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IN THE DISTRICT COURT OF THE FOURTH JUDICIAL DISTRICT OF THE

STATE OF IDAHO, IN AND FOR THE COUNTY OF ADA

LAWRENCE P. MANLAPIT, JR., and DORINE E. NORKO, AS CO-ADMINISTRATORS OF THE ESTATE OF LAWRENCE P. MANLAPIT, III, DECEASED,

Plaintiffs,

vs.

KRUJEX FREIGHT TRANSPORT CORP.; KRUJEX TRANSPORTATION CORP.; KRUJEX TRANSPORTATION SYSTEMS, LLC; KRUJEX LOGISTICS, INC.; ALBERTSON'S COMPANIES; CORNELIEU VISAN; DANIEL VISAN; LIGRA VISAN; STATE OF IDAHO; STATE OF IDAHO DEPARTMENT OF TRANSPORTATION; IDAHO STATE POLICE; PENHALL COMPANY; PARAMETRIX, INC.; SPECIALTY CONSTRUCTION SUPPLY LLC; and DOES 1 through 150, inclusive, whose names are unknown,

Defendants.

STATE OF IDAHO,

Third-Party Plaintiff,

vs.

PAUL SEIDEMAN, TRESCO OF IDAHO, INC., PERSONAL REPRESENTATIVE OF THE ESTATE OF ILLYA D. TSAR,

Third-Party Defendants.

Lead Case No. CV01-19-06625
(Consolidated with Case Nos. CV01-19-23246, CV01-20-00653, CV01-20-02624, CV01-20-07803 and CV01-20-08172)

DECLARATION OF JIM C. LEE , PH.D., P.E., P.T.O.E. IN SUPPORT OF MANLAPIT PLAINTIFFS' JOINT MOTION FOR LEAVE TO AMEND COMPLAINTS TO ADD PRAYER FOR PUNITIVE DAMAGES AGAINST DEFENDANTS PENHALL CORPORATION AND SPECIALTY CONSTRUCTION SUPPLY LLC

STATE OF IDAHO,

Cross-Claimant,

vs.

KRUJEX FREIGHT TRANSPORT CORP; KRUJEX TRANSPORT CORP; KRUJEX TRANSPORT SYSTEMS, LLC; CORNELIU VISAN; DANIEL VISAN; LIGIA VISAN,

Cross-Defendants.

DECLARATION OF JIM C. LEE, PH.D, P.E., P.T.O.E.

I, Jim C. Lee, declare and affirm as follows:

1. I have been retained in the consolidated matters of *Manlapit v. Krujex Freight Transport Corp., et al.*, Lead Case No. CV01-19-06625*; Norko v. Krujex Freight Transport Corp., et al.*, Case No. CV01-19-23246*;* and *Estate of Lawrence P. Manlapit, III, v. Krujex Freight Transport Corp., et al.*, Case No. CV01-20-02624, District Court of Fourth Judicial District of State of Idaho, In and For County of Ada, for the purpose of reviewing facts produced in these cases, evaluating those facts and providing the opinions and conclusions I reach from those evaluations as it relates to the relevant and appropriate standards of care relevant to such facts. I was further asked to evaluate the actual levels of care exhibited by Penhall Company and Specialty Construction Supply with respect to the creation, approval and implementation of the original and revised/modified/amended Temporary Traffic Control Plan for the I-84, Five-Mile

to Orchard Road & Ramps Project, Idaho Federal Aid Project No. A019 (289), Contract No. 8217. I was also asked to evaluate and discuss other operational considerations of those two companies with respect to said Project and causation within my areas of specialized knowledge and expertise.

2. That I am a traffic engineer with over 50 years of experience. I have a Bachelor of Science in Civil Engineering from the University of New Mexico, a Master of Engineering in Civil Engineering from the Pennsylvania State University, and a Ph.D. in Civil Engineering from the University of Oklahoma. I worked as a District Traffic Engineer and Traffic Planning Engineer for the Oklahoma Highway Department (now the Oklahoma Department of Transportation) for five years. Following that, I served as City Traffic Engineer for the City of Amarillo, Texas, and Director of Transportation for the City of Beaumont, Texas. I then worked for two consulting engineering firms for a total of seven years before starting Lee Engineering, where I worked for 32 years before retiring in April 2020. My resume is attached as Exhibit A.

