The data collected from the FRA's Office of Safety Analysis may be out of date and may not depict the current conditions at the crossing.

Because of the data limitations available for examination, additional studies may be warranted to better evaluate crossings for improvement. This would include traffic studies for the roadways at and near the crossing, evaluation of land use near the crossing to assess risks to safety, such as nearby schools, hospitals and emergency services, and updated counts of trains passing through the grade crossing.

3.2 Data Evaluation

3.2.1 Improvements to Safety

Information from the FRA's Office of Safety Analysis highway-railroad grade crossing inventory and accident database was used to examine accident data, and to evaluate the existing highway traffic controls for the 18 at-grade crossings selected. The FRA crossing inventory report indicates the existing warning devices, and physical safety measures at each grade crossing. Grade crossing geometry, accident history, and site conditions at each crossing were also examined as part of infrastructure improvements to increase vehicle and pedestrian safety.

Copies of the FRA highway-railroad grade crossing inventories and accident reports used for this evaluation of the 18 grade crossings are available from Caltrans upon request.

3.2.2 Improvements to GHG Emissions

Projected decrease in GHG emissions resulting from grade separations were analyzed. The analysis used the Annual Average Daily Traffic (AADT) traffic data and "red light times" on affected cross-streets to approximate GHG emissions reductions from vehicles that would no longer be idling as trains pass through these intersections. Idling emissions rates at the air basin level from the US EPA approved EMFAC2011–HD model, available on the CARB's website at http://www.arb.ca.gov/msei /categories.htm, were used to calculate emissions rates from diesel medium-heavy and heavy-heavy trucks and buses by converting rates in g/veh–hr to rates in grams/hours, using available AADT data. Emissions rates for LDVs traveling at 5 mph, obtained by the US EPA approved EMFAC2011–LDV model, also available at the CARB website, was multiplied by five, to convert emissions rates in grams/mi (running emissions rates) to grams/hr (idling emissions rates).

Emissions rates in grams/hr was converted to emissions by multiplying the converted idling emissions rate data for light LDVs and medium/heavy duty vehicles (HD) to emissions in grams (lbs. or tons), using total delay times in seconds at each intersection.

GHG emissions key:

1. Carbon Dioxide (CO_2)
2. Methane (CH_4)
3. Nitrous Oxide (N_20)
4. Hydrofluorocarbons (HFC)
5. Perfluorocarbons (PFC)
6. Sulfur Hexafluoride (SF_6)

3.2.3 Improvements to Service Levels

The study examined previous and planned improvements to grade crossings adjacent to the crossing being examined to determine crossing improvements that can have a corridor-wide impact in service levels. These service level improvements include additional at-grade crossing safety measures, as well as, a recommended grade separation where applicable. Only Rosecrans provides a significant improvement to service levels by allowing space for the future third track construction. All others provided minimal improvement – delays caused by accidents at the crossing.

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4. Conclusion

This Report examined 18 highway-railroad grade crossings on State-supported intercity rail passenger corridors: Pacific Surfliner, San Joaquin, and the Capitol. These 18 crossings were identified as the most accident prone crossings on the corridors, with a predicted collision risk of 0.15 or greater, using the FRA's Web Accident Prediction System

GHG emissions can be reduced by the construction of grade separations. This decreases emissions by reducing idling time while vehicles wait for trains to pass through the crossing. Reduction in annual metric tons of carbon dioxide by constructing grade separations at the crossings examined, ranged from a low of 107 for Bellevue Avenue in Atwater, to a high of 5,059 at Rosecrans/Marquardt in Santa Fe Springs.

Safety can be improved by installation of at-grade safety improvements and the construction of grade separations. Installation of quad gates and pedestrian gates, with fencing, at the 18 crossings that were examined, can minimize crossing accidents. The construction of grade separations eliminates at-grade crossing accidents.

Service levels can minimally be increased by increasing the speed of trains by installing quad gates at the crossings or by constructing a grade separation. Increased speeds provide the opportunity for faster travel times and increased train frequency. To significantly improve service levels a corridor level improvements study would have to be conducted to consider overall strategies. However one crossing was considered to have a significant service level improvement. This was the Rosecrans/Marquardt crossing in Santa Fe Springs. Construction of a grade separation at this location would allow the completion of a third main line through the crossing, providing an opportunity to increase train speed and frequency of service.

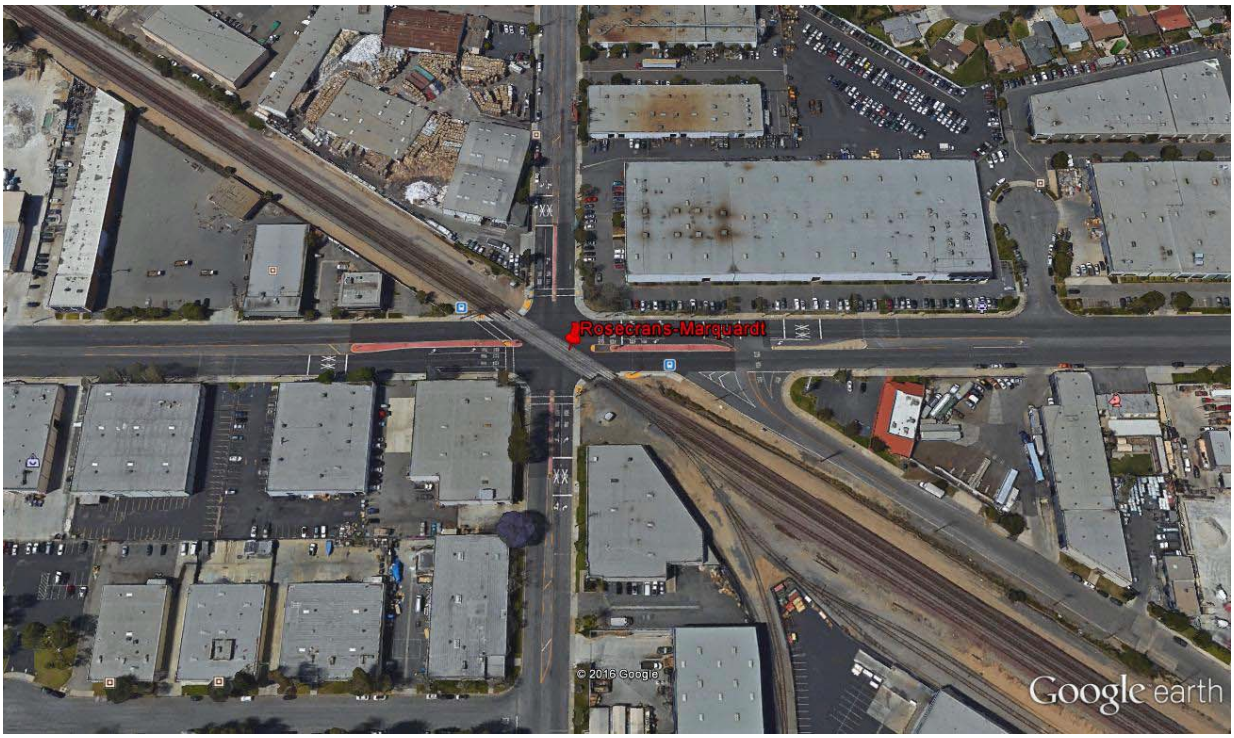
The Planning Level evaluation was limited in the scope of evaluation by data that was readily available. Further analysis may be needed to collect additional information about the crossings. This information would provide for a more in-depth evaluation of the benefits of improving these crossings. The evaluations should include traffic studies and an interdisciplinary safety study of the grade crossing and of nearby streets. Corridor evaluations should also be considered to identify potential service level increases.

4.1 Rosecrans–Marquardt; USDOT Crossing Number 027656A

4.1.1 Description of Crossing

Rosecrans–Marquardt grade crossing is located in Los Angeles County, in the city of Santa Fe Springs. Two streets cross the tracks, Rosecrans Avenue, a four lane street, with two lanes in each direction, and Marquardt Avenue, a two lane street, with one lane in each direction. Both streets have turn lanes. Stage Road parallels the railroad tracks at the southwest quadrant of the grade crossing. Stage Road intersects Rosecrans Avenue at an approximate a 45-degree angle. BNSF Railway is the owner of two railroad tracks and the grade crossing safety equipment at this location and operates 83 daily freight trains through this crossing. The State-supported Pacific Surfliner operates 22 weekday trains through this crossing, and Metrolink operates 28 weekday commuter trains through this crossing. The FRA's Web Accident Prediction System projected and annual collision risk of 0.29 for this crossing.

