HIGHWAY FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

Highway Attachment – Biloxi Public School District Grade Crossing Report, Dated March 15, 2017

Biloxi, Mississippi

HWY17MH010

(40 pages)

Biloxi Public Schools

Transportation

341 Agincourt Avenue, Biloxi, MS 39531 • (228) 436-5140

Sam Bailey, Director

On June 14, 2017, Biloxi School District Transportation Director Sam Bailey met with Peter Abide (Biloxi City Attorney), Edward Donovan (School District Attorney), and David Nichols (School District Director of Personnel). The purpose of the meeting was to discuss Bailey's March 15, 2017 report on railroad crossings and the request from National Transportation Safety Board (NTSB) for a copy of the report.

During the meeting, Bailey offered the following additional insights and information:

That when he began his job as Transportation Director in 2003, Bailey conducted an assessment of all Biloxi railroad crossings with relation to school buses using those crossings. At most crossings, Bailey placed a 12 ounce coke can at the highest point of the crossing and had a school bus (2000 GMC) drive over the tracks. The bus was unloaded and had normal tire pressure. A coke can was not utilized at Benachi, Iroquois and possibly Querens as it was obvious that the clearances were inadequate. On all other crossings the bus cleared the tracks without toppling the coke can.

In 2005 following Hurricane Katrina, Bailey conducted a visual inspection of the tracks and the contour of the intersections for each crossing. The purpose was to look for any damage to the rails or potentially problematic changes to the roadway contour. Bailey noted no noticeable damage to the tracks or road contours beyond what he had noted in 2003.

In March 2017, within 2-3 days following the tragic charter tour bus accident, Bailey utilized a newer District school bus to assess the crossings. This bus was also unloaded with normal tire pressure. Bailey took a photo as the bus crossed each crossing tested. Bailey observed the clearance at Main Street at one inch, Nixon at 2 inches and Lee at 2 inches. The crossing at Lameuse concerned Bailey enough to add it to the list in the March 15 report. After noticing that the clearances were less than when last assessed, Bailey chose to undertake a more thorough investigation to also include a variety of measurements of the intersections.

As a follow up, Bailey will determine the year, make and model of the buses used for the clearance assessments. The District will permit the city to obtain copies of the photos made at the various crossings by Bailey in response to an appropriate freedom of information or public records request.

The above information is correct:

[redacted]

Sam Bailey

Biloxi
Public
Schools

Transportation

341 Agincourt Avenue, Biloxi, MS 39531 • (228) 436-5140
[redacted] *Sam Bailey, Director*

March 15, 2017

Summary

Current railroad crossing conditions suggest decades of subtle increment railroad elevations. This may have contributed to a "humped" profile that adversely affected the safe operation of roadway traffic over certain Biloxi railroad crossings. A third-party study of the Biloxi railroad crossings is likely needed.

Overview

There are 30 railroad crossings in the City of Biloxi. This rail system runs the entire east to west length of Biloxi. In just a little over one decade, two avoided crossings for school buses have grown to seven (7) for the Biloxi Public Schools Transportation Department due to certain safety reasons. The reason is low clearance levels and visibility to the other side of the tracks. For these two reasons, school buses will avoid these railroad crossings: Querens, Benachi, Iroquois, Lamuese, Main, Nixon, and Lee.

The most recent tragic charter bus incident on the fatal Tuesday, March 7, 2017 caused me to reevaluate all Biloxi Railroad crossings. I conducted a school bus route related survey of the railroad crossings beginning at Debuys Rd and worked to east ending at Oak St.

The purpose to reassess every rail crossing was for the safety of school bus routes. A visual survey of these same 30 crossings was conducted by me in the summer of 2003 when I became a Biloxi pupil transportation director. My next visual survey was conducted shortly after Hurricane Katrina in 2005. This year followed by the charter bus accident I studied the crossing on both a visual and a measurement level.

Signs of Railroad Elevation

Railroad maintenance and other improvements are ongoing. I am seeing signs of railroad elevation in increments of about 2-3 inches. These elevations are developing a "hump" affect. In recent years, a Pepsi truck was struck by a train as its trailer lodged onto the Main St crossing tracks. This is the same location the charter bus lodged itself on the tracks.

Main St railroad crossing was a very common crossing for many vehicles of all types. I recently observed a 71-passenger school bus pass over with a mere 2-inch clearance, where in the past decade this was four or more inches of ground clearance.

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2 of 2

643.4.6.11 Low Ground Clearance Grade Crossing Sign (W10-5) Manual on Uniform Traffic Device (MUTCD Section 8B.23). This sign is correctly posted at the Main St railroad crossing:

U.S. Department of Transportation, Federal Highway Administration

Railroad-Highway Grade Crossing Handbook – Revised Second Edition August 2007,

4 Identification of Alternatives

https://safety.fhwa.dot.gov/hsip/xings/com_roaduser/07010/sec04c.cfm

Crossing Geometry

Vertical alignment. It is desirable that the intersection of highway and railroad be made as level as possible from the standpoint of sight distance, ride ability, and braking and acceleration distances.

Track maintenance can result in raising the track as new ballast is added to the track structure. Unless the highway profile is properly adjusted, this practice will result in a "humped" profile that may adversely affect the safety and operation of highway traffic over the railroad.

Low-clearance vehicles, such as those low to the ground relative to the distance between axles, pose the greatest risk of becoming immobilized at highway-rail grade crossings due to contact with the track or highway surface.

Continued Height Elevation Example

Most notable layers of height elevations is seen at the Holly St railroad-crossing. A six-inch concrete curbing is paved over with an approximate 9-inch asphalt layer. A couple more asphalt layers over the existing street by another four (4) inches, rather than smooth to the road. This intersection is subtle tapered in north and south directions. Nonetheless, the north-west side has a retention wall. This wall appears to have assisted in this intersection elevation to meet the tracks for a smoother transition. Not all crossing are this fortunate. There are several crossings where visibility to the other side is hindered by a steep railroad vertical curves.

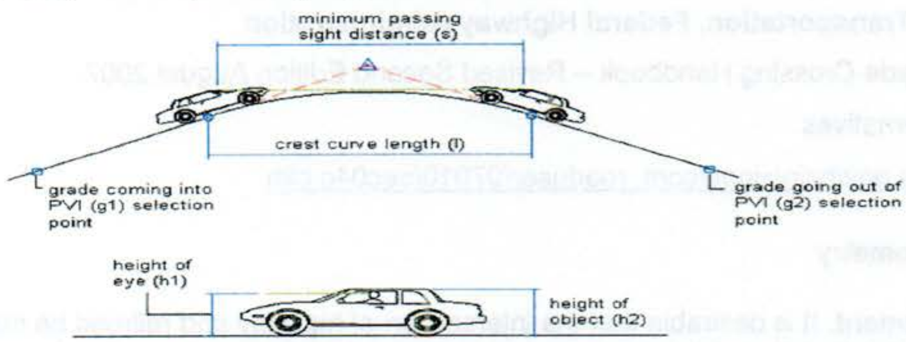
Stopping Site Distance (Vertical Curves)

Continued height elevations over the decades have caused certain crossing to have vertical curve stopping site distance safety concerns. Querens, Benachi, and Irouois railroad intersections limit the vehicle operator site distance. These crossing have a grade tangent (gradient slope) so steep that the driver is looking to the sky until near the top of the tracks. There is no going back at this point. Speed limit on these roads are 25-MPH. Two of the roads have a north intersecting road within 60-feet of the track crossing. I see "Stopping Site Distance (SSD)" to be a concern should hazard need avoid while traveling these intersections. American Association of State Highway and Transportation Officials (ASSHTO) provides the leading industry policy on geometric design of highways and streets. I use the following ASSHTO stopping site distance charts for posted speed limits and needed reactionary stopping distance for bus stop locations:

Passing Sight Distance

This design method for crest curves provides a minimum curve length. The curve must be long enough so that the driver of a standard vehicle can always see an oncoming vehicle within a safe distance for the designed speed of travel.

Diagram of passing sight distance



Design Control for Crest Vertical Curves

Design Speed (mph)	Stopping Sight Distance (ft)	Design Rate of Vertical Curvature, (K Value)
15	80	3
20	115	7
25	155	12
30	200	19
35	250	29
40	305	44
45	360	61
50	425	84
55	495	114
60	570	151
65	645	193
70	730	247
75	820	312
80	910	384

Design Control for Sag Vertical Curves

Design Speed (mph)	Stopping Sight Distance (ft)	Design Rate of Vertical Curvature, (K Value)
15	80	10
20	115	17
25	155	26
30	200	37
35	250	49
40	305	64
45	360	79
50	425	96
55	495	115
60	570	136
65	645	157
70	730	181
75	820	206
80	910	231

Metric				
Design speed (km/h)	Brake reaction distance (m)	Braking distance on level (m)	Stopping sight distance Calculated (m)	Stopping sight distance Design (m)
20	13.9	4.6	18.5	20
30	20.9	10.3	31.2	35
40	27.8	18.4	46.2	50
50	34.8	28.7	63.5	65
60	41.7	41.3	83.0	85
70	48.7	56.2	104.9	105
80	55.6	73.4	129.0	130
90	62.6	92.9	155.5	160
100	69.5	114.7	184.2	185
110	76.5	138.8	215.3	220
120	83.4	165.2	248.6	250
130	90.4	193.8	284.2	285

US Customary				
Design speed (mph)	Brake reaction distance (ft)	Braking distance on level (ft)	Stopping sight distance Calculated (ft)	Stopping sight distance Design (ft)
15	55.1	21.6	76.7	80
20	73.5	38.4	111.9	115
25	91.9	60.0	151.9	155
30	110.3	86.4	196.7	200
35	128.6	117.6	246.2	250
40	147.0	153.6	300.6	305
45	165.4	194.4	359.8	360
50	183.8	240.0	423.8	425
55	202.1	290.3	492.4	495
60	220.5	345.5	566.0	570
65	238.9	405.5	644.4	645
70	257.3	470.3	727.6	730
75	275.6	539.9	815.5	820
80	294.0	614.3	908.3	910

Note: Brake reaction distance predicated on a time of 2.5 s; deceleration rate of 3.4 m/s² [11.2 ft/s²] used to determine calculated sight distance.

from ASSHTO *A Policy on Geometric Design of Highways and Streets*, 2001

Note: this table assumes level grade (G = 0)

Quick Reference Resources

Engineering Policy Guide, 643.4 Railroads

http://epg.modot.mo.gov/index.php?title=643.4_Railroads#643.4.1.12_Crossing_Surfaces

643.4.1.7 Railroad Operating Right of Way

Railroads usually consider a 100 ft. width of right of way centered about their main track centerline as the minimum on which they can effectively operate. Any encroachment within this limit, even if it is only for ditch cleanout or erosion control, is not welcomed by the railroad and therefore is to be avoided. When encroachment on railroad operating property is absolutely necessary, the roadway plans and other information noted above, including cross sections sheets showing the work on railroad operating right of way throughout the encroachment, are submitted to MO-RR.