Materials Reviewed

3. I reviewed the following provided to me by counsel:

a. Complaints filed in CV01-2019-06625, filed by Mr. Manlapit on behalf of his son Lawrence Manlapit III; CV01-2019-23246 filed by Ms. Norko on behalf of her son Lawrence Manlapit III; CV01-2020-02624 filed by Mr. Manlapit and Ms. Norko as co-administrators of the Estate of Lawrence P. Manlapit III.

b. Idaho Vehicle Collision Report Case No. B18001815 (Exhibit 2 to Declaration of Clay Robbins III in Support of Opposition to Albertson's Motion for Summary Judgment).

c. Idaho State Police Post Crash Driver/Vehicle Examination Report, 6/19/2018 (Exhibit 3 to Declaration of Clay Robbins, III).

d. Idaho State Police Traffic Collision Reconstruction and Analysis Report dated June 12, 2019 (Exhibit 4 to Declaration of Clay Robbins, III).

e. National Transportation Safety Board, Motor Carrier Factors Group Chairman's Factual Report (Exhibit 5 to Declaration of Clay Robbins, III) and documents referred to therein contained in the NTSB docket.

f. National Transportation Safety Board, Highway Factors Group Chairman's Factual Report (Exhibit 6 to Declaration of Clay Robbins, III) and documents referred to therein contained in the NTSB docket).

g. Documents produced by the State of Idaho in this case.

h. Documents produced by Penhall Company in this case.

i. Documents produced by Specialty Construction Supply, LLC, in this case.

j. Deposition of Bryon Breen and documents attached thereto.

k. Depositions of Jason Brinkman, individually, and as Idaho Transportation Department designee, and documents attached thereto.

l. Deposition of Jon Mensinger and documents attached thereto.

m. Deposition of Margaret Pridmore, and documents attached thereto.

n. Deposition of Josh Roper and documents attached thereto.

o. Deposition of Blaine Schwendiman and documents attached thereto.

p. Deposition of Dave Statkus and documents attached thereto.

q. Deposition of David Van Lydegraf and documents attached thereto.

r. Deposition of Sergeant Kenneth Beckner and documents attached thereto.

s. Deposition of Oliver C. Chase, III, and documents attached thereto.

t. Deposition of Bruce Kidd and documents attached thereto.

u. Deposition of Scott Reed and documents attached thereto.

v. Deposition of Josh Roper and documents attached thereto.

w. Deposition of Mason Garling and documents attached thereto.

x. Deposition of Jake Loux and documents attached thereto.

y. Deposition of Daniel Kircher and documents attached thereto.

z. Deposition of Jeromy Magill and documents attached thereto.

aa. Deposition of Eric Blackburn and documents attached thereto.

bb. Declaration of Ken Colson, P.E. and documents attached thereto.

THE CONSTRUCTION PROJECT

4. In Fall, 2017 through Spring, 2018 (with a brief hiatus between November 2017 and May 2018), highway construction activities were performed on the east and westbound lanes of I-84 in Boise, Idaho. The Project included diamond grinding of concrete pavement, resealing concrete pavement joints, repairing concrete cracks and repairing pavement spalls. It was designated Federal Aid Project No. A 019 (289), I-84 Five-Mile Road to Orchard Road and Ramps (the Project). The Project was run by the Idaho Department of Transportation (ITD). ITD retained Penhall Company as the prime contractor to perform all work on the project. ITD allowed Penhall to subcontract the job of Traffic Control Manager (TCM) for the Project to Specialty Construction Supply (Specialty). Daniel Kircher was Traffic Control Administrator for Specialty. Josh Roper, then Mason Garling, were the TCMs.