4.1.1.1 Aerial View



4.1.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–30,506, 19 percent trucks
- Total passenger trains through the crossing daily–50
- Total freight trains through the crossing daily–83
- Passenger train speed–79 mph
- Freight train speed–64 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
  - 2013: A pedestrian stopped on the crossing was struck by a freight train as it was passing through the crossing
  - 2012: An automobile moving over the crossing was struck by a freight train as it was passing through the crossing
  - 2012: A pedestrian moving over the crossing was struck by a passenger train as it was passing through the crossing
- Other–No Quad Gates, 45 mph on Rosecrans–Marquardt. Average time for train crossing and complete warning light/gate operation is 43.55 seconds

4.1.3 Evaluation of Improvements

4.1.3.1 Safety

Los Angeles Metropolitan Transportation Authority is currently conducting a comprehensive study to realign Rosecrans Boulevard and adjacent roadways.

The study will include recommendations for a grade separation and construction of a third track to accommodate freight, commuter, and intercity passenger trains, including high-speed rail. No at-grade improvements are recommended as part of this examination.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/ Other Site Features**	**Safety Recommendations**
Rosecrans/ Marquardt 027656A	Principal Arterial	W 10–1 Stop Lines RR Xing Symbols Raised Medians	(6) Cantilever gates (6) Mast Flashing Lights	Roadway Intersection at rail crossing	No at-grade improvements recommended, Grade Separation recommended

Due to the complex geometry of this crossing and adjacent streets, and the planned addition of a third track, a comparable grade separation concept was not identified for this Report. Based on engineering estimates, the cost to construct a grade separation at this crossing is approximately $120 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Rosecrans /Marquardt 027656A	Under Caltrans planning study to realign roadways and grade separate for future BNSF third track and CAHSR tracks					$120,000,000 (Engr. Est)

4.1.3.2 GHG Emissions

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

Rosecrans—Marquardt Crossing [PSL] Freight Line [BNSF] DOT Crossing [027656A]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO_{2e}[b]**
South Coast	5,059	4,882

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

4.1.3.3 Service Levels

Construction of a grade separation, as considered in the study, will describe service level improvements. These improvements may include increased train speed and additional passenger train frequencies.

4.1.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Rosecrans/ Marquardt 027656A	0.29	120	Significant	5059 / 4882

4.2 Grand Avenue—Santa Ana; USDOT Crossing Number 026741L

4.2.1 Description of Crossing

Grand Avenue is located in Orange County in the city of Santa Ana. Grand Avenue is a six lane road, with three lanes in each direction. Metrolink is the owner of two railroad tracks and the grade crossing safety equipment at this location. The State-supported Pacific Surfliner operates 22 weekday trains through this crossing. Metrolink operates 45 weekday commuter trains through this crossing. The FRA's Web Accident Prediction System projected and annual collision risk of 0.28 for this crossing.

- **Aerial View**

4.2.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–30,430, 6 percent trucks
- Total passenger trains through the crossing daily–67
- Total freight trains through the crossing daily–0
- Passenger train speed–90 mph
- Freight train speed–n/a
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
    - 2014: A pedestrian moving over the crossing was struck by a passenger train as it was passing through the crossing
    - 2011: An automobile stalled or stuck on the crossing was struck by a passenger train as it was passing through the crossing
    - 2010: A pick–up truck moving over the crossing was struck by a passenger train as it was passing through the crossing
- Other–No Quad Gates, 45 mph on Grand Avenue. Average time for train crossing and complete warning light/gate operation is 40.53 seconds

4.2.3 Evaluation of Improvements

- **Safety**

At-grade safety could be improved by installing quad gates. This improvement has the potential to reduce most vehicular accidents at this grade crossing. Quad gates minimize crashes caused by vehicles moving through the crossing when the gates are down. The estimated cost to install the at-grade improvements is $500,000–$1,000,000.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/ Other Site Features**	**Safety Recommendations**
Grand Ave. 026741L	Principal Arterial	W 10–1 Stop Lines RR Xing Symbols Raised Medians	(4) Cantilever gates (2) Mast Flashing Lights (4) Pedestrian gates	E Hunter Ave. intersection within 75' of rail crossing	Install Quad gates

A grade separation at this crossing could be constructed by depressing the roadway and building a railroad bridge to accommodate the railroad tracks. The potential cost to construct this grade separation is approximately $90 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Grand Ave. 026741L	Depress Grand Ave.	Maintain existing grade	Railroad Bridge– structure width approx. 50' railroad ROW	Lower intersection at E Hunter Ave. to conform to depressed Grand Ave.	State College Blvd. Grade Separation	$90,000,000.00

- **GHG Emissions**

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

Grand Avenue–Santa Ana—Crossing [PSL] Freight Line [SCAX] DOT Crossing [026741L]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO [b] $_{2e}$**
South Coast	720	694

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

- **Service Levels**

The intercity rail passenger service improvements that could be achieved by making safety improvements to this crossing is considered minimal. Service improvements typically require improvements along several miles of the rail corridor. Further evaluation of adjacent crossings and the track and signal structure in this corridor may identify potential service level improvements.

4.2.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Grand Ave. 026741L	0.28	$ 90	Minimal	720 / 694

4.3 Hesperian Boulevard; USDOT Crossing Number 79745L

4.3.1 Description of Crossing

Hesperian Boulevard is located in Alameda County, in the city of San Leandro. Hesperian Boulevard is a six-lane road, with three lanes in each direction. The Union Pacific Railroad is the owner of the single track and the grade crossing safety equipment at this location, and operates 10 daily freight trains, through this crossing. The Capitol Corridor operates 14 weekday trains through this crossing. The FRA's Web Accident Prediction System projected an annual collision risk of 0.28 for this crossing.

4.3.1.1 Aerial View

4.3.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–30,000, 5 percent trucks
- Total passenger trains through the crossing daily–14
- Total freight trains through the crossing daily–10
- Passenger train speed–79 mph
- Freight train speed–64 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
  - 2014: A pedestrian moved onto the tracks while a passenger train as it was passing through the crossing
  - 2011: A van stopped on the crossing while a passenger train as it was passing through the crossing
  - 2010: A pedestrian moved onto the tracks while a passenger train as it was passing through the crossing
- Other–No Quad Gates, 40 mph on Hesperian Blvd. Average time for train crossing and complete warning light/gate operation is 42.57 seconds

4.3.3 Evaluation of Improvements

4.3.3.1 Safety

This crossing is currently planned for at-grade safety improvements funded by the FHWA Railway–Highways Crossing (Section 130) Program. The FHWA Section 130 Program is jointly administered by Caltrans and the California Public Utilities Commission (CPUC).

The Section 130 safety improvements were recommended by an interdisciplinary safety team that evaluated the crossing accident history and conducted an on-site evaluation of the crossing conditions. Because of this, additional at-grade safety improvements were withdrawn from further consideration.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name / DOT Crossing #	**Road Classification at Crossing**	**Warning Signs /Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing**	**Safety Recommendation**
Hesperian Blvd. 749745L	Principal Arterial	W 10–1 Stop Lines RR Xing Symbols Raised Medians	(2) Cantilever gates (2) Mast Flashing Lights	Springlake Dr. intersection within 50' of rail crossing	NA

A grade separation at this crossing could be constructed by depressing the roadway and building a railroad bridge to accommodate the railroad tracks. The potential cost to construct this grade separation is approximately $90 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Hesperian Blvd. 749745L	Depress Hesperian Blvd.	Accommodate future second Niles Sub track	Railroad Bridge to span est. 100' railroad ROW	Depress Springlake Dr. Parcel acquisition along Hesperian Blvd.	State College Blvd. Grade Separation	$90,000,000.00

4.3.3.2 GHG Emissions

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel, and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles, conform to the Low Carbon Fuel System (LCFS) standards prescribed in Assembly Bill 1493, Chapter 200, Pavley, which achieves reductions in vehicles produced during these years, through the use of low-carbon fuel and increased fuel economy.

Hesperian Boulevard Crossing: ICPR Route CCJPA, Freight Line UPRR, DOT Crossing 74945L		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO [b] $_{2e}$**
San Francisco Bay	223	215

Notes:

a. Carbon dioxide equivalents include methane (CH4) and nitrous oxide (N2O) tailpipe emissions based on their Global Warming Potential (GWP), which for these pollutants, is equivalent to 36 and 298 times unit carbon dioxide (CO2) emissions, respectively.

b. LCFS emissions reflect the regulation of passenger vehicle GHG emissions, prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–to 2016 models.

4.3.3.3 Service Levels

Construction of a grade separation, as considered in the study, will improve service level improvements. These improvements may include increased train speed and additional passenger train frequencies.

4.3.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Hesperian Blvd. 749745L	0.28	$ 90	Minimal	223 / 215

4.4 Grand Avenue—Carlsbad; USDOT Crossing Number 026820X

4.4.1 Description of Crossing

Grand Avenue is located in San Diego County, in the city of Carlsbad. Grand Avenue is a four lane road, with two lanes in each direction. The North County Transit District (Coaster) is the owner of one railroad track and the grade crossing safety equipment at this location. The State-supported Pacific Surfliner operates 22 weekday trains through this crossing. In addition, 22 weekday Coaster commuter trains operate through this crossing. The FRA's Web Accident Prediction System projected and annual collision risk of 0.25 for this crossing.