643.4.1.10 Resurfacing Projects

When railroad grade crossings are within the limits of a roadway resurfacing project, MO-RR can request the railroad to make any necessary repairs or replacement of the track crossings, warning devices, and adjustment of high or low tracks to provide for a better grade crossing.

Resurfacing projects will typically mill to match the existing roadway elevation at the railroad crossing. If for some reason this cannot be done, the district will review all railroad crossings within the project limits and determine if a track adjustment is necessary and can be justified. If an adjustment appears beneficial, a profile of top of rail (both rails if the track is on a curve) for 500 ft. in each direction from the crossing will be obtained. This information will be submitted to MO-RR together with a recommended adjustment height.

The district initiates a review of all railroad grade crossings within the limits of or affected by a project by submitting Form D-20 as soon as a project is added to the STIP.

A review of advance warning signs should also be done at the same time to ensure they are correctly placed on either side of the crossing.

Resurfacing projects with paving limits up to the crossing surface or within 25 ft. of the tracks will require a JSP that includes railroad protective liability insurance and flagging. Seal coat projects, with limits stopping 50 ft. before the tracks, may require a No Railroad Involvement JSP. MO-RR will coordinate the necessary provisions with the impacted railroad, as soon as the required information is submitted in the Form D-20.

643.4.1.12 Crossing Surfaces

Railroads are responsible for the installation and maintenance of all public railroad-highway grade crossing surfaces. If a district desires to pay for a crossing surface or a portion of a crossing surface, they will work with MO-RR before entering into any oral agreement or arrangement to pay for the crossing, which is strictly voluntary.

Agreements for installation of high type crossing surfaces are prepared by MO-RR and submitted to the railroad for execution. These high type surfaces are composed of rubber or concrete. MO-RR will transmit the agreement to the district for execution by the local agency, if applicable, after execution by the railroad. Once it has been executed by the local agency, MO-RR will notify the railroad to proceed with the installation. District construction personnel will inspect the work. The District Construction and Materials engineer responsible for Construction will notify MO-RR when the installation is completed.

43.4.4.3 Roadway Taper at Railroad Crossings

A rough riding railroad crossing is sometimes caused by the buildup of the asphalt approach pavement to the crossing. On overlay projects, depth transitions should be constructed approaching the railroad crossing to meet the elevation of the tracks. Modified cold-milling should be used to create a taper of 1" to 100' (1:200) and the overlay placed at the intended thickness. As some flexibility exists, the district will need to review the route and any exceptions to determine the appropriate adjustments for each location within the project.

643.4.6.11 Low Ground Clearance Grade Crossing Sign (W10-5) Manual on Uniform Traffic Device (MUTCD Section 8B.23)

Support.

U.S. Department of Transportation, Federal Highway Administration

Railraod-Highway Grade Crossing Handbook – Revised Second Edition August 2007

4 Identification of Alternatives

https://safety.fhwa.dot.gov/hsip/xings/com_roaduser/07010/sec04c.cfm

Crossing Geometry

Vertical alignment. It is desirable that the intersection of highway and railroad be made as level as possible from the standpoint of sight distance, ride ability, and braking and acceleration distances. Drainage would be improved if the crossing were located at the peak of a long vertical curve on the highway. Vertical curves should be of sufficient length to ensure an adequate view of the crossing and consistent with the highway design or operating speed.

Track maintenance can result in raising the track as new ballast is added to the track structure. Unless the highway profile is properly adjusted, this practice will result in a "humped" profile that may adversely affect the safety and operation of highway traffic over the railroad.

Two constraints often apply to the maintenance of grade crossing profiles: drainage requirements and resource limitations. Coordination of maintenance activities between rail and highway authorities, especially at the city and county level, is frequently informal and unstructured. Even when the need to coordinate has been identified, there may be a lack of knowledge regarding whom to contact.

In some cases, highway authorities become aware of increases in track elevation (a by-product of track maintenance) only after the fact. As a result, even if state standards exist, there is little opportunity to enforce them. Often, an individual increase in track elevation may not violate a guideline, but successive track raises may create a high-profile crossing.

Low-clearance vehicles, such as those low to the ground relative to the distance between axles, pose the greatest risk of becoming immobilized at highway-rail grade crossings due to contact with the track or highway surface. With the exception of specialized vehicles such as tank trucks, there is little standardization within the vehicle manufacturing industry regarding minimum ground clearance. Instead, manufacturers are guided by the requirements of shippers and operators.[110]

A similar problem may arise where the crossing is in a sag vertical curve. In this instance, the front or rear overhangs on certain vehicles may strike or drag the pavement.[111]

Alternatives to this problem include a design standard that deals with maximum grades at the crossing; prohibiting truck trailers with a certain combination of under clearance and wheelbase from using the crossing; setting trailer design standards; posting warning signs in advance of the crossing; minimizing the rise in track due to maintenance operations; or reconstructing the crossing approaches.[112]

The AREMA *Manual for Railway Engineering* recommends that the crossing surface be in the same plane as the top of rails for a distance of 600 millimeters (2 feet) outside of the rails, and that the surface of the highway be not more than 75 millimeters (3 inches) higher or lower than the top of the nearest rail at a point 7.5 meters (30 feet) from the rail, unless track superelevation dictates otherwise. This standard has been adopted by AASHTO in *A Policy on Geometric Design of Highways and Streets* (see Figure 56).[113]

Eck and Kang surveyed a large number of low-clearance vehicles on an interstate route in West Virginia and also obtained vehicle length and ground clearance data from Oregon and other sites. Based on field and engineering data, they proposed a low-clearance vehicle for design purposes that would have an 11-meter (36-foot) wheelbase and a 125-millimeter (5-inch) ground clearance.[114]

Eck and Kang also identified and summarized a number of state and railroad crossing profile standards in addition to the AREMA and AASHTO criteria described above. Among them were:

â€¢ The Illinois Commerce Commission specifies that from the outer rail of the outermost track, the road surface should be level for about 600 millimeters (24 inches). From there, for a distance of 7.6 meters (25 feet), a maximum grade of 1 percent is specified. From there to the railroad right-of-way line, a maximum grade of 5 percent is specified.

â€¢ The Division of Highways in West Virginia recommends 3 meters (10 feet) of run-off length for every 25 millimeters (1 inch) of track raise.

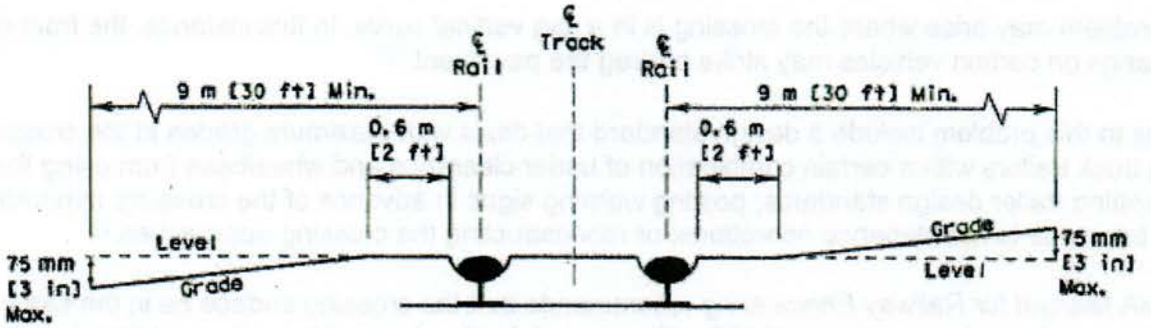
â€¢ A standard developed by the Southern Pacific Railroad prior to its merger with Union Pacific recommends that for a distance of 6 meters (20 feet) from a point 2 feet from the near rail, the maximum descent should be 150 millimeters (6 inches). From that point, for a distance of another 6 meters, the maximum descent should be 600 millimeters (2 feet).

â€¢ Tennessee state law requires that the road be graded level with the rails for a distance of 3 meters (10 feet) on either side of the track and between the rails thereof.

â€¢ A number of European countries have developed geometric design guidelines for highway-rail grade crossings. Great Britain provides a circular curve roadway profile. There are three categories of radii depending on traffic volume and traffic "moment" (the product of vehicular and rail traffic).

Eck and Kang developed a software package for the analysis of crossing profiles. HANGUP was developed to simulate the movement of low-clearance vehicles on grade crossings. It is useful as an analysis tool for evaluating crossings where low-clearance vehicles or overhang dragging may be a problem.[115] At the time of this writing, the program package was being updated.

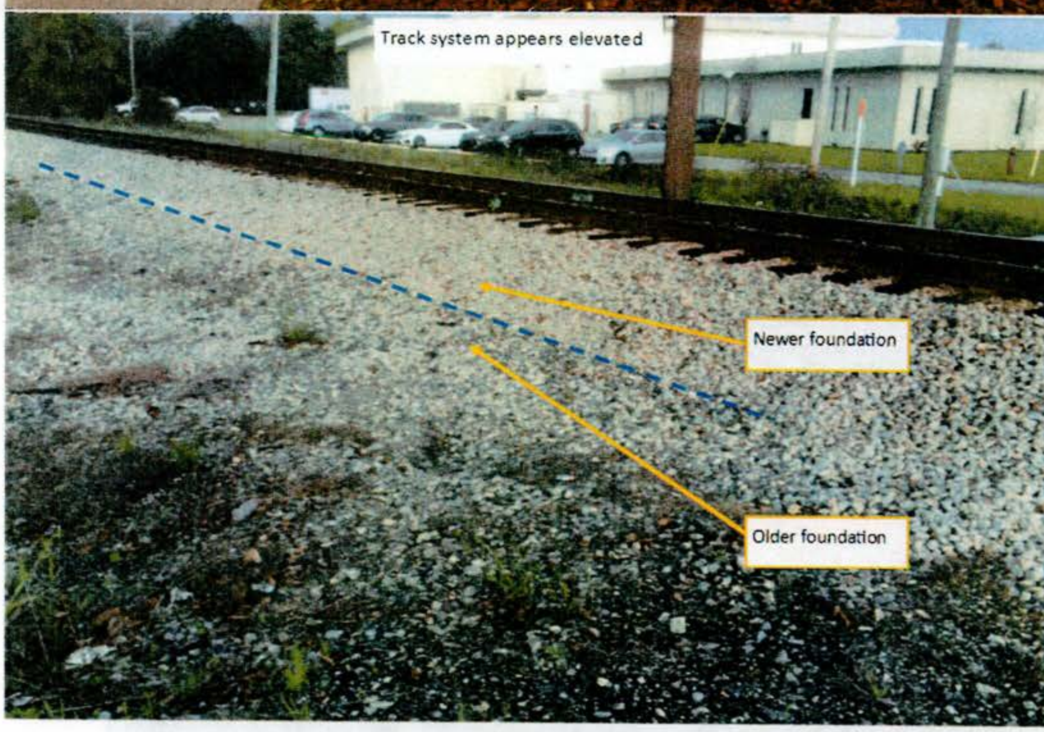
Figure 56. Highway-Rail Grade Crossing Cross Section