5. Resident Engineer in charge of the Project for ITD was Bryon Breen; David Statkus was ITD Project Coordinator; Vincent Coletta, then Henry "Shields" Sullivan, were the Project Managers for Penhall, then various other individuals in what was a continuing revolving door of personnel, ultimately landing on Jeromy Magill. Bruce Kidd and Scott Reed were Penhall on-site Superintendents.

6. When work resumed on the Project in Spring of 2018, Penhall was under pressure to finish the Project on time, so as to avoid a liquidated damages penalty of $1,600.00 per day of delay.

7. The ITD classified this work zone project as a significant project requiring the development of a Transportation Management Plan (TMP). The TMP included a traffic

control plan (TCP).[1] ITD contracted with Parametrix, a traffic engineering firm, to develop a construction staging and TCP along with Special Provisions requiring nighttime work and limiting lane closures.[2] The construction work times were limited to 10 pm until 5 am on weekday nights, 10 p.m. until 7 a.m. on Friday nights, and 10 p.m. until 9 a.m. on Saturday nights through Sunday mornings. Parametrix used the Highway Capacity Manual 2010 for capacity evaluations and determined that the capacity of 1-84 in this area was 1,450 vehicles per lane per hour and, required that two lanes be maintained open at all times in the eastbound and westbound directions on sections that had four existing through lanes, such as at the accident location.[3] These Special Provisions and the TCP were provided to the contractors (Penhall and Specialty) in the contract documents.

8. The Special Provisions and the TCP also detailed the process by which contractors could request changes to the construction staging and/or traffic control plan. Proposed changes required a written amended plan *if* the existing plan did not follow the contractor's intended operational plan. However, any proposed changes in the TCP and Special Provisions required written plans prepared by an engineer licensed in Idaho and submitted to ITD at least 14 days in advance of any intended changes. The existing plan would remain in place

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[1] See Highway Attachment, "Idaho Transportation Department Work Zone Safety and Mobility Program January 2012."

[2] See Highway Attachment, "Traffic Control Plan and Special Contract Provisions."; *see also generally* Declaration of Ken Colson, P.E.

[3] See Highway Attachment, "Traffic Control Design e-mail from March 7, 2017, detailing rational for estimating lane capacity and requirement for two lanes to be open in 4-lane sections of I-84."; *see also* Declaration of Ken Colson, P.E. at ¶ 8.

unless and until ITD approved a submitted change. No written requests for changes were ever submitted by the contractors and/or approved by ITD on the Project at any time before the June 16, 2018, accident.[4] Ken Colson, a professional licensed engineer employed by Parametrix testified as follows regarding the TCP and Special Provisions: "Parametrix's temporary traffic control plan and special provisions required that at least two lanes remain open to traffic in either direction on four-lane sections of the highway during all phases of the work, including in the work zone. The special provisions also detailed the process by which contractors could request changes to the construction staging and/or traffic control plan. Proposed changes required a written amended plan to be completed by an engineer licensed in Idaho. The amended plan had to be submitted for approval to ITD at least 14 days in advance of any intended changes. Moreover, the special provisions provided that the existing traffic control plan must remain in place until ITD approved any proposed changes to the plan."[5]

9. The plan[6] showed details for the double lane drop that the contractor was to follow, including the following signs:

- Portable Changeable Message Sign
- W20-1 ROAD WORK AHEAD
- INCREASED FINES FOR WORK ZONE SPEED VIOLATIONS
- W3-5 SPEED LIMIT 55 AHEAD

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[4] See Highway Attachment, "Traffic Control Plan and Special Contract Provisions."; *see also* Declaration of Ken Colson, P.E. at ¶ 8.
[5] See Declaration of Ken Colson, P.E. at ¶ 8.
[6] I-84, Five Mile Road to Orchard Road and Ramps, Boise Federal Aid Project No. a1019(289), sheets 12-14 of 47.