- **Aerial View**

4.4.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–7,500, 15 percent trucks
- Total passenger trains through the crossing daily–44
- Total freight trains through the crossing daily–0
- Passenger train speed–90 mph
- Freight train speed–N/A
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
    - 2014: A pedestrian moving over the crossing was struck by a freight train as it was passing through the crossing
    - 2013: A pedestrian moving over the crossing was struck by a passenger train as it was passing through the crossing
    - 2011: A pedestrian moving over the crossing was struck by a passenger train as it was passing through the crossing
    - 2010: A pedestrian stopped on the crossing was struck by a freight train as it was passing through the crossing
- Other–No Quad Gates, 25 mph on Grand Avenue. Average time for train crossing and complete warning light/gate operation is 40.53 seconds

4.4.3 Evaluation of Improvements

- **Safety**

At-grade safety could be improved by installing quad gates and pedestrian gates. These improvements have the potential to reduce most vehicular and pedestrian accidents at this grade crossing. Quad gates minimize crashes caused by vehicles moving through the crossing when the gates are down. Pedestrian gates provide a barrier to the tracks and limit pedestrian movement across the tracks. The estimated cost to install the at-grade improvements is $500,000–$1,000,000.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/ Other Site Features**	**Safety Recommendations**
Grand Ave. 026820X	Urban Local	W 10–1 Stop Lines RR Xing Symbols Raised Medians	(4) Quad Cantilever gates (4) Mast Flashing Lights (4) Pedestrian gates	Washington St. intersection within 50' of rail crossing	Install Quad gates Install Pedestrian gates

A grade separation at this crossing could be constructed by depressing the roadway and building a railroad bridge to accommodate the railroad tracks. The potential cost to construct this grade separation is approximately $86 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Grand Ave. 026820X	Depress Grand Ave.	Maintain existing grade	Railroad Bridge– structure width approx. 50' railroad ROW	Provide pedestrian access to existing Carlsbad Village Station	Placentia Ave. Undercrossing	$86,000,000.00

- **GHG Emissions**

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

Grand Avenue–Carlsbad—Crossing [PSL] Freight Line [SDNX] DOT Crossing [026820X]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO_{2e}[b]**
San Diego	275	266

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

- **Service Levels**

The intercity rail passenger service improvements that could be achieved by making safety improvements to this crossing is considered minimal. Service improvements typically require improvements along several miles of the rail corridor. Further evaluation of adjacent crossings and the track and signal structure in this corridor may identify potential service level improvements.

4.4.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA PREDICTION Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Grand Ave. 026820X	0.25	$ 86	Minimal	275 / 266

4.5 La Palma Avenue; USDOT Crossing Number 026642N

4.5.1 Description of Crossing

La Palma Avenue is located in Orange County, in the city of Anaheim. La Palma Avenue is a four lane road, with two lanes in each direction. Metrolink is the owner of two railroad tracks and the grade crossing safety equipment at this location. The State-supported Pacific Surfliner operates 22 weekday trains through this crossing and Metrolink operates 19 weekday commuter trains through this crossing. Eleven daily freight trains operate through this crossing. The FRA's Web Accident Prediction System projected and annual collision risk of 0.24 for this crossing.

- **Aerial View**

4.5.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–21,000, 11 percent trucks
- Total passenger trains through the crossing daily–41
- Total freight trains through the crossing daily–11
- Passenger train speed–79 mph
- Freight train speed–64 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
    - 2013: A pedestrian moving over the crossing was struck by a passenger train as it was passing through the crossing
    - 2010: A pedestrian moving over the crossing was struck by a passenger train as it was passing through the crossing
- Other–No Quad Gates, 35 mph on La Palma Avenue Average time for train crossing and complete warning light/gate operation is 41.60 seconds

4.5.3 Evaluation of Improvements

- **Safety**

At-grade safety could be improved by installing quad gates. This improvement has the potential to reduce most vehicular accidents at this grade crossing. Quad gates minimize crashes caused by vehicles moving through the crossing when the gates are down. The estimated cost to install the at-grade improvements is $500,000–$1,000,000.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/ Other Site Features**	**Safety Recommendation**
La Palma Ave. 026642N	Principal Arterial	W 10–1 Stop Lines RR Xing Symbols Raised Medians	(4) Cantilever gates (4) Mast Flashing Lights (4) Pedestrian gates		Install Quad gates

A grade separation at this crossing could be constructed by depressing the roadway and building a railroad bridge to accommodate the railroad tracks. The potential cost to construct this grade separation is approximately $86 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
La Palma Ave. 026642N	Depress La Palma Ave.	Maintain existing grade	Railroad Bridge—structure width approx. 50' railroad ROW		Placentia Ave. Undercrossing	$86,000,000.00

- **GHG Emissions**

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

La Palma Avenue Crossing [PSL] Freight Line [SCAX] DOT Crossing [026642N]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO_{2e}[b]**
South Coast	716	691

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

- **Service Levels**

The intercity rail passenger service improvements that could be achieved by making safety improvements to this crossing is considered minimal. Service improvements typically require improvements along several miles of the rail corridor. Further evaluation of adjacent crossings and the track and signal structure in this corridor may identify potential service level improvements.

4.5.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
La Palma Ave. 026642N	0.24	$ 86	Minimal	716 / 691

4.6 Ferry Street; USDOT Crossing Number 751734Y

4.6.1 Description of Crossing

Ferry Street is located in Contra Costa County, in the city of Martinez. Ferry Street is a two lane street, with one lane in each direction. The Union Pacific Railroad is the owner of four railroad tracks and the grade crossing safety equipment at this location, and operates 17 daily freight trains, though this crossing. There are 38 weekday State-supported trains that operate through the Ferry Street grade crossing. The Capitol Corridor operates 30 weekday trains through this crossing, and the San Joaquin Corridor operates 8 weekday trains through this crossing. Amtrak operates four passenger trains a day through this crossing, the California Zephyr and Coast Starlight. The Martinez Amtrak station is located immediately west of the crossing. The FRA's Web Accident Prediction System projected an annual collision risk of 0.23 for this crossing.

4.6.1.1 Aerial View

4.6.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–3,000, 18 percent trucks
- Total passenger trains through the crossing daily–42
- Total freight trains through the crossing daily–17
- Passenger train speed–40 mph
- Freight train speed–25 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction Systems reporting period:
  - 2013–An automobile trapped on the crossing and was struck by a passenger train as it was passing through the crossing
  - 2011–A pedestrian was stopped on the crossing and was struck by a passenger train as it was passing through the crossing
  - 2011–A pedestrian stopped on the crossing and was struck by a passenger train as it was passing through the crossing
  - 2011–A pick-up truck was stalled on the crossing and was struck by a freight train as it was passing through the crossing
- Other–No Quad Gates, 25 mph on Ferry Street. Average time for train crossing and complete warning light/gate operation is 44.79 seconds

4.6.3 Evaluation of Improvements

4.6.3.1 Safety

This crossing is currently planned for at-grade safety improvements funded by the FHWA Railway–Highways Crossing (Section 130) Program. The FHWA Section 130 Program is jointly administered by Caltrans and the CPUC.

The Section 130 safety improvements were recommended by an interdisciplinary safety team that evaluated the crossing accident history and conducted an on-site evaluation of the crossing conditions. Because of this, additional at-grade safety improvements were withdrawn from further consideration.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name / DOT Crossing #	**Road Classification at Crossing**	**Warning Signs / Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing**	**Safety Recommendation**
Ferry St. 751734Y	Urban Local	W 10–1 Stop Lines RR Xing Symbols No median	(2) Cantilever gates No Mast Flashing Lights	Crossing at north end of Martinez station platform	NA

A pedestrian grade separation is recommended at Ferry Street to cross over the railroad tracks. The potential cost to construct this pedestrian grade separation is approximately $25 million.

A vehicular grade separation was not considered as part of this evaluation because of the proximity of this roadway to the Martinez Station, the Martinez Regional Shoreline Park, and tidal wetlands. More detailed engineering design studies and preliminary environmental studies would be needed to evaluate the feasibility of constructing a vehicular grade separation at Ferry Street. The potential GHG emission reductions from the construction of a vehicular grade separation are set forth in the GHG emissions subsection.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Ferry St. 751734Y	At-grade crossing safety improvements	Possible alignment shift on outer track to accommodate center fence	Pedestrian Overpass structure		Burbank Airport Metrolink Pedestrian Grade Separation Project	$25,000,000.00

4.6.3.2 GHG Emissions

Ferry Street Crossing [ICPR Route CCJPA, SJ] Freight Line [UPRR] DOT Crossing [751734Y]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2 (Pavley and LCFS) and CO_{2e} [b]**
San Francisco Bay	216	208

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their Global Warming Potential (GWP), which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009 –to 2016 models.