Source: From A Policy on Geometric Design of Highway and Streets, 2004, *by the American Association of State Highway and Transportation Officials, Washington, DC. Used by permission.*

School Bus Route Railroad Crossing Discoveries

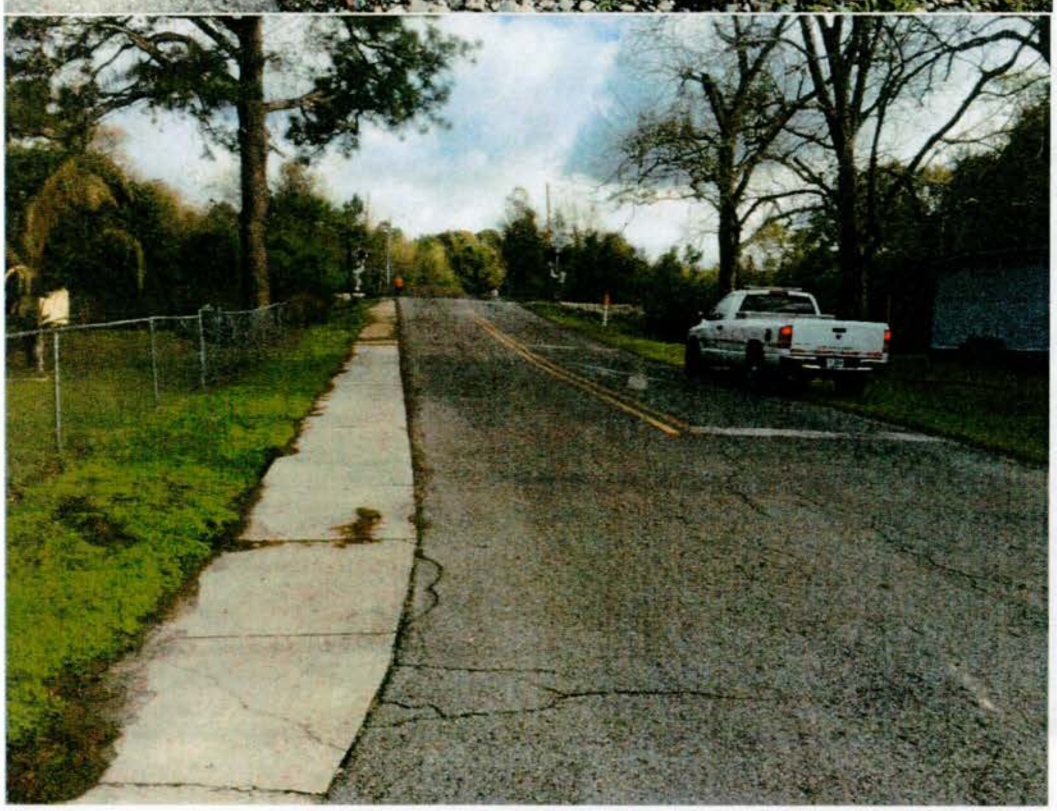
1. Debuys Rd: Raised elevation with overlap pavement extended onto the existing roadway.



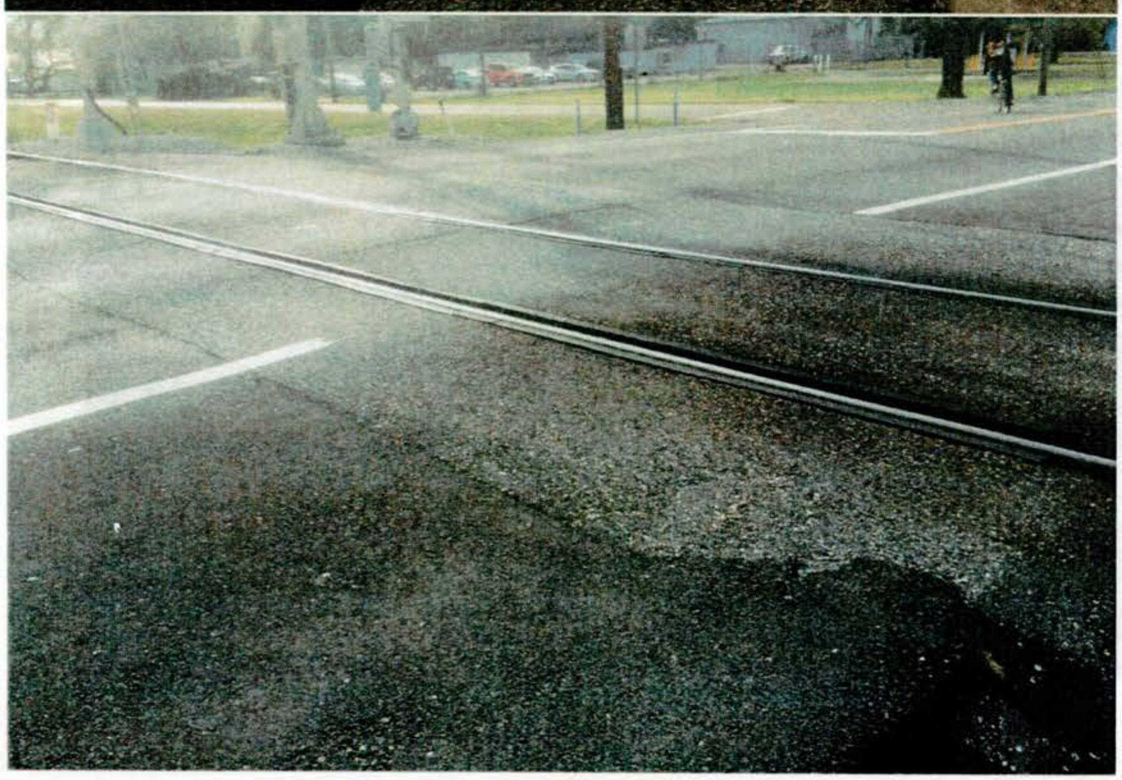
2. Eisenhower Dr.: A few inches higher than the roadway, but has a smooth transition with a near level profile.

3. Beavoir Rd: Over all elevation above the existing roadway appears to approximately seven (7) inches, but it is spread over a 43 foot span from both sides of the track system.

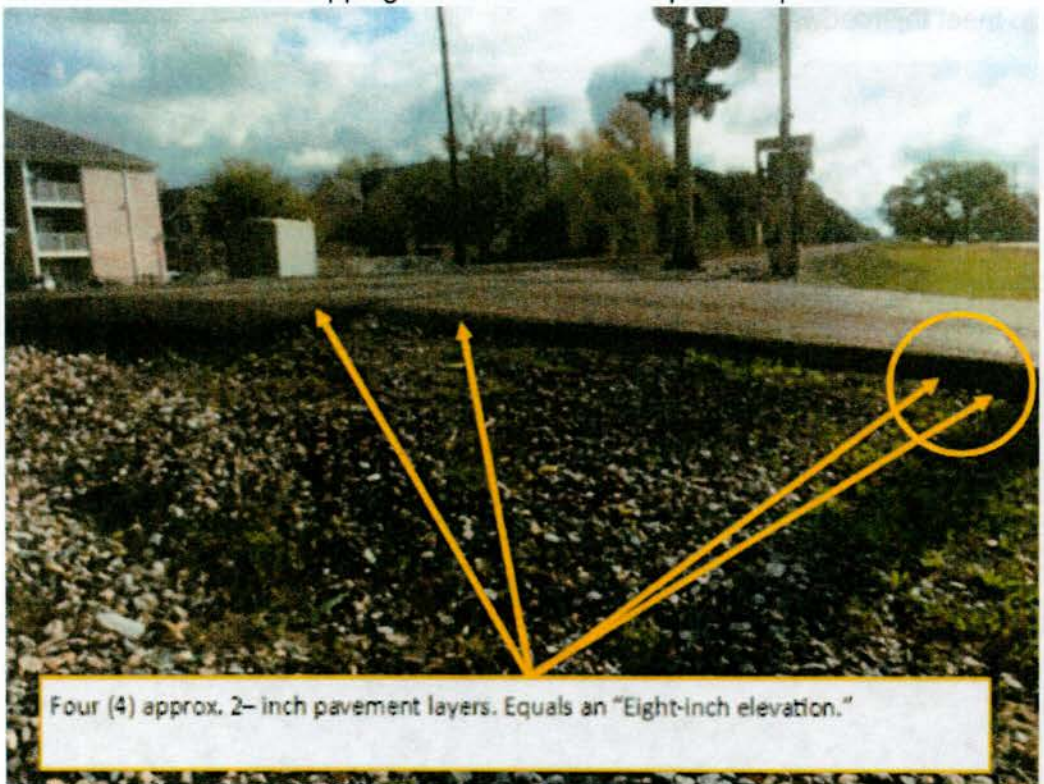
4. Iris St.: Elevated intersection with north bound pavement raised and overlapping the existing roadway. South bound tapers smoothly, but eliminates the sidewalk curb for this transition adjustment. The new pavement span across the intersection is 39-feet.

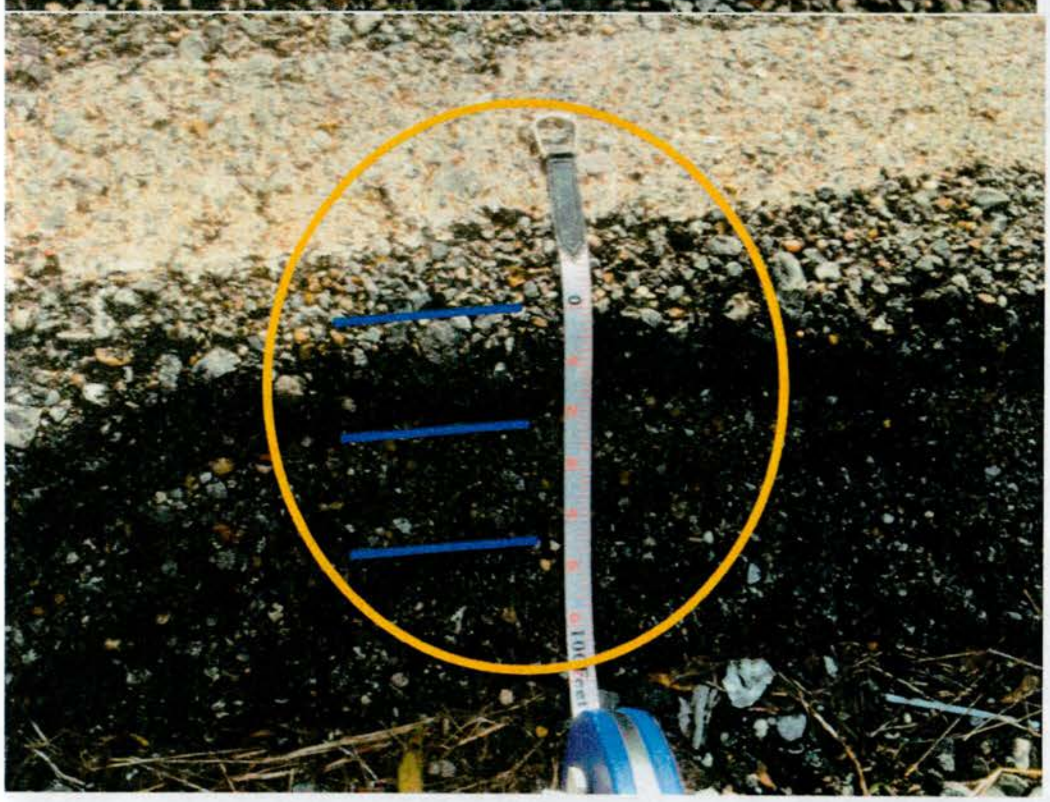


5. Veteran's Ave.: Fairly new paved level surface match. It has a new 2-inch rise transition pavement onto the existing roadway. Notice the side road entrance has a significant new elevation to meet the roadway.