- R2-1 SPEED LIMIT 55
- W20-5 2 LEFT LANES CLOSED AHEAD[7]
- W4-2L left lane ends symbol sign

The plans also detail the following tapers and tangents:

- shoulder taper
- Lane 4 merge (660')
- 1320' tangent
- Lane 3 merge (660')

10. The State/Penhall contract also required an *experienced* Traffic Control Manager (TCM) to be provided during all work activities. Among other things, it stated:

> "This work shall . . . consist of furnishing an experienced Traffic Control Manager (TCM) for resolution of traffic control conflicts, continuous monitoring of the traffic flow through a work zone setup and determine any potential improvement to the traffic control operations and phasing in accordance with the approved traffic control plans. . . . The TCM shall maintain a daily diary and document the design and approval of all work zones and any changes in configuration to an established work zone, and direction from coordinating with the Prime Contractor."[8]

The State/Penhall contract further specified:

> "Unless otherwise directed by the Engineer, maintain the road for use by traffic and minimize traffic delays during roadway construction. Ensure that individual traffic delays do not exceed 15 minutes and that all traffic delays do not exceed a total of 30 minutes through the length of the project, unless otherwise approved, in writing, by the Engineer. Implement remedial action to eliminate the excess delays to traffic."[9]

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[7] Penhall and Specialty had the three left lanes closed but should have only had the two left lanes closed.
[8] Penhall contract with ITD, page 12 of 23, PENHALL000041.
[9] Parametrix000000127.

11. Parametrix's final construction staging and traffic control plan which were stamped and then submitted to the ITD, was prepared to be consistent with the requirements of the *Manual on Uniform Traffic Control Devices* (MUTCD), which is a national standard to provide uniform treatment of traffic control device applications throughout the country. Notably, Ken Colson/Parametrix, the professional licensed engineer who stamped the TCP, testified the TCP "fully complied with the MUTCD and relevant federal and state standards, along with the standard of care recognized in the traffic engineering industry."[10]

THE ACCIDENT

12. On Saturday, June 16, 2018, about 11:32 p.m., a multivehicle collision occurred involving a 2019 Volvo truck-tractor in combination with a 2015 Great Dane refrigerated semitrailer, operated by Krujex Freight Transport Corporation (KFTC), which was traveling east on I-84, near Boise, Idaho. The truck, driven by Illya Tsar, had departed Yakima, Washington, and was en route to Methuen, Massachusetts, on a multiday trip.

13. Work zone lane closures began on eastbound 1-84 ahead of the initial crash location, resulting in a lengthy traffic queue (approaching 1.25 miles). The traffic queue extended from the beginning of the work zone back over a mile into the advance warning area for the zone, with most of the traffic in the queue either stopped or traveling at a slow speed. The driver of the 2019 Volvo, traveling in the third lane from the left, did not apply brakes or otherwise respond to

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[10] *See* Declaration of Ken Colson, P.E. at ¶ 7.

the traffic queue ahead. His vehicle collided with the rear of a slow-moving 2008 Jeep Wrangler, near the Cloverdale Road overpass, at an estimated speed of 62 mph.

14. After being struck by the 2019 Volvo truck, the Jeep was pushed forward so that it underrode the trailer of a 2003 Volvo truck-tractor in combination with a 2008 Great Dane refrigerated semitrailer in the same lane.

15. The Jeep was occupied by driver Carlos Johnson and passengers Lawrence Manlapit, III, and Karlie Ann Westall, all stationed at nearby Mountain Home Air Force Base. The three young occupants of the Jeep died as a result of the collision and postcrash fire. The driver of the 2019 Volvo truck also died as a result of the postcrash fire.

16. The crash occurred in the advance-warning area of an active work zone. The general highway configuration is a controlled access highway with four east and four westbound lanes divided by a 32-inch tall concrete median barrier. The eastbound segments are comprised of four 12-foot-wide lanes delineated by 12-foot-long solid white pavement stripes at 38-foot intervals. The 12-foot-wide median shoulder is delineated from the #1 lane by a solid yellow pavement stripe. The right-hand or #4 lane is delineated from the 12-foot-wide right-hand shoulder by a solid white pavement stripe.[11]

THE MUTCD

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[11] National Transportation Safety Board Highway Factors Group Chairman's Factual Report, page 3 of 24

17. The Federal Highway Administration prepares the MUTCD, which is adopted (with revisions) by each state and is ". . . the national standard for all traffic control devices installed . . ."[12] The wording in the MUTCD is carefully selected as follows:

"Section 1A.13 Definitions of Headings, Words, and Phrases in this Manual Standard:

01 When used in this Manual, the text headings of Standard, Guidance, Option, and Support shall be defined as follows:

A. Standard—a statement of required, mandatory, or specifically prohibitive practice regarding a traffic control device. All Standard statements are labeled, and the text appears in bold type. The verb "shall" is typically used. The verbs "should" and "may" are not used in Standard statements. Standard statements are sometimes modified by Options.