4.6.3.3 Service Levels

Construction of a grade separation, as considered in the study, will improve service level improvements. These improvements may include increased train speed and additional passenger train frequencies.
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4.6.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Ferry St. 751734Y	0.23	$ 25	Minimal	216 / 208

4.7 Cutting Boulevard; USDOT Crossing Number 751678U

4.7.1 Description of Crossing

Cutting Boulevard is located in Contra Costa County, in the city of Richmond. Cutting Boulevard is a four lane street, with two lanes in each direction, and also has turn lanes. The Union Pacific Railroad is the owner of three railroad tracks and the grade crossing safety equipment at this location, and operates 22 daily freight trains, through this crossing. There are 38 State-supported intercity trains that operate through the Cutting Boulevard grade crossing. The Capitol Corridor operates 30 weekday trains through this crossing, and the San Joaquin Corridor operates eight weekday trains through this crossing. In addition, Amtrak operates four passenger trains a day through this crossing, the California Zephyr and Coast Starlight. The FRA's Web Accident Prediction System projected an annual collision risk of 0.21 for this crossing.

4.7.1.1 Aerial View

4.7.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–40,000, 15 percent trucks
- Total passenger trains through the crossing daily–42
- Total freight trains through the crossing daily–22
- Passenger train speed–79 mph
- Freight train speed–64 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction Systems reporting period:
  - 2014–A pedestrian moving over the crossing was struck by a passenger train as it was passing through the crossing
  - 2011–A truck–trailer stopped on the crossing was struck by a freight train as it was passing through the crossing
- Other–No Quad Gates, 35 mph on Cutting Boulevard. Average time for train crossing and complete warning light/gate operation is 42.23 seconds

4.7.3 Evaluation of Improvements

4.7.3.1 Safety

This crossing is currently planned for at-grade safety improvements funded by the FHWA Railway Highways Crossing (Section 130) Program. The FHWA Section 130 Program is jointly administered by Caltrans and the CPUC.

The Section 130 safety improvements were recommended by an interdisciplinary safety team that evaluated the crossing accident history and conducted an on-site evaluation of the crossing conditions. Because of this, additional at-grade safety improvements were withdrawn from further consideration.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name / DOT Crossing #	**Road Classification at Crossing**	**Warning Signs / Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing**	**Safety Recommendation**
Cutting Blvd. 751678U	Principal Arterial	W 10–1 Stop Lines RR Xing Symbols No median	(2) Cantilever gates No Mast Flashing Lights	Carlson Blvd intersection with 50' of rail crossing	NA

A grade separation at Cutting Boulevard could be constructed by depressing the roadway and building a railroad bridge to accommodate the railroad tracks. The potential cost to construct this grade separation is approximately $83 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Cutting Blvd. 751678U	Depress Cutting Blvd.	Maintain existing grade	Railroad Bridge to span est. 100' railroad ROW	Depress Carlson Blvd.	Kraemer Blvd. Undercrossing	$83,000,000.00

4.7.3.2 GHG Emissions

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

Cutting Boulevard Crossing [ICPR Route CCJPA, SJ] Freight Line [UPRR] DOT Crossing [751678U]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO [b] $_{2e}$**
San Francisco Bay	2,361	2,278

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

4.7.3.3 Service Levels

Construction of a grade separation, as considered in the study, will improve service level improvements. These improvements may include increased train speed and additional passenger train frequencies.

4.7.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Cutting Blvd. 751678U	0.21	$ 83	Minimal	2361 / 2278

4.8 Vineland Avenue; USDOT Crossing Number 746006D

4.8.1 Description of Crossing

Vineland Avenue is located in Los Angeles County, northwest of the city of Burbank, and near the Bob Hope Airport. Vineland Avenue is a four lane road, with two lanes in each direction. Southern California Regional Rail Authority (Metrolink) is the owner of two railroad tracks and the grade crossing safety equipment at this location. The State-supported Pacific Surfliner operates 10 weekday trains through this crossing. Amtrak's Coast Starlight operates twice a day through this crossing. Metrolink operates 22 weekday commuter trains through this crossing. In addition, five daily freight trains operate through this crossing. The FRA's Web Accident Prediction System projected and annual collision risk of 0.18 for this crossing.

- **Aerial View**

4.8.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–19,000, 18 percent trucks
- Total passenger trains through the crossing daily–34
- Total freight trains through the crossing daily–5
- Passenger train speed–79 mph
- Freight train speed–64 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
    - 2014: A pedestrian stopped on the crossing was struck by a passenger train as it was passing through the crossing
    - 2010: An automobile moving over the crossing was struck by a freight train as it was passing through the crossing
- Other–No Quad Gates, 35 mph on Vineland Avenue. Average time for train crossing and complete warning light/gate operation is 41.21 seconds

4.8.3 Evaluation of Improvements

- **Safety**

At-grade safety could be improved by installing quad gates and pedestrian gates. These improvements have the potential to reduce most vehicular and pedestrian accidents at this grade crossing. Quad gates minimize crashes caused by vehicles moving through the crossing when the gates are down. Pedestrian gates provide a barrier to the tracks and limit pedestrian movement across the tracks. The estimated cost to install the at-grade improvements is $500,000–$1,000,000.

Site Conditions at Crossing and Potential at-grade safety improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/Other Site Features**	**Safety Recommendations**
Vineland Ave. 746006D	Principal Arterial	W 10–1 Stop Lines RR Xing Symbols Raised Medians	(4) Cantilever gates (4) Mast Flashing Lights		Install Quad gates Install Pedestrian gates

A grade separation at this crossing could be constructed by depressing the roadway and building a railroad bridge to accommodate the railroad tracks. The potential cost to construct this grade separation is approximately $86 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Vineland Ave. 746006D	Depress Vineland Ave	Maintain existing grade	Railroad Bridge– structure width approx. 75' railroad ROW		Placentia Ave Undercrossing	$86,000,000.00

- **GHG Emissions**

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

Vineland Avenue Crossing [PSL] Freight Line [SCAX] DOT Crossing [746006D]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO [b] $_{2e}$**
South Coast	769	742

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

- **Service Levels**

The intercity rail passenger service improvements that could be achieved by making safety improvements to this crossing is considered minimal. Service improvements typically require improvements along several miles of the rail corridor. Further evaluation of adjacent crossings and the track and signal structure in this corridor may identify potential service level improvements.

4.8.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Vineland Ave. 746006D	0.18	$ 86	Minimal	769 / 742

4.9 Los Nietos Road; USDOT Crossing Number 027650J

4.9.1 Description of Crossing

Los Nietos Road is located in Los Angeles County in the city of Santa Fe Springs. Los Nietos Road is a four lane road, with two lanes in each direction with turn lanes. BNSF Railway is the owner of three railroad tracks and the grade crossing safety equipment at this location and operates 59 daily freight trains, through this crossing. The State-supported Pacific Surfliner operates 22 weekday trains through this crossing and Metrolink operates 28 weekday commuter trains through this crossing. The FRA's Web Accident Prediction System projected and annual collision risk of 0.18 for this crossing.

4.9.1.1 Aerial View

4.9.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–12,000, 22 percent trucks
- Total passenger trains through the crossing daily–50
- Total freight trains through the crossing daily–59
- Passenger train speed–79 mph
- Freight train speed–64 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
  - 2014: An automobile stopped on the crossing was struck by a passenger train as it was passing through the crossing
  - 2010: An automobile stalled or stuck on the crossing was struck by a freight train as it was passing through the crossing
- Other–No Quad Gates, 40 mph on Los Nietos Road. Average time for train crossing and complete warning light/gate operation is 43.16 seconds

4.9.3 Evaluation of Improvements

4.9.3.1 Safety

At-grade safety could be improved by installing quad gates and pedestrian gates. These improvements have the potential to reduce most vehicular and pedestrian accidents at this grade crossing. Quad gates minimize crashes caused by vehicles moving through the crossing when the gates are down. Pedestrian gates provide a barrier to the tracks and limit pedestrian movement across the tracks. The estimated cost to install the at-grade improvements is $500,000–$1,000,000.

Site Conditions at Crossing and Potential at-grade safety improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/ Other Site Features**	**Safety Recommendations**
Los Nietos Rd. 027650J	Urban Minor Arterial	W 10–1 Stop Lines RR Xing Symbols Raised Medians	(2) Cantilever gates (2) Mast Flashing Lights	Norwalk Blvd. intersection within 200' of severely skewed rail crossing	Install Quad gates Install Pedestrian gates

A grade separation at this crossing could be constructed by building a roadway overpass. The potential cost to construct this grade separation is approximately $106 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Los Nietos Rd. 027650J	Raise Los Nietos Rd. and Norwalk Blvd. to create elevated crossing	Maintain existing grade	Roadway overpass structure at Los Nietos Rd. and Norwalk Blvd. over existing railroad corridor	Realign Los Nietos Rd. to create elevated intersection with Norwalk	Tustin Ave/Rose Dr. Overcrossing	$106,000,000.00

4.9.3.2 GHG Emissions

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

Los Nietos Road Crossing [PSL] Freight Line [BNSF] DOT Crossing [027650J]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO [b]$_{2e}$**
South Coast	1,834	1,770

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

4.9.3.3 Service Levels

Construction of a grade separation, as considered in the study, will improve service level improvements. These improvements may include increased train speed and additional passenger train frequencies.