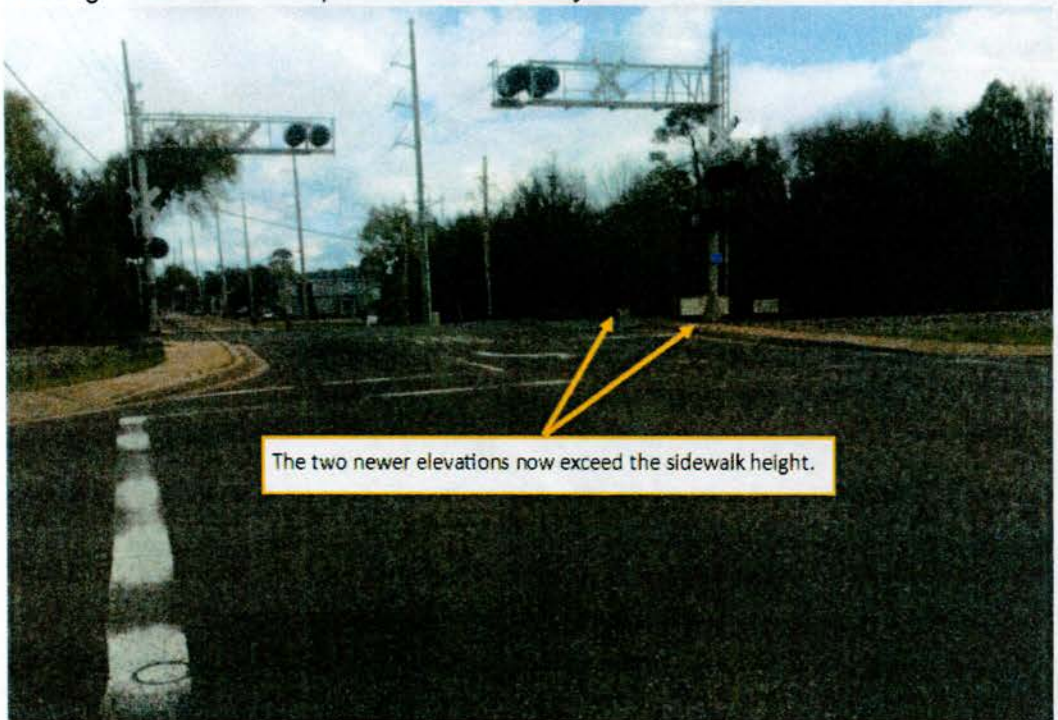


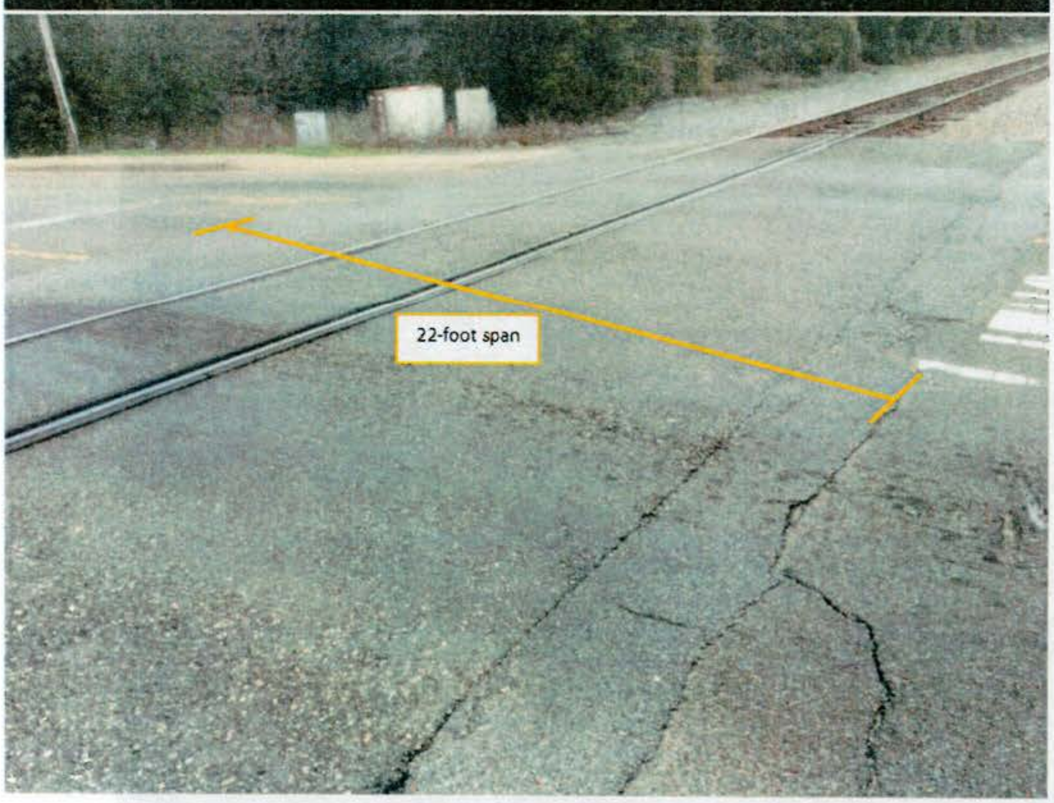
6. McDonnel Ave.: Four (4) levels of elevation. Posted stop sign just over the tracks may be in conflict with ASSHTO stopping site distance for the posted speed limit.



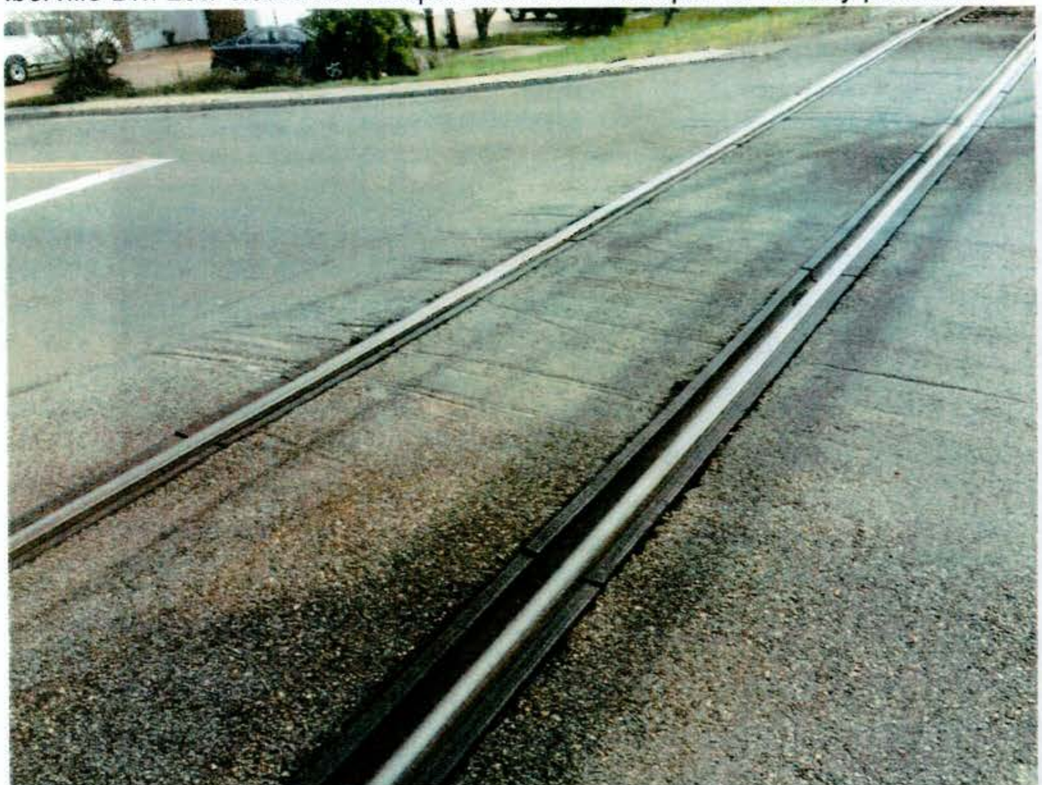


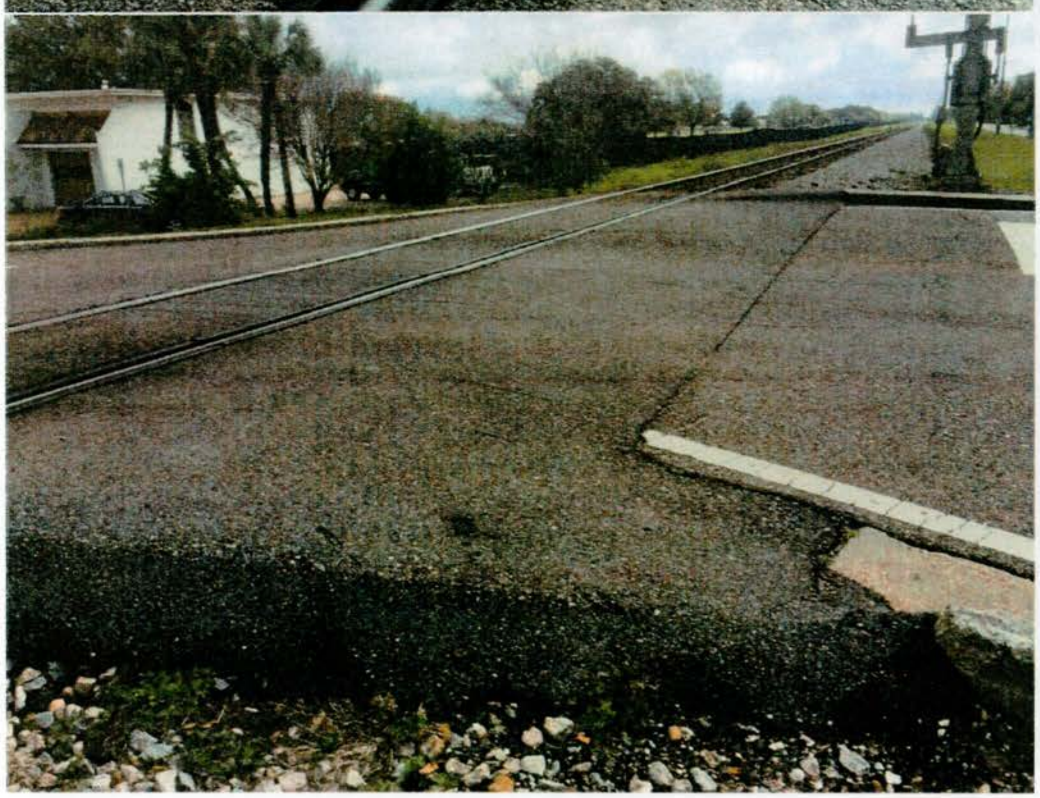
7. Rodenberg Ave.: Track height elevated with two separate time overlapping layers onto the existing road. The total span of the added layers is 22-feet.