B. Guidance—a statement of recommended, but not mandatory, practice in typical situations, with deviations allowed if engineering judgment or engineering study indicates the deviation to be appropriate. All Guidance statements are labeled, and the text appears in unbold type. The verb "should" is typically used. The verbs "shall" and "may" are not used in Guidance statements. Guidance statements are sometimes modified by Options.

C. Option—a statement of practice that is a permissive condition and carries no requirement or recommendation. Option statements sometime contain allowable modifications to a Standard or Guidance statement. All Option statements are labeled, and the text appears in unbold type. The verb "may" is typically used. The verbs "shall" and "should" are not used in Option statements.

D. Support—an informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. Support statements are labeled, and the text appears in unbold type. The verbs "shall," "should," and "may" are not used in Support statements."[13]

According to the MUTCD:

"Warning signs call attention to unexpected conditions on or adjacent to a highway, street, or private roads open to public travel and to situations that might not be

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[12] *Manual on Uniform Traffic Control Devices*, Federal Highway Administration, 2009 Edition, page I-1.
[13] *Manual on Uniform Traffic Control Devices*, Federal Highway Administration, 2009 Edition, Section 1A.13.

readily apparent to road users. Warning signs alert road users to conditions that might call for a reduction of speed or an action in the interest of safety and efficient traffic operations."[14]

18. This basic need to warn drivers of unexpected conditions that are not readily apparent is the primary reason for temporary traffic control, because motorists do not expect situations such as a queue of stopped vehicles on a freeway, particularly late at night. Such a condition poses a severe risk for motorists if they are not warned sufficiently in advance of the obstruction or don't see it in time to stop.

Part 6 – Temporary Traffic Control

19. Because of the importance of temporary traffic control, the MUTCD has an entire part devoted to it.[15] The components of temporary traffic control zones include four areas:

- Advance warning area: where road users are informed about the work zone;
- Transition area: where road users are redirected out of their normal path;
- Activity area: where work activity takes place; and
- Termination area: where road users return to their normal driving path.

20. The advance warning area is critical to a safe work zone because it alerts drivers about the work zone's impacts on roadway conditions, including the possible presence of slowing or stopping traffic. The amount of advance warning depends on the road type, as shown in Table 6C-1[16] below.

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[14] *Manual on Uniform Traffic Control Devices*, Federal Highway Administration, 2009 Edition, Section 2C.01.
[15] *Manual on Uniform Traffic Control Devices*, Federal Highway Administration, 2009 Edition, Part 6, pages 547-729.
[16] *Manual on Uniform Traffic Control Devices*, Federal Highway Administration, 2009 Edition, Table 6C-1, page 554.

Table 6C-1. Recommended Advance Warning Sign Minimum Spacing

Road Type	Distance Between Signs**		
	A	B	C
Urban (low speed)*	100 feet	100 feet	100 feet
Urban (high speed)*	350 feet	350 feet	350 feet
Rural	500 feet	500 feet	500 feet
Expressway / Freeway	1,000 feet	1,500 feet	2,640 feet

* Speed category to be determined by the highway agency
** The column headings A, B, and C are the dimensions shown in Figures 6H-1 through 6H-46. The A dimension is the distance from the transition or point of restriction to the first sign. The B dimension is the distance between the first and second signs. The C dimension is the distance between the second and third signs. (The "first sign" is the sign in a three-sign series that is closest to the TTC zone. The "third sign" is the sign that is furthest upstream from the TTC zone.)