4.9.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Los Nietos Rd. 027650J	0.18	$ 106	Minimal	1834 / 1770

4.10 7th Street; USDOT Crossing Number 028424N

4.10.1 Description of Crossing

7th Street is located in Kings County, in the city of Hanford. 7th Street is a four lane street, with two lanes in each direction. BNSF Railway is the owner of two railroad tracks and the grade crossing safety equipment at this location, and operates 25 daily freight trains, through this crossing. In addition, the San Joaquin Corridor operates 12 weekday trains through this crossing. The FRA's Web Accident Prediction System projected an annual collision risk of 0.18 for this crossing.

4.10.1.1 Aerial View

4.10.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–9,504, 10 percent trucks
- Total passenger trains through the crossing daily–12
- Total freight trains through the crossing daily–25
- Passenger train speed–45 mph
- Freight train speed–30 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
  - 2014: A pedestrian stopped on the crossing was struck by a freight train as it was passing through the crossing
  - 2014: An automobile stalled on the crossing was struck by a freight train as it was passing through the crossing
  - 2013: A pedestrian stopped on the crossing was struck by a freight train as it was passing through the crossing
- Other–No Quad Gates, 30 mph posted on 7th Street. Average time for train crossing and complete warning light/gate operation is 48.02 seconds

4.10.3 Evaluation of Improvements

4.10.3.1 Safety

At-grade safety could be improved by installing quad gates. This improvement has the potential to reduce most vehicular accidents at this grade crossing. Quad gates minimize crashes caused by vehicles moving through the crossing when the gates are down. The estimated cost to install the at-grade improvements is $500,000–$1,000,000.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name / DOT Crossing #	**Road Classification at Crossing**	**Warning Signs /Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway Near Crossing / Other Site Features**	**Safety Recommendation**
7th St. 028424N	Principal Arterial	W 10–1 Stop Lines RR Xing Symbols Raised Medians	(2) Cantilever gates (2) Mast Flashing Lights (2) Pedestrian gates	Crossing at south end of Hanford Amtrak station platform	Install Quad gates

A grade separation at this crossing could be constructed by depressing the roadway and building a railroad bridge to accommodate the railroad tracks. The potential cost to construct this grade separation is approximately $86 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
7th St. 028424N	Depress 7th St.	Maintain existing grade	Railroad Bridge– structure width approx. 50' railroad ROW	Provide pedestrian access to existing Hanford Station, close Santa Fe Ave. at 7th St.	Placentia Ave. Undercrossing	$86,000,000.00

4.10.3.2 GHG Emissions

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

7th Street Crossing [SJ] Freight Line [BNSF] DOT Crossing [028424N]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO_{2e}[b]**
San Joaquin Valley	277	267

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

4.10.3.3 Service Levels

Construction of a grade separation, as considered in the study, will improve service level improvements. These improvements may include increased train speed and additional passenger train frequencies.

4.10.4 Summary

A detailed summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
7th St. 028424N	0.18	$ 86	Minimal	277 / 267

4.11 Washington Street; USDOT Crossing Number 026857M

4.11.1 Description of Crossing

Washington Street is located in San Diego County, in the city of San Diego. Washington Street is a four lane road, with two lanes in each direction. The Coaster is the owner of four railroad tracks and the grade crossing safety equipment at this location. The State-supported Pacific Surfliner operates 22 weekday trains through this crossing. Coaster operates 22 weekday commuter trains through this crossing. San Diego Metropolitan Transit System operates 132 light rail trains through this crossing. In addition, 88 daily freight trains operate through this crossing. The FRA's Web Accident Prediction System projected an annual collision risk of 0.17 for this crossing.

- **Aerial View**

4.11.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–17,000, 18 percent trucks
- Total passenger trains through the crossing daily–176
- Total freight trains through the crossing daily–88
- Passenger train speed–65 mph
- Freight train speed–50 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
    - 2012: A truck–trailer stopped the crossing was struck by a passenger train as it was passing through the crossing
    - 2012: A pedestrian moving over the crossing was struck by a passenger train as it was passing through the crossing
- Other–No Quad Gates, 25 mph on Washington Street. The number of light rail trains operating through crossing is 132 and is included in the passenger train count above. Average time for train crossing and complete warning light/gate operation is 44.76 seconds

4.11.3 Evaluation of Improvements

- **Safety**

At-grade safety could be improved by installing quad gates and pedestrian gates. These improvements have the potential to reduce most vehicular and pedestrian accidents at this grade crossing. Quad gates minimize crashes caused by vehicles moving through the crossing when the gates are down. Pedestrian gates provide a barrier to the tracks and limit pedestrian movement across the tracks. The estimated cost to install the at-grade improvements is $500,000–$1,000,000.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/ Other Site Features**	**Safety Recommendations**
Washington St. 026857M	Principal Arterial	W 10–1 Stop Lines RR Xing Symbols Raised Medians	(2) Cantilever gates (2) Mast Flashing Lights	Crossing shared with adjacent light rail tracks, crossing at end of Washington St. Station	Install Quad gates Install Pedestrian gates at end of platform

A grade separation at this crossing could be constructed by depressing the roadway and building a railroad bridge to accommodate the railroad tracks. The potential cost to construct this grade separation is approximately $77 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Washington St. 026857M	Depress Washington St.	Maintain existing grade	Railroad Bridge– structure width approx. 75' railroad ROW	undercrossing to clear existing light rail and commuter/freight track	Sand Canyon Ave. Undercrossing	$77,000,000.00

- **GHG Emissions**

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

Washington Street—Crossing [PSL] Freight Line [SDNX] DOT Crossing [026857M]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO [b] $_{2e}$**
San Diego	5,042	4,866

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

- **Service Levels**

The intercity rail passenger service improvements that could be achieved by making safety improvements to this crossing is considered minimal. Service improvements typically require improvements along several miles of the rail corridor. Further evaluation of adjacent crossings and the track and signal structure in this corridor may identify potential service level improvements.

4.11.4 Summary

The summary for each area examined is set forth below:

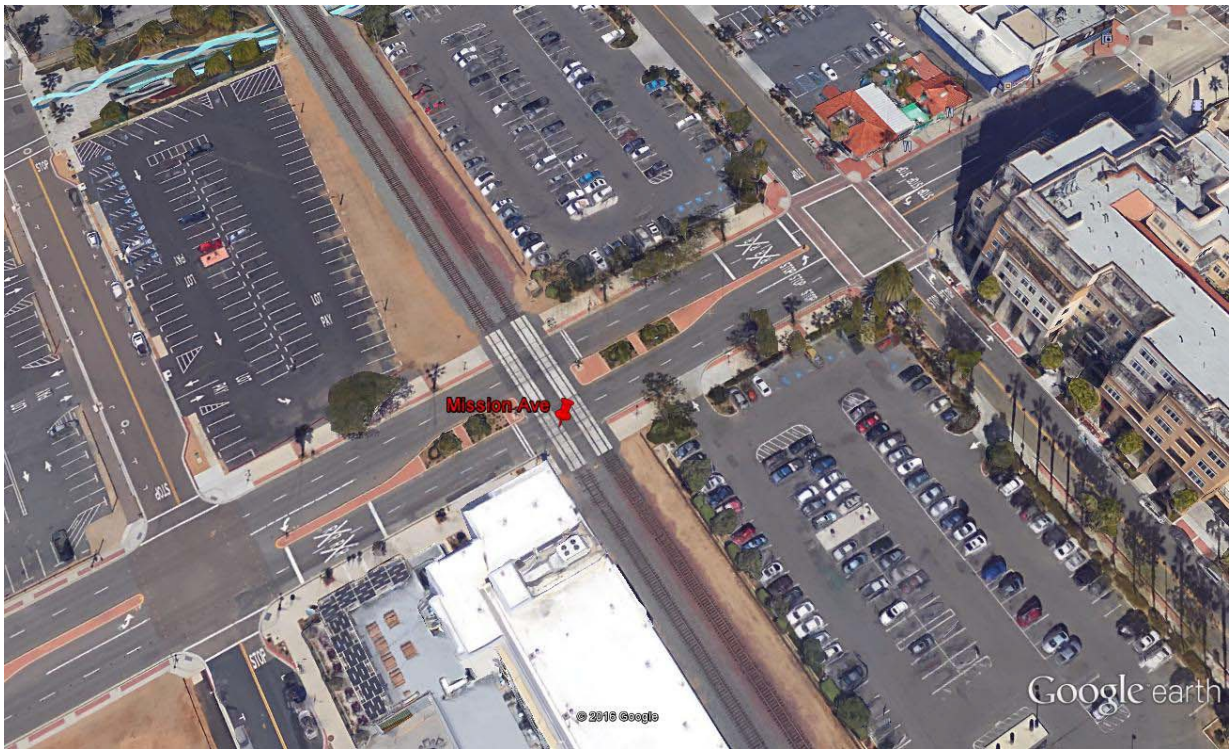
Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Washington St. 026857M	0.17	$ 77	Minimal	5042 / 4866

4.12 Mission Avenue; USDOT Crossing Number 027062B

4.12.1 Description of Crossing

Mission Avenue is located in San Diego County, in the city of Oceanside. Mission Avenue is a four lane road, with two lanes in each direction. The Coaster is the owner of two railroad tracks and the grade crossing safety equipment at this location. Twenty–eight daily freight trains operate through this crossing. The State-supported Pacific Surfliner operates 22 weekday trains through this crossing. Metrolink operates 16 weekday commuter trains through this crossing. The FRA's Web Accident Prediction System projected an annual collision risk of 0.17 for this crossing.