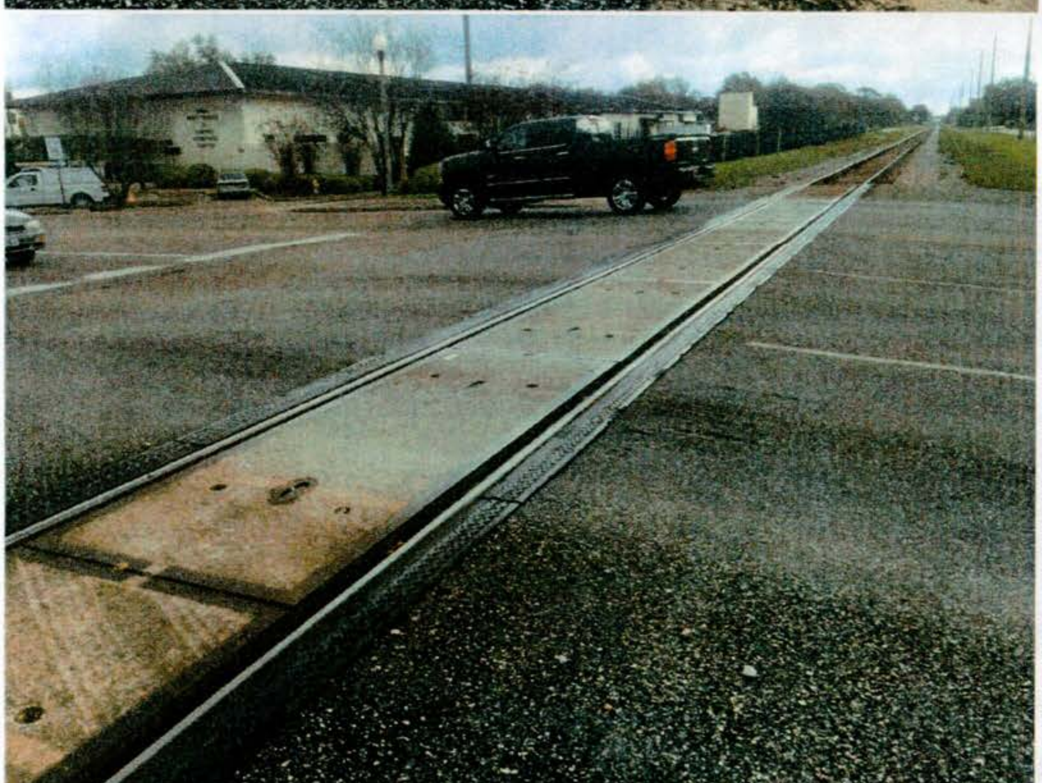


8. Iberville Dr.: Low clearance scrapes with a 17-foot span of overlay pavement.



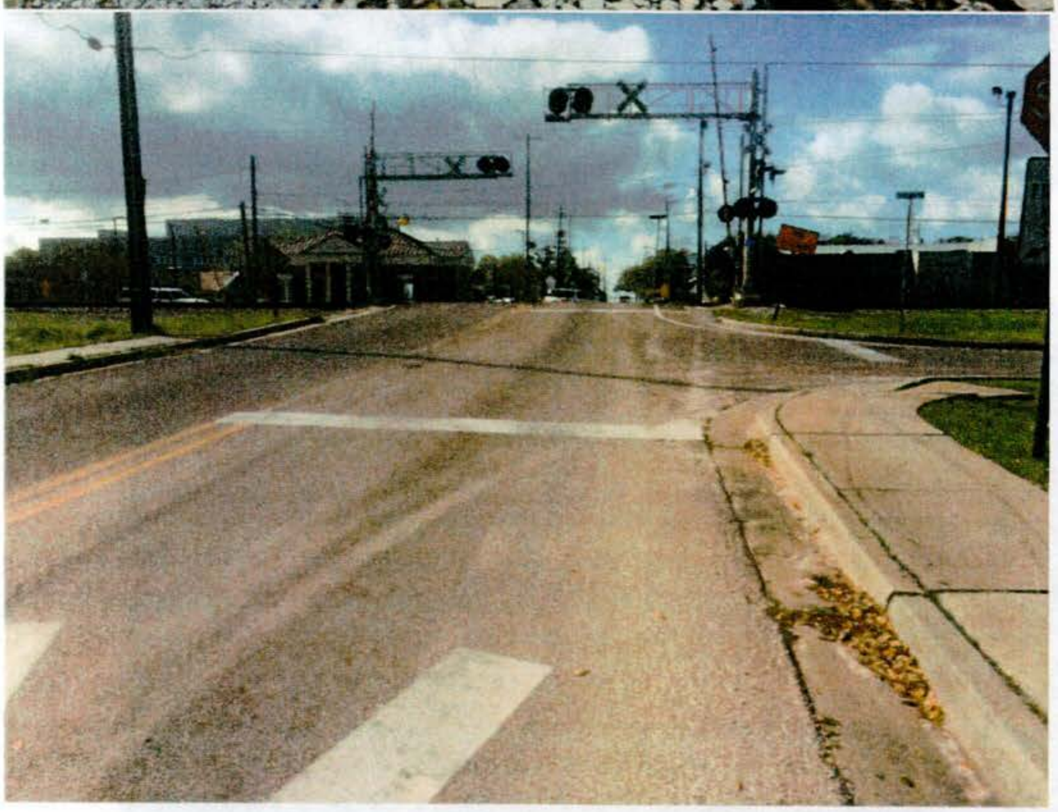


9. White Ave.: Keesler AFB entrance. Its elevation has scrape marks on the south bound side. The pavement overlay spans a total of 33 feet across the tracks.

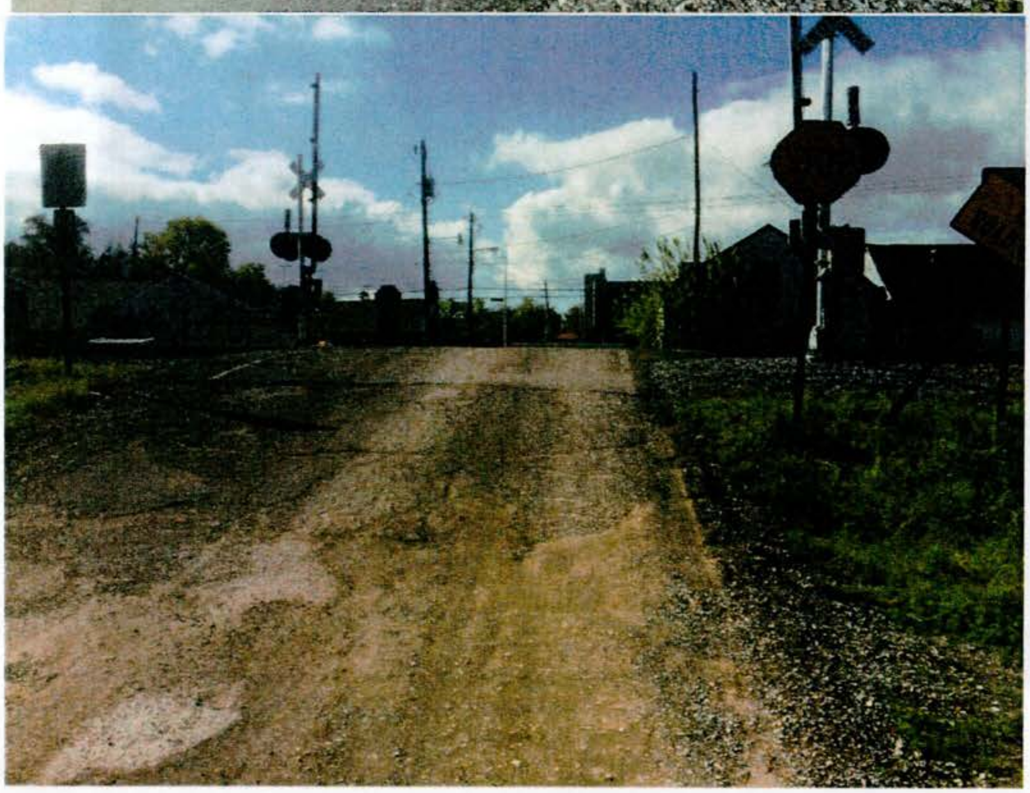


10. Gill Ave.: Speed limit is 25-MPH. Track to stop sign is 162-feet. It has elevation with a 16-foot hump span smoothly transitioning to the existing roadway. South side has an incline; North side is fairly level.