It is noteworthy that the MUTCD states:

"The distances contained in Table 6C-1 are approximate, are intended for guidance purposes only, and should be applied with engineering judgment. These distances should be adjusted for field conditions, if necessary, by increasing or decreasing the recommended distances."[17]

21. Although the advance warning area on the TCP developed and adopted by the State (and reviewed by both Penhall and Specialty) was adequate *for the required two moving lanes of traffic*, it was not sufficient for the single open lane made available by Penhall and Specialty at the time of the crash. Based on the information I have reviewed, it appears that Specialty Construction, the project's traffic control subcontractor, implemented a revised TCP as directed by Penhall (with an additional third lane closed in a four-lane section of eastbound I-84) without considering the importance of the above MUTCD guidance regarding distances in Table 6C-1. Because the capacity of one lane is roughly half that of two lanes, and the single lane did not have adequate

[17] *Manual on Uniform Traffic Control Devices*, Federal Highway Administration, 2009 Edition, Section 6C.04 paragraph 06, page 552.

capacity to accommodate the arriving volume on the night of the subject crash, a long queue predictably developed on June 16, 2018, prior to the crash. This same condition caused by the additional lane reduction was allowed to exist on the nights leading up to the crash. The purpose of the advance warning is to sufficiently notify, warn, and prepare approaching drivers for the upcoming hazard. In this case, the upcoming hazard was the stopped queue of vehicles resulting from the single open lane, rather than the specified two open lanes. In my opinion, on June 16, 2018 (and the nights before), drivers on eastbound I-84 were not given advanced warning of either the traffic queue or that three traffic lanes had been blocked. This horrific crash resulted.

WHY ONLY ONE OPEN LANE OF TRAFFIC?

22. Since the TCP and the contract Special Provisions clearly required two open lanes be maintained in a four-lane stretch of highway and only one lane was available to traffic at the time of the crash, one must wonder why. Some relevant history follows:

- On August 16, 2017, Vincent Coletta (Penhall) emailed ITD, inquiring about the desired work sequence on ramps/connectors discussed at the August 2017 preconstruction meeting. This was a worker safety issue unrelated to the number of open lanes. Dave Statkus (ITD) replied that Penhall needed to submit a revised TCP showing the proposed work sequence changes. Coletta emailed Specialty requesting that they prepare the revised TCP. Daniel Kircher (Specialty) answered that they do not have the required engineer for that. I found no evidence of a revised TCP being submitted. Based on deposition testimony presented later in this report, Penhall used the new method without the required written ITD approval.

- The only written request for a change in the TCP that I have found was a request from Specialty to increase the spacing of tubular markers in tangents from 55 feet to 110 feet, which ITD denied.[18]

- On May 31, 2018, ITD and Penhall held a second pre-construction conference. Penhall requested permission to close a third lane. There were no minutes; however, the ITD Resident Engineer told the NTSB that ITD required a written request to consider such a request.[19] I found no evidence that such a request was submitted.

- Penhall was aware that two lanes were required to be open but instructed Specialty to close three lanes, leaving only one lane open. I have not found a written request to Specialty to do so.

- Specialty closed the left three lanes on eastbound I-84 leaving only one lane open to traffic. Penhall and Specialty operated with only one lane open for several nights before the crash, according to daily traffic control diaries.

- In Spring 2018, Penhall was under pressure to complete the Project on an expedited basis so as to avoid substantial liquidated damages penalties for late completion. Closing an additional lane facilitated an expedited completion of the Project and allowed Penhall to avoid being penalized.

NOTICE OF I-84 WORK ZONE PROBLEMS

Traffic Control Maintenance Diary Entries

23. Penhall and Specialty violated their contract by closing three of the four lanes for several nights before the subject crash, as evidenced by the Traffic Control Maintenance Diary entries. Those Traffic Control Maintenance Diaries were submitted to Specialty management each

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[18] Penhall001181-001182.
[19] National Transportation Safety Board, Highway Factors Group Chairman's Factual Report, page 9.

day for review. Specialty clearly knew the TCP was being violated and clearly knew the violation was causing severe and dangerous traffic congestion on the work nights leading up to the crash.