- **Aerial View**



4.12.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–8,500, 5 percent trucks
- Total passenger trains through the crossing daily–38
- Total freight trains through the crossing daily–28
- Passenger train speed–90 mph
- Freight train speed–75 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
- 2013: A pedestrian moving over the crossing was struck by a freight train as it was passing through the crossing.
- 2013: A pedestrian moving over the crossing was struck by a freight train as it was passing through the crossing.
- Other–No Quad Gates, 25 mph on Mission Avenue. Average time for train crossing and complete warning light/gate operation is 42.23 seconds

4.12.3 Evaluation of Improvements

- **Safety**

This crossing is currently planned for at-grade safety improvements funded by the FHWA Railway Highways Crossing (Section 130) Program. The FHWA Section 130 Program is jointly administered by Caltrans and the CPUC.

The Section 130 safety improvements were recommended by an interdisciplinary safety team that evaluated the crossing accident history and conducted an on-site evaluation of the crossing conditions. Because of this, additional at-grade safety improvements were withdrawn from further consideration.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/Other Site Features**	**Safety Recommendations**
Mission Ave. 027062B	Urban Minor Arterial	W 10–1 Stop Lines RR Xing Symbols Raised Medians	(2) Cantilever gates (2) Mast Flashing Lights		NA

A grade separation at this crossing could be constructed by depressing the roadway and building a railroad bridge to accommodate the railroad tracks. The potential cost to construct this grade separation is approximately $90 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Mission Ave. 027062B	Depress Mission Ave.	Maintain existing grade	Railroad Bridge–structure width approx. 100' railroad ROW	Depress N Cleveland Ave. and N Myers Ave.	State College Blvd. Grade Separation	$90,000,000.00

- **GHG Emissions**

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

Mission Avenue Crossing [PSL] Freight Line [SDNX] DOT Crossing [027062B]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO_{2e}[b]**
San Diego	170	164

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

- **Service Levels**

The intercity rail passenger service improvements that could be achieved by making safety improvements to this crossing is considered minimal. Service improvements typically require improvements along several miles of the rail corridor. Further evaluation of adjacent crossings and the track and signal structure in this corridor may identify potential service level improvements.

4.12.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Mission Ave. 027062B	0.17	$ 90	Minimal	170 / 164

4.13 Grape Street; USDOT Crossing Number 026867T

4.13.1 Description of Crossing

Grape Street is located in San Diego County, in the city of San Diego. Grape Street is a one way street, with three lanes. The Coaster is the owner of two railroad tracks and the grade crossing safety equipment at this location. The State-supported Pacific Surfliner operates 22 weekday trains through this crossing. In addition, 22 weekday Coaster commuter trains operate through this crossing. The FRA's Web Accident Prediction System projected and annual collision risk of 0.17 for this crossing.

4.13.1.1 Aerial View

4.13.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–26,300, 20 percent trucks
- Total passenger trains through the crossing daily–44
- Total freight trains through the crossing daily–0
- Passenger train speed–50 mph
- Freight train speed–N/A
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
  - 2013: An automobile stalled or stuck on the crossing was struck by a passenger train as it was passing through the crossing
  - 2013: An automobile stopped the crossing was struck by a passenger train as it was passing through the crossing
- Other–No Quad Gates, 25 mph on Grape Street. Average time for train crossing and complete warning light/gate operation is 40.95 seconds

4.13.3 Evaluation of Improvements

4.13.3.1 Safety

Federal regulations provide the option to establish quiet zones, provided certain supplemental or alternative safety measures are in place, and the crossing accident rate meets FRA standards. A quiet zone eliminates the requirement that locomotive engineers blow the train horn when approaching and travelling through an at-grade crossing. Grape Street is a one–way street within a railroad quiet zone.

The current safety equipment at this crossing has met the strict federal regulatory safety requirements for at-grade improvements within a quiet zone. Because of this, no additional at-grade improvements are recommended.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/ Other Site Features**	**Safety Recommendations**
Grape St. 026867T	Principal Arterial	W 10–1 Stop Lines RR Xing Symbols no median (one–way traffic)	(2) Cantilever gates (2) Mast Flashing Lights (1) Pedestrian gates	Quiet zone, adjacent to light rail trench	No further at-grade improvements, Grade Separation recommended

Grape Street and Hawthorne Street are parallel one-way streets in the City of San Diego. Intercity/commuter rail passenger tracks and light rail tracks cross these two streets within the same railroad right of way. The intercity/commuter rail tracks are at-grade with the streets but the light rail tracks are lowered into a trench next to the intercity rail tracks. Because of this separation of grades between the two types of tracks, these two grade crossings were considered together for the grade separation concept.

The grade separation concept proposed for these two grade crossings is to lower the intercity/commuter rail passenger tracks below grade to the same level as the light rail tracks. The estimated cost to construct the 1.5 mile long railroad trench is $320 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Grape St. 026867T	Maintain Exist	Lower freight/commuter track corridor to match light rail grade	1.5 mile long railroad trench	Depress railroad trackway between Santa Fe Depot Station and Middletown Station	CAHSR planning studies for 10 percent Alignment Analysis	$320,000,000.00
Hawthorn St. 026866L	Maintain Exist	Lower freight/commuter track corridor to match light rail grade				

4.13.3.2 GHG Emissions

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

Grape Street—Crossing [PSL] Freight Line [SDNX] DOT Crossing [026867T]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO [b] $_{2e}$**
San Diego	1,314	1,268

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

4.13.3.3 Service Levels

Construction of a grade separation, as considered in the study, will improve service level improvements. These improvements may include increased train speed and additional passenger train frequencies.

4.13.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Grape St. 026867T	0.17	$ 320	Minimal	1314 / 1268

4.14 Hawthorn Street; USDOT Crossing Number 026866L

4.14.1 Description of Crossing

Hawthorn Street is located in San Diego County, in the city of San Diego. Hawthorn Street is a one-way street, with three lanes. The Coaster is the owner of two railroad tracks and the grade crossing safety equipment at this location. The State-supported Pacific Surfliner operates 22 weekday trains through this crossing. In addition, 22 weekday Coaster commuter trains operate through this crossing. The FRA's Web Accident Prediction System projected and annual collision risk of 0.17 for this crossing.

4.14.1.1 Aerial View

4.14.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–24,750, 20 percent trucks
- Total passenger trains through the crossing daily–44
- Total freight trains through the crossing daily–0
- Passenger train speed–50 mph
- Freight train speed–N/A
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
  - 2014: A pedestrian moving over the crossing was struck by a passenger train as it was passing through the crossing
  - 2013: An automobile stopped or stuck on the crossing was struck by a passenger train as it was passing through the crossing
- Other–No Quad Gates, 30 mph on Hawthorn Street. Average time for train crossing and complete warning light/gate operation is 40.95 seconds

4.14.3 Evaluation of Improvements

4.14.3.1 Safety

Federal regulations provide the option to establish quiet zones provided certain supplemental or alternative safety measures are in place and the crossing accident rate meets FRA standards. A quiet zone eliminates the requirement that locomotive engineers blow the train horn when approaching and travelling through an at-grade crossing. Hawthorn Street is a one–way street within a railroad quiet zone.

The current safety equipment at this crossing has met the strict federal regulatory safety requirements for at-grade improvements within a quiet zone. Because of this, no additional at-grade improvements are recommended.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/ Other Site Features**	**Safety Recommendations**
Hawthorn St. 026866L	Principal Arterial	W 10–1 Stop Lines RR Xing Symbols no median (one–way traffic)	(2) Cantilever gates (2) Mast Flashing Lights (1) Pedestrian gates	Quiet zone, adjacent to light rail trench	No further at-grade improvements, Grade Separation recommended

Grape Street and Hawthorn Street are parallel one–way streets in the City of San Diego. Intercity/commuter rail passenger tracks and light rail tracks cross these two streets within the same railroad right of way. The intercity/commuter rail tracks are at-grade with the streets but the light rail tracks are lowered into a trench next to the intercity rail tracks. Because of this separation of grades between the two types of tracks, these two grade crossings were considered together for the grade separation concept.