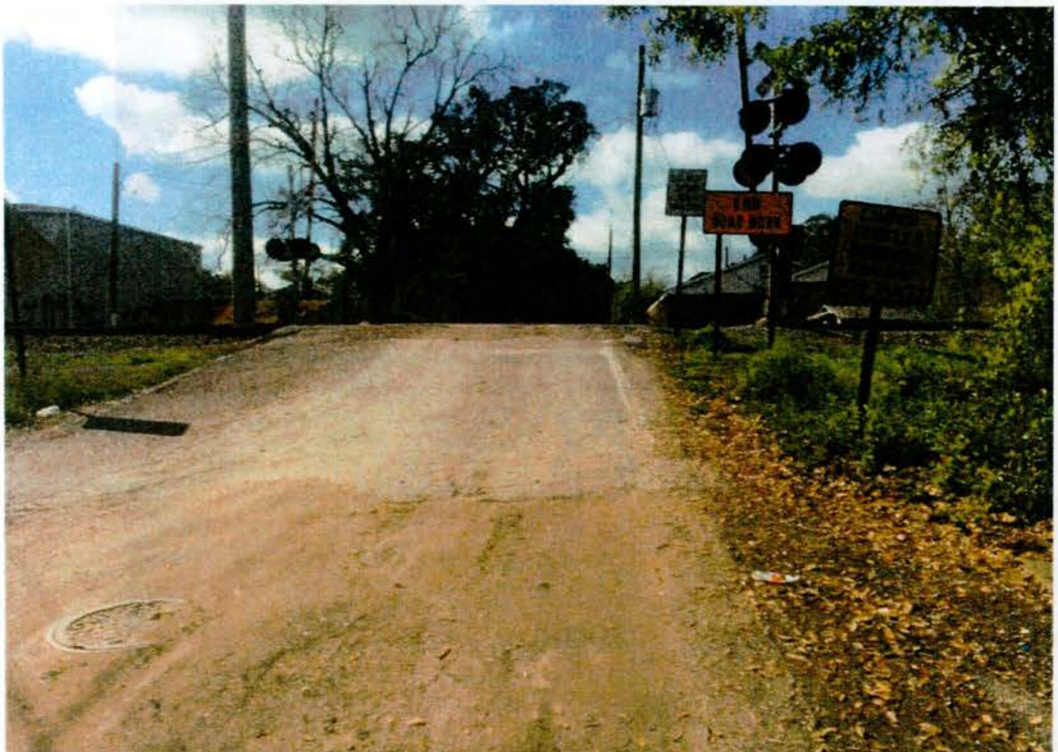
11. Porter Ave.: Newer elevation spans 26-feet across. It is smooth and level.



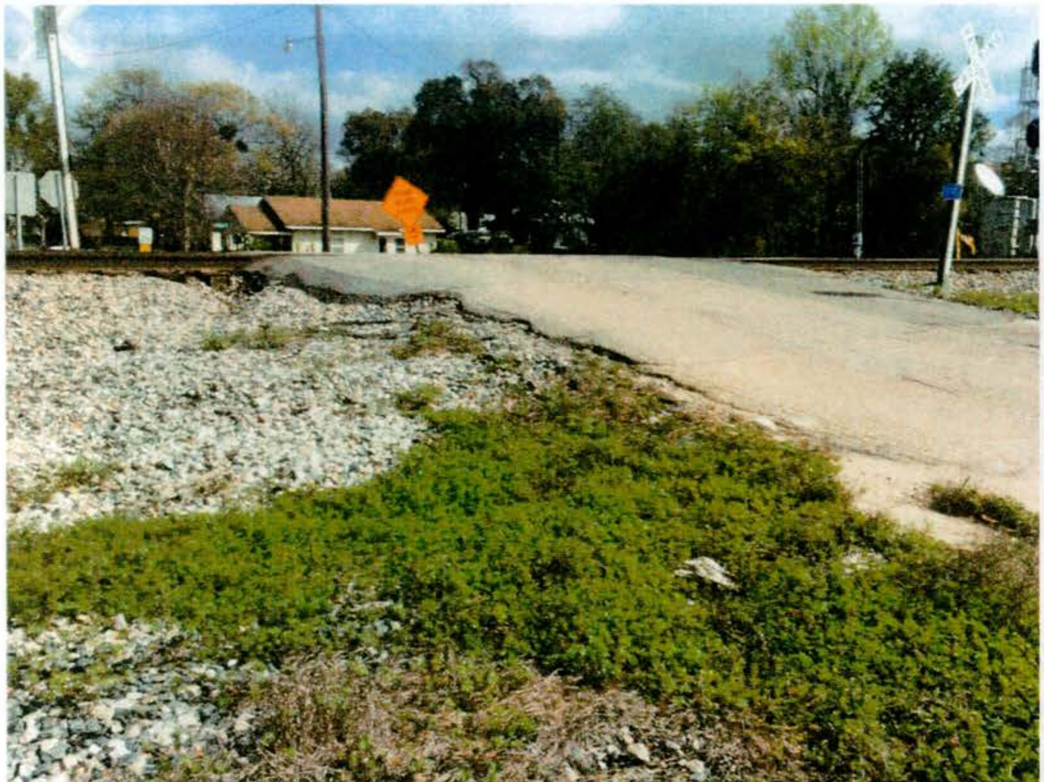
12. Querens Ave.: **(NO SCHOOL BUS CROSSING)** Equipped with north and south stop signs at the tracks. Speed limit is 25-MPH. Elevations of the track required two added overlapping layers. One spans 46-feet and the most recent is 17-foot span. Visibility from a vehicle driver is poor with this steep incline on both sides. Querens / Howard south bound traffic sign is 101-feet from the railroad track.



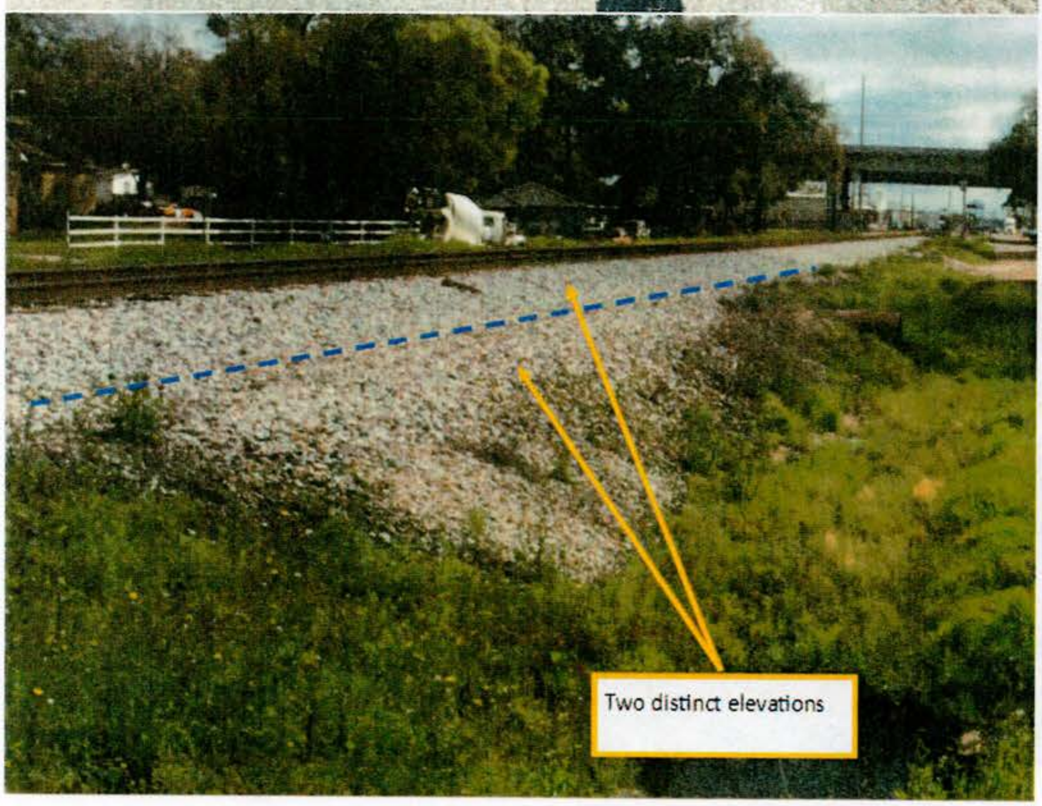
13. Benachi Ave.: **(NO SCHOOL BUS CROSSING)** Very steep grade creating poor visibility from both side of the track. A driveway is on the south side. Three (3) consecutive, elevated layers span at 30-feet (first), 23-feet (second), and 20-feet (third). A south bound Howard Ave stop sign is 152-feet from the railroad.



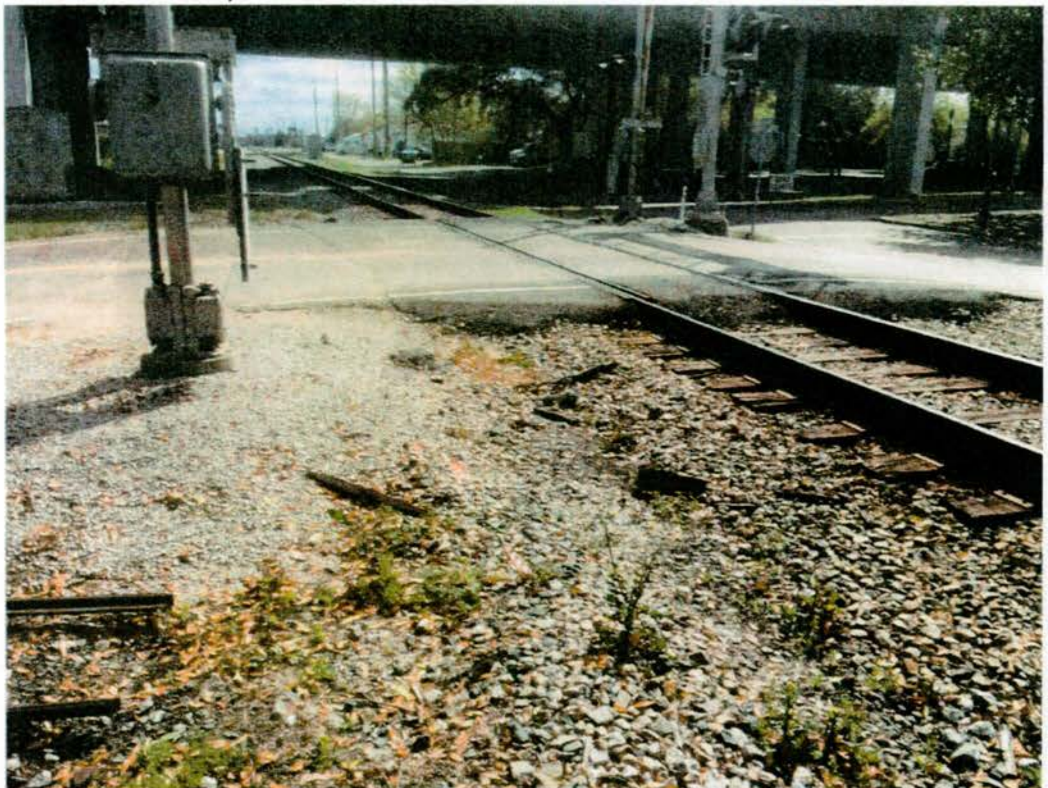
14. Iroquous: **(NO SCHOOL BUS CROSSING)** Steep grade creating poor visibility from both side of the track. Stop signs at both sides of the track. 25 MPH posted. Three (3) consecutive, elevated layers span at 49-feet (first), 18-feet (final). A south bound Howard Ave stop sign is 284-feet from the railroad.