- May 31, 2018: Penhall wanted "a triple"; Specialty told them they would give them a triple "when we set the RLC."[20] The "triple" means three lanes are closed.
- June 1, 2018: "Staged for a triple right for the next night."[21]
- June 2, 2018: "Started Triple Right starting at East End of project WB."[22]
- June 3, 2018: "Pulled on triple again @ 9:35 pm."[23]
- June 4, 2018: "Traffic was backing up because of this merge but not bad, and it worked out better because it slowed traffic down."[24] This statement demonstrates a lack of concern for queued traffic.
- June 14, 2018: ". . . I dropped off the Three Left Lanes Closed Ahead signs for EB. . .. David, Zack and Jake started pulling on the triple left lane closures on EB I-84. . . . Traffic EB was backed up passed (sic) the Locust Grove overpass due to the lane closures."[25]

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[20] Specialty00318
[21] Specialty00319
[22] Specialty00320
[23] Specialty00332
[24] Specialty00334
[25] Specialty00347

- June 15, 2018: "Chad and David put up the signs for the triple left lane closures upon EB and the speed reduction signs. . .. At 11:00 traffic EB was backed up passed (sic) Locust Grove and was at a standstill."[26]
- June 16, 2018: "We showed up onsite at 8:30, Anthony put up the speed reduction and lane closure signs for the triple left lane closure EB. . .. Traffic EB was backed up passed (sic) Locust Grove. . .. There was a major accident EB at the Cloverdale overpass. A semi was not paying attention to the traffic that was slowed due to the merging and struck 5 other vehicles. The semi then caught on fire."[27]

24. Specialty's Traffic Control Manager made the maintenance diary entries, which clearly indicate the presence of long queues approaching the work zone. The references to Locust Grove refer to Locust Grove Road, which is about 2 miles upstream of the subject crash and about 2.5 miles upstream of the start of the first lane closure.[28]

25. On the night of the subject crash, the taper to start the first lane closure (which marks the boundary between the advance warning area and the transition area) began at milepost 47.451. The first sign to notify eastbound motorists of the work zone was positioned at milepost 46.148, about 1.3 miles upstream of there.[29]

26. As such, approaching motorists were simply informed in advance prior to the start of the first lane closure that they were approaching a construction zone and later that speed was

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[26] Specialty00349
[27] Specialty00351
[28] National Transportation Safety Board, Highway Factors Group Chairman's Factual Report, page 17.
[29] National Transportation Safety Board, Highway Factors Group Chairman's Factual Report, pages 15, 17.

reduced to 55 miles per hour. This was inadequate. The 2.5-mile queues documented by the diary entries are well in advance of the signing plan in place on the night of the subject crash. Therefore, at the time of the accident, approaching traffic was not informed they were approaching an area of "traffic congestion" or that any lanes ahead of them were closed (let alone 3 out of 4 lanes).

Public Complaints of Traffic Congestion Leading Up to the June 16, 2018, Crash

27. On the night before the subject crash, June 15, 2018, the Idaho State Police (ISP) received numerous calls from motorists complaining about traffic congestion, long queues, and frustrated motorists driving unsafely trying to get around the queue approaching the work zone on eastbound I-84.

28. A motorist called Justin at the ISP at approximately 11:30 pm asking, "what's the deal with I-84 eastbound". The caller said all four lanes were "pretty much stopped" for a couple of miles from Meridian to the Flying Wye. The caller said, "it's pretty bad" and suggested they "make signs farther down the road." Justin said he would let ITD know and see "if they can activate the reader boards." The caller said they have been "stop and go for a couple miles" and are "just now starting to hit construction signs."[30] Meridian Road is about 3 miles upstream of the subject crash and about 3.5 miles upstream of the start of the first lane closure.