The grade separation concept proposed for these two grade crossings is to lower the intercity/commuter rail passenger tracks below grade to the same level as the light rail tracks. The estimated cost to construct the 1.5 mile long railroad trench is $320 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Grape St. 026867T	Maintain Exist	Lower freight/commuter track corridor to match light rail grade	1.5 mile long railroad trench	Depress railroad trackway between Santa Fe Depot Station and Middletown Station	CAHSR planning studies for 10 percent Alignment Analysis	$320,000,000.00
Hawthorn St. 026866L	Maintain Exist	Lower freight/commuter track corridor to match light rail grade				

4.14.3.2 GHG Emissions

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

Hawthorn Street—Crossing [PSL] Freight Line [SDNX] DOT Crossing [026866L]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO_{2e}[b]**
San Diego	1,237	1,194

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

4.14.3.3 Service Levels

Construction of a grade separation, as considered in the study, will improve service level improvements. These improvements may include increased train speed and additional passenger train frequencies.

4.14.4 Summary

The summary for each area examined is set forth below:

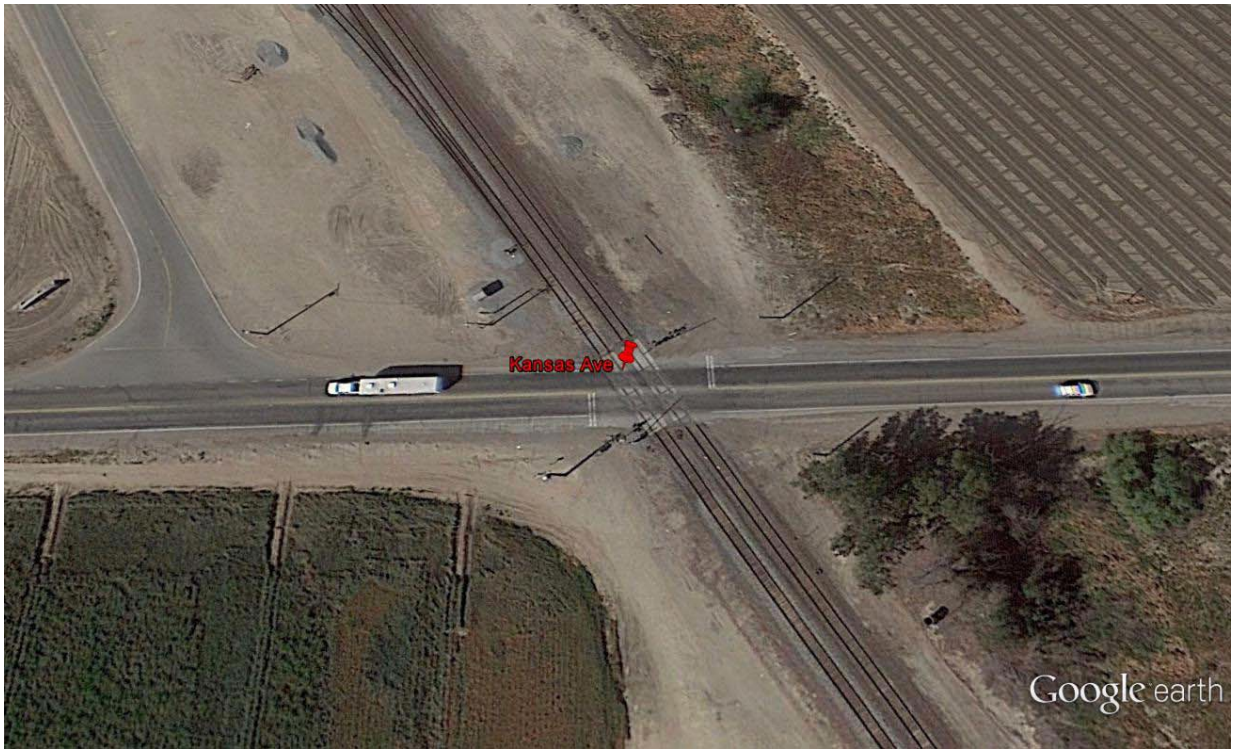
Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Hawthorn St. 026866L	0.17	$ 320	Minimal	1237 / 1194

4.15 Kansas Avenue; USDOT Crossing Number 028400A

4.15.1 Description of Crossing

Kansas Avenue is located in Kings County near the community of Guernsey. Kansas Avenue is a two lane street, with one lane in each direction. BNSF Railway is the owner of two railroad tracks and the grade crossing safety equipment at this location, and operates 26 daily freight trains through this crossing. The State-supported San Joaquin Corridor operates 12 weekday trains through this crossing. The FRA's Web Accident Prediction System projected and annual collision risk of 0.16 for this crossing.

4.15.1.1 Aerial View



4.15.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–6,000, 20 percent
- Total passenger trains through the crossing daily–12
- Total freight trains through the crossing daily–26
- Passenger train speed–79 mph
- Freight train speed–64 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
  - 2014: An automobile stopped on the crossing was struck by a freight train as it was passing through the crossing
  - 2012: An automobile moving over the crossing was struck by a freight train as it was passing through the crossing
  - 2012: A truck-trailer moving over the crossing was struck by a passenger train as it was passing through the crossing
- Other–No Quad Gates, 55 mph on Kansas Avenue. Average time for train crossing and complete warning light/gate operation is 43.83 seconds

4.15.3 Evaluation of Improvements

4.15.3.1 Safety

This crossing is currently planned for at-grade safety improvements funded by the FHWA Railway Highways Crossing (Section 130) Program. The FHWA Section 130 Program is jointly administered by Caltrans and the CPUC.

The Section 130 safety improvements were recommended by an interdisciplinary safety team that evaluated the crossing accident history and conducted an on–site evaluation of the crossing conditions. Because of this, additional at-grade safety improvements were withdrawn from further consideration.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near crossing/Other Site Features**	**Safety Recommendation**
Kansas Ave. 028400A	Rural Minor Arterial	W 10–1 Stop Lines RR Xing Symbols No median	(2) Cantilever gates (2) Mast Flashing Lights		NA

A grade separation at this crossing could be constructed by building a roadway overpass. The potential cost to construct this grade separation is approximately $19 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Kansas Ave. 028400A	Raise Kansas Ave. grade over railroad	Maintain existing grade	Roadway overpass to span approx. 75' railroad ROW	Raise 10th Ave. to conform to elevated Kansas Ave grade	South Wilmington Grade Separation	$19,000,000.00

4.15.3.2 GHG Emissions

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

Kansas Avenue Crossing [SJ] Freight Line [BNSF] DOT Crossing [028400A]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO_{2e}[b]**
San Joaquin Valley	297	287

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

4.15.3.3 Service Levels

Construction of a grade separation, as considered in the study, will improve service level improvements. These improvements may include increased train speed and additional passenger train frequencies.

4.15.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Kansas Ave. 028400A	0.16	$ 19	Minimal	297 / 287

4.16 11th Avenue; USDOT Crossing Number 028427J

4.16.1 Description of Crossing

11th Avenue is located in Kings County, in the city of Hanford. 11th Avenue is a four lane street, with two lanes in each direction. BNSF Railway is the owner of two railroad tracks and the grade crossing safety equipment at this location, and operates 25 daily freight trains, through this crossing. In addition, the State-supported San Joaquin Corridor operates 12 weekday trains through this crossing. The FRA's Web Accident Prediction System projected and annual collision risk of 0.16 for this crossing.

4.16.1.1 Aerial View

4.16.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–19, 120, 10 percent trucks
- Total passenger trains through the crossing daily–12
- Total freight trains through the crossing daily–25
- Passenger train speed–45 mph
- Freight train speed–30 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
  - 2014: A pedestrian moving over the crossing was struck by a freight train as it was passing through the crossing
  - 2010: A pedestrian stopped on the crossing was struck by a freight train as it was passing through the crossing
- Other–No Quad Gates, 35 mph posted speed on 11th Avenue. Average time for train crossing and complete warning light/gate operation is 48.02 seconds

4.16.3 Evaluation of Improvements

4.16.3.1 Safety

At-grade safety could be improved by installing quad gates and pedestrian gates. These improvements have the potential to reduce most vehicular and pedestrian accidents at this grade crossing. Quad gates minimize crashes caused by vehicles moving through the crossing when the gates are down. Pedestrian gates provide a barrier to the tracks and limit pedestrian movement across the tracks. The estimated cost to install the at-grade improvements is $500,000–$1,000,000.