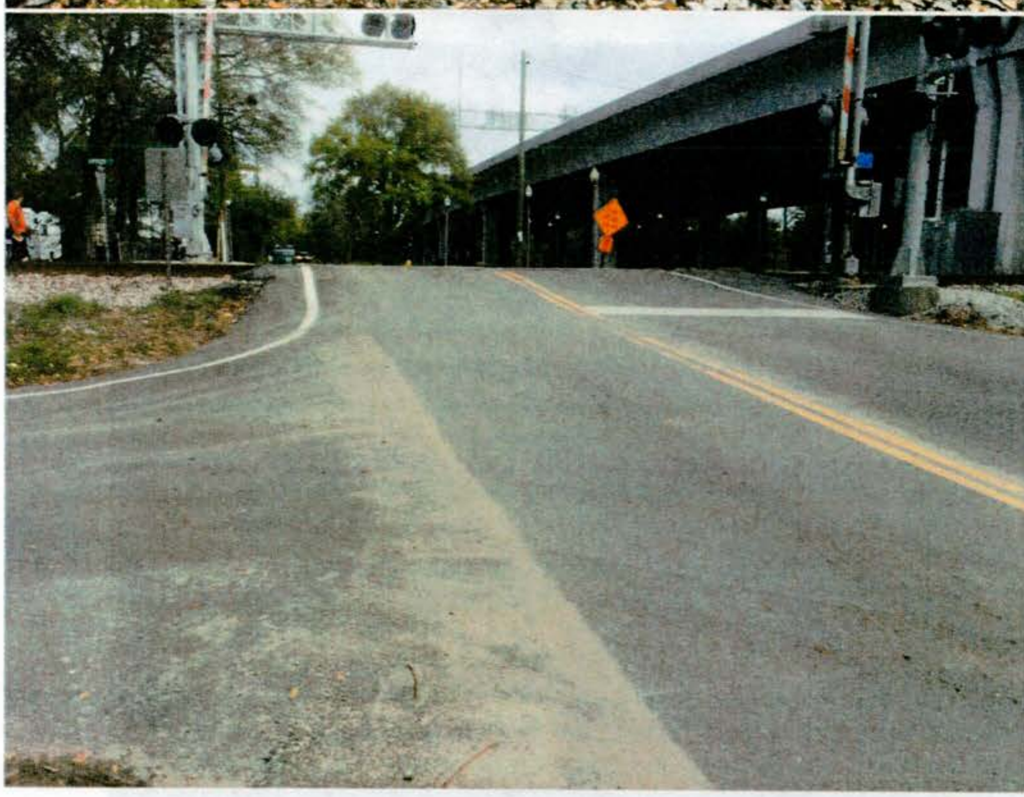


15. Seal Ave.: Posted 15-MPH. Two (2) consecutive, elevated layers span at 37-feet (first), 15-feet (second). South bound Howard stop sign is 307-feet from the track. "No Trucks" posted, but safe for school bus travel.



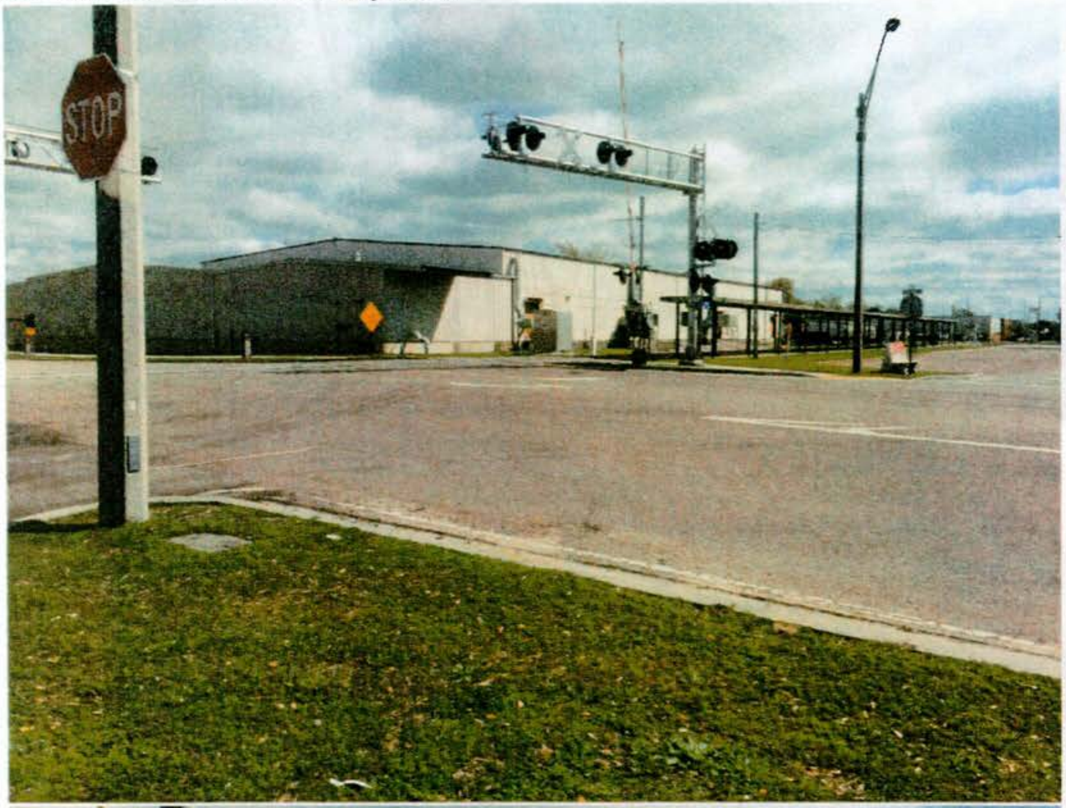
16. Hopkins Blvd.: Three (3) elevated layers spanning a total 34-feet of level top. Relatively level. North bound steeper than south bound.





17. Bohn St.: One elevation spanning 23-feet. Relatively level.

18. Caillavet St.: Smoot and fairly level.



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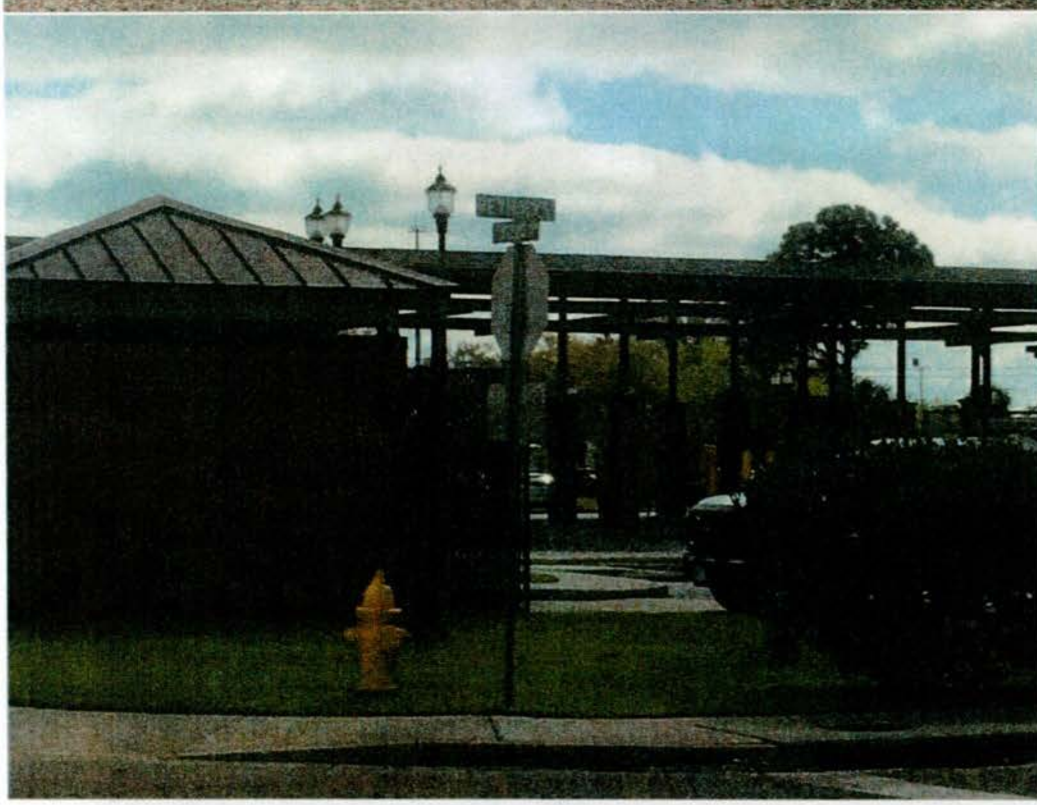
19. Reynoir St.: One added layer with a smooth, non-overlapping transition to existing roadway. Sidewalk and street curb not impeded.



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20. Magnolia St.: Posted 15-MPH. Almost smooth transitions. Three (3) subtle elevations. Two of the most recent elevations span 49-feet and 17-feet. Stop signs at the tracks for north and south bound. Obstructed stop sign is 28-feet south of the tracks.

21. Delaunley St.: Subtle elevation. Very slight elevation.

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22. Lamuese St.: **(NO SCHOOL BUS CROSSING)** Three elevated layers. Deep scraping across the track area. Low ground clearance signs.

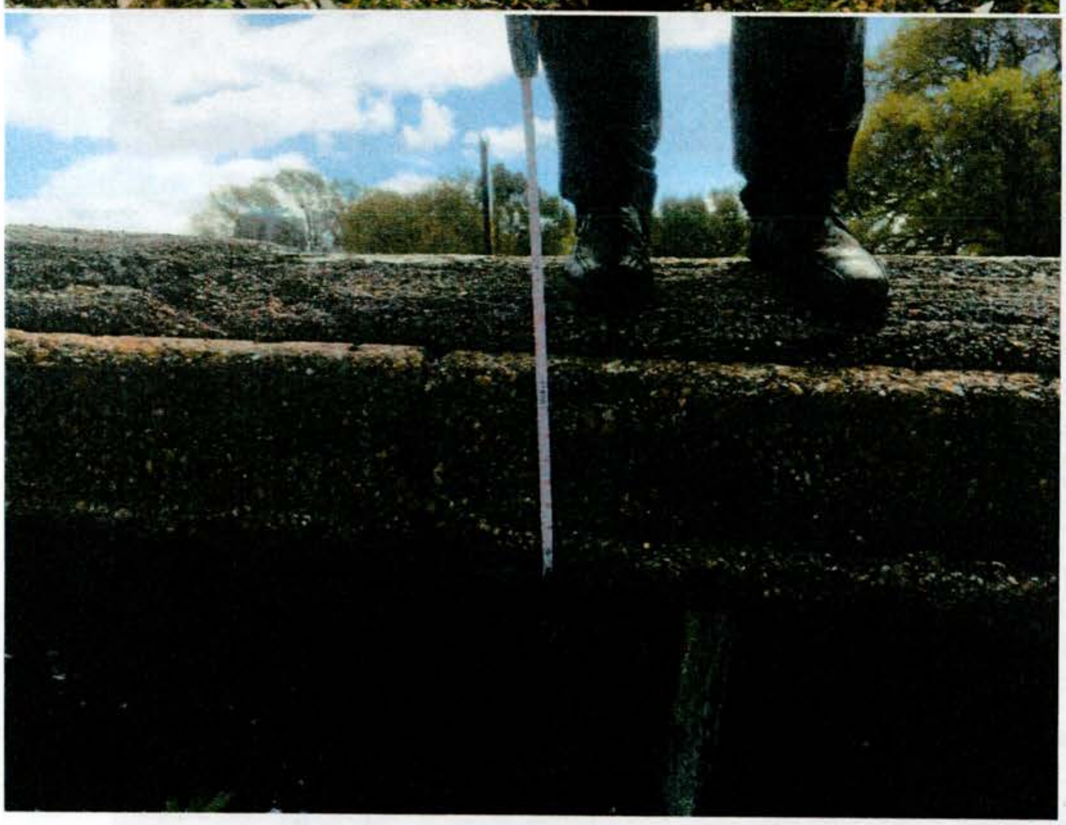
23. Main St.: **(NO SCHOOL BUS CROSSING)** One fairly new layer over laying the existing roadway surface. Steep on the north side with multiple heavy vehicle scraping. South side of the crossing transition is subtle and near level due to street improvements on the Main / Esters roadway intersection. "Low Clearance" sign posted.