Site Conditions at Crossing and Potential at-grade safety improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/Other Site Features**	**Safety Recommendations**
11th Ave. 028427J	Urban Minor Arterial	W 10–1 Stop Lines RR Xing Symbols Raised Medians	(4) Cantilever gates (2) Mast Flashing Lights	Ivy St/11th Ave. intersection within 75' of rail crossing	Install Quad gates Install Pedestrian gates

A grade separation at this crossing could be constructed by building a roadway overpass. The potential cost to construct this grade separation is approximately $130 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
11th Ave. 028427J	Raise 11th St. grade over railroad	Maintain existing grade	Saddle bent roadway overpass structure	Cul-de-sac Elm St to close railroad crossing; realign Ivy St and create ramp for elevated 11th St/Ivy St intersection	Orangethorpe Ave. Grade Separation	$130,000,000.00

4.16.3.2 GHG Emissions

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

11th Avenue Crossing [SJ] Freight Line [BNSF] DOT Crossing [028427J]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO_{2e}[b]**
San Joaquin Valley	565	545

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

4.16.3.3 Service Levels

This evaluation did not identify any intercity rail passenger service improvements that could be achieved by making safety improvements to this crossing. Service improvements typically require improvements along several miles of the rail corridor. Further evaluation of adjacent crossings and the track and signal structure in this corridor may identify potential service level improvements.

4.16.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
11th Ave. 028427J	0.16	$ 130	Minimal	565 / 545

4.17 Bellevue Avenue; USDOT Crossing Number 028688J

4.17.1 Description of Crossing

Bellevue Avenue is located in Merced County, in the city of Atwater. Bellevue Avenue is a two lane street, with one lane in each direction. The railroad crossing is located at the terminus of Bellevue Avenue at Santa Fe Drive. BNSF Railway is the owner of two railroad tracks and the grade crossing safety equipment at this location and operates 33 daily freight trains through this crossing. In addition, the State-supported San Joaquin Corridor operates 12 weekday trains through this crossing. The FRA's Web Accident Prediction System projected and annual collision risk of 0.16 for this crossing.

4.17.1.1 Aerial View

4.17.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

- Average daily traffic volume–4,500, 8 percent trucks
- Total passenger trains through the crossing daily–12
- Total freight trains through the crossing daily–33
- Passenger train speed–79 mph
- Freight train speed–64 mph
- Crossing safety and warning devices–Yes

- Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:
  - 2011: An automobile moving over the crossing was struck by a passenger train as it was passing through the crossing
  - 2011: A truck stalled or stuck on the crossing was struck by a freight train as it was passing through the crossing
- Other–No Quad Gates, 35 mph on Bellevue Avenue. Average time for train crossing and complete warning light/gate operation is 44.07 seconds

4.17.3 Evaluation of Improvements

4.17.3.1 Safety

At-grade safety could be improved by installing quad gates and pedestrian gates. These improvements have the potential to reduce most vehicular and pedestrian accidents at this grade crossing. Quad gates minimize crashes caused by vehicles moving through the crossing when the gates are down. Pedestrian gates provide a barrier to the tracks and limit pedestrian movement across the tracks. The estimated cost to install the at-grade improvements is $500,000–$1,000,000.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name/ DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/Other Site Features**	**Safety Recommendations**
Bellevue Ave. 028688J	Urban Expressway	W 10–1 Stop Lines RR Xing Symbols Raised Medians	(1) Cantilever gates (2) Mast Flashing Lights	No gate on left turn into rail crossing, no gates on NB Santa Fe Dr.	Install Quad gates Install Pedestrian gates

A grade separation at this crossing could be constructed by depressing the roadway and building a railroad bridge to accommodate the railroad tracks. The potential cost to construct this grade separation is approximately $66 million.

Grade Separation Concept						
Existing Road Crossing	**Road Design**	**Track Design**	**Structure Type**	**Other Grade Separation Considerations**	**Comparable Project**	**Potential Project Cost (20 percent contingency included)**
Bellevue Ave. 028688J	Lower Bellevue Ave. and Santa Fe Dr. to create depressed intersection	Maintain existing grade	Railroad Bridge–structure width approx. 75' railroad ROW	Lower intersection at Spaceport Entry driveway to conform to depressed Santa Fe Dr.	17th Street. Grade Separation project (Santa Ana)	$66,000,000.00

4.17.3.2 GHG Emissions

Construction of a grade separation has the potential to reduce GHG emissions produced when vehicles are idling while waiting for a train to pass through a crossing. The first emission reduction column represents the estimated reduction in emissions for all vehicles using standard fuel and with standard fuel economy. The second emission reduction column assumes 2009–2016 passenger vehicles conform to the LCFS standards prescribed in Assembly Bill 1493, which achieves reductions in vehicles produced during these years through the use of low-carbon fuel and increased fuel economy.

Bellevue Avenue Crossing [SJ] Freight Line [SCAX] DOT Crossing [028688J]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO_{2e}[b]**
San Joaquin	107	103

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

4.17.3.3 Service Levels

Construction of a grade separation, as considered in the study, will improve service level improvements. These improvements may include increased train speed and additional passenger train frequencies.

4.17.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Bellevue Ave. 028688J	0.16	$ 66	Minimal	107 / 103

4.18 Church Avenue; USDOT Crossing Number 028512Y

4.18.1 Description of Crossing

Church Avenue is located in Fresno County, in the city of Fresno. Church Avenue is a four lane street, with two lanes in each direction. The Burlington Northern Santa Fe railway is the owner of three railroad tracks and the grade crossing safety equipment at this location, and operates 30 daily freight trains, through this crossing. In addition, the San Joaquin Corridor operates 12 weekday trains through this crossing. The FRA's Web Accident Prediction System projected an annual collision risk of 0.15 for this crossing.

4.11.1.1 Aerial View

4.18.2 Data Inputs

The evaluation of this grade crossing included consideration of the following data inputs and variables:

4.18.2.1 Average daily traffic volume–12,000, 18 percent trucks

4.18.2.2 Total passenger trains through the crossing daily–12

4.18.2.3 Total freight trains through the crossing daily–30

4.18.2.4 Passenger train speed–40 mph

4.18.2.5 Freight train speed–25 mph

4.18.2.6 Crossing safety and warning devices–Yes

4.18.2.7 Accidents occurring during the 2010–2014 FRA's Web Accident Prediction System reporting period:

- 2013–A pedestrian moving over the crossing was struck by a passenger train
- 2012–An automobile moving over the crossing was struck by a freight train

4.18.2.8 Other–No Quad Gates, 40 mph on Church Avenue. Average time for train crossing and complete warning light/gate operation is 50.08 seconds

4.18.3 Evaluation of Improvements

4.18.3.1 GHG Safety

The California High Speed Rail Authority (CHSRA) is in the process of constructing a grade separation at Church Avenue. No at-grade crossing improvements are recommended.

Site Conditions at Crossing and Potential at-grade Safety Improvements					
Road Name / DOT Crossing #	**Road Classification at Crossing**	**Warning Signs/ Channelization**	**Gates/Flashing Lights**	**Intersecting Roadway near Crossing/ Other Site Features**	**Safety Recommendations**
Church Ave. 028512Y	Urban Minor Arterial	W 10–1 Stop Lines RR Xing Symbols No median	(2) Cantilever gates (2) Mast Flashing Lights	SE Ave intersection within 50' of rail crossing BNSF Stockton Sub and UPRR Fresno Sub cross Church within 400' of each other	No at-grade improvements, CAHSR CP 1 project to build Church Ave Overhead Structure

The CHSRA is in the process of constructing a grade separation at Church Avenue. No further improvements are recommended.

Existing Road Crossing	Road Design	Track Design	Structure Type	Other Grade Separation Considerations	Comparable Project	Potential Project Cost (20 percent contingency included)
Church Ave. 028512Y	CAHSR CP 1 project to build Church Ave Overhead Structure to span over BNSF and UPRR tracks					

4.18.3.2 GHG Emissions

The CHSRA is in the process of constructing a grade separation at Church Avenue. The following estimated GHG emissions reductions are provided for information only.

Church Avenue Crossing [SJ] Freight Line [BNSF] DOT Crossing [028512Y]		
Estimated GHG Emissions Reduction (Annual Metric Tons)		
Air Basin	**CO_2 and CO_{2e}[a]**	**CO_2(Pavley and LCFS) and CO [b]$_{2e}$**
San Joaquin Valley	772	745

Notes:

a. Carbon dioxide equivalents include methane (CH_4) and nitrous oxide (N_2O) tailpipe emissions based on their GWP, which for these pollutants, is equivalent to 36 and 298 times unit carbon dioxide (CO_2) emissions, respectively.

b. Pavley and LCFS emissions reflect the regulation of passenger vehicle GHG emissions prescribed by California Assembly Bill 1493. Amendments to the bill occurred most recently on September 24, 2009, and aim at reducing GHG emissions from 2009–2016 models.

4.18.3.3 Service Levels

Construction of a grade separation, as considered in the study, will improve service level improvements. These improvements may include increased train speed and additional passenger train frequencies.

4.18.4 Summary

The summary for each area examined is set forth below:

Grade Crossing Summary				
Existing Road Crossing	**FRA Accident Prediction Value (2014)**	**Grade Separation Cost (In Millions)**	**Service level Improvement**	**Estimated GHG Reduction (CO_2 & CO_{2e} / Pavley)**
Church Ave. 028512Y	0.15	CAHSR	Minimal	772 / 745