24. Nixon St.: **(NO SCHOOL BUS CROSSING)** Steep north and south. "No Truck" sign posted. Overlay layers suggest a one-foot track elevation. Asphalt levels to curb height.

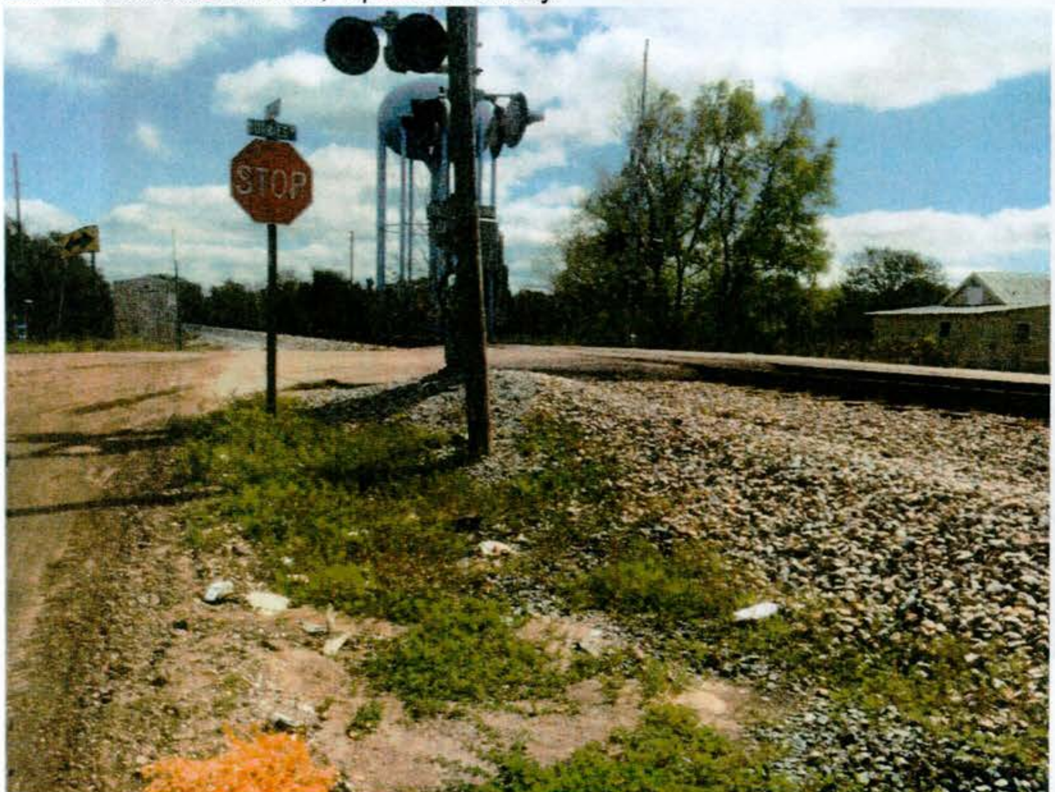
25. Lee St.: **(NO SCHOOL BUS CROSSING)** Two layers. Vehicle scraping across the tracks. "Low Clearance" sign posted.

26. Keller Ave.: Very thick layers of asphalt to create a tapered roadway elevation. Smooth transition across the tracks.

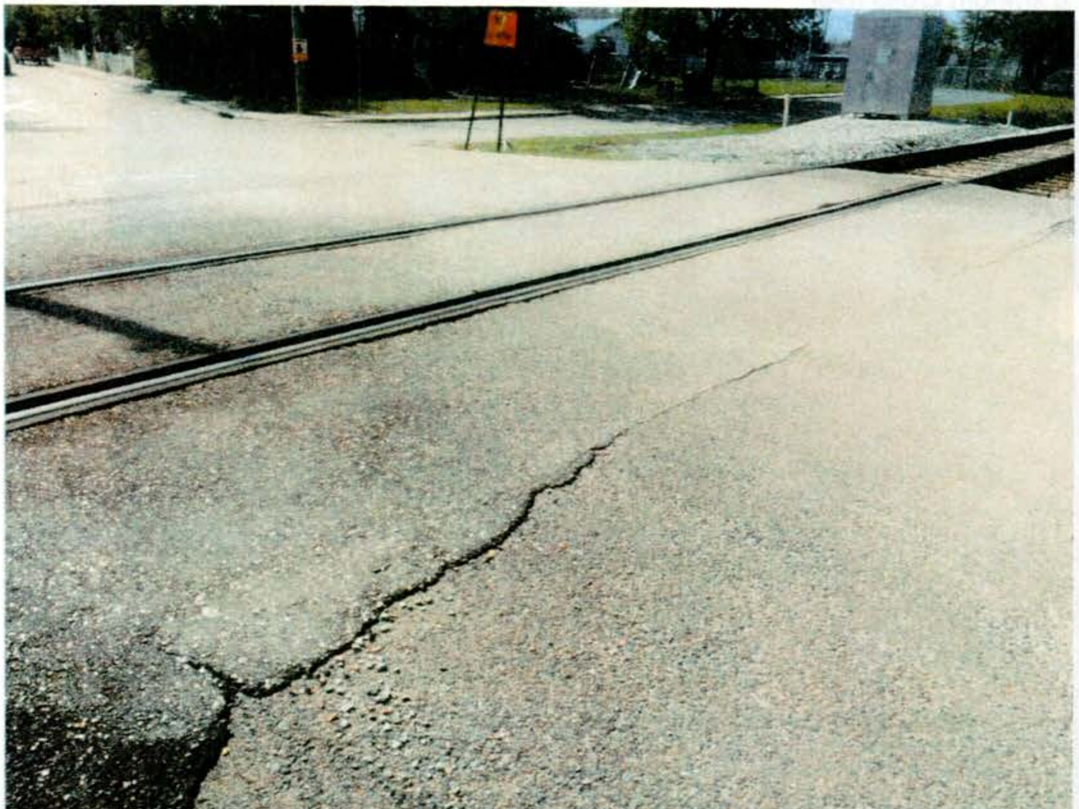
27. Holly St.: Curbing completely covered by asphalt. Two recent railroad pavement overlay brings this crossing to an approximate 13-inch in just roadway pavement to keep pace with the track elevations.



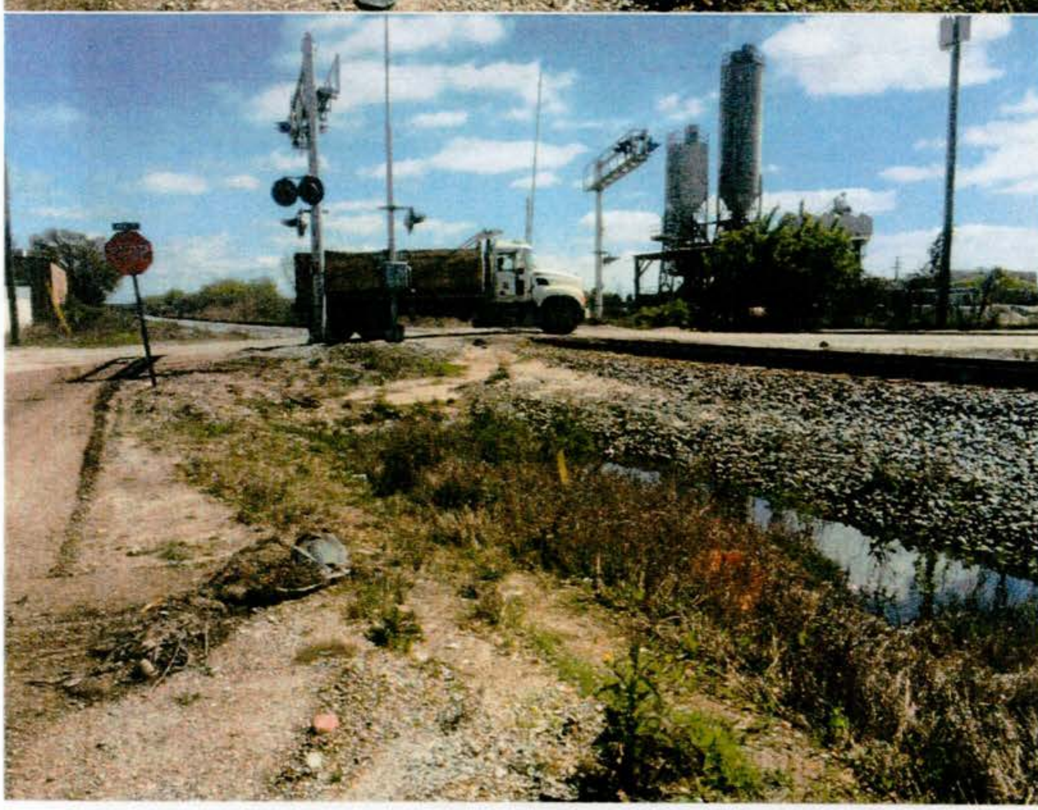
28. Dorries St.: Near level. Very subtle crossing. Four (4) overlay layers. Graded roadway improvement make it a subtle cross over. Three layers keeping pace with railroad elevation increases span 187-feet, 38-feet, and most recent at 17-feet. A retention wall on the north-west corner assist the smooth, tapered roadway.



29. Crawford St.: Smooth. Two recent railroad elevations span 29-feet and 14-feet across the intersection.



30. Oak St.: Subtle elevated cross over. Four (4) roadway layers spread over a long distance to create a smooth cross over.



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