29. Justin called Sergeant Kenneth Beckner with ISP to alert him that they had received several calls that there was not proper signage to alert motorists. Sgt. Beckner said there was "plenty of signage."[31] The ISP officer did not appreciate that the signs were not located where they

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[30] ISP 100_Audio_25870.
[31] ISP 105_Audio_258675.

should have been to warn motorists before they reached the queue because there was inadequate capacity with only one lane open. The location of the signs as specified in the TCP would have been appropriate *if* two lanes were available, as Parametrix recommended and as the contract required.

30. The caller was correct; warning signs (including those for construction) must be placed in advance of the condition for which the sign is placed. Unfortunately, Penhall and Specialty did not do that. Kevin Beringer called ISP (Justin) and said that ISP needs to direct traffic on EB 84 because "damn Department of Transportation" won't do anything. People were driving down the closed left lane ignoring lane closed signs, and even driving on the shoulder. The callers said, "they need to remark it."[32]

31. Kelly (ISP Dispatch) again called Sgt. Beckner, saying, "we are getting tons of calls of everybody flying down the left lane when the lane is closed in the construction zone to pass people." Kelly said, "I've let ITD know." Sgt. Beckner said, "I don't know what to do about it . . . there's plenty of signs."[33] It is impossible to correct the fundamental deficiency of insufficient work zone capacity (because of a single open lane rather than the contract-required two) with signing. Moving the advance warning devices farther upstream can at least provide some advance notice to motorists before they reach the end of the queue. It is troubling that for days before this tragic accident, Penhall and Specialty knew of the hazardous condition they had created by permitting only one open lane rather than the required two, yet they did not do anything to at least

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[32] ISP 110_Audio_258680
[33] ISP 111_Audio_258681

ensure that advance warning signs were adequately placed. More to the point, they did nothing to remedy the hazardous obstruction.

32. An Idaho State Communications Center ITD Highway Incident report with a description "Construction Problem" identifies the individuals ISP dispatchers contacted to advise of the numerous calls from motorists about the long queue and resulting frustration and hazardous driving. Bryant Caruthers left messages for Josh Roper (Specialty) and Jeromy Magill (Penhall). He notified Bruce Kidd (Penhall) about the calls complaining about the long queues and lack of adequate signage. After being notified that people are using the median to pass, Caruthers called Kidd again advising him that people are driving in the median."[34] Kidd replied, "Can't they write them some tickets for something for that."[35] He did not accept, nor was he in any way concerned, that there was something wrong with the Project's construction sequencing and traffic control.

33. The ISP documented these calls and reported issues in their communication logs.[36] Even with the many serious concerns reported by citizens to ISP and passed on to Penhall, neither Penhall nor Specialty acted to correct the situation on or before the night of June 15, 2018. The same three-lane closure with only one open lane was repeated on June 16, 2018, the night of the crash that caused four deaths.

IT IS BEYOND REASONABLE DISPUTE THAT TRAFFIC QUESES THROUGH CONSTRUCTION ZONES PRESENT A WELL-RECOGNIZED RISK OF REAR-END COLLISIONS, PARTICULARLY INVOLVING HEAVY TRUCKS

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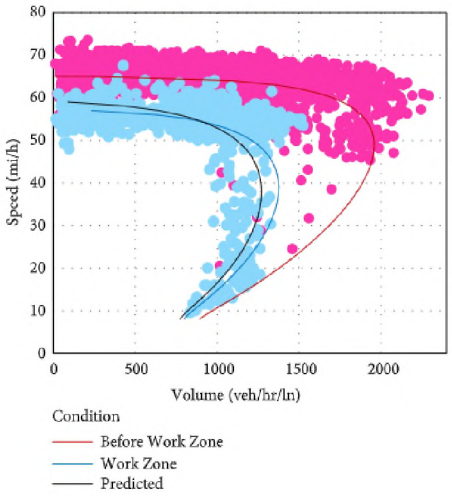
[34] STATE_COMM000005.
[35] STATE_COMM000010.
[36] ISP 00032, ISP 00033, ISP 00035, ISP 00036, ISP 00038, ISP 00039.

34. There has been considerable work zone research over the past 30 years, including much recognizing the danger of rear-end crashes of trucks with vehicles slowed or stopped in a traffic queue. Some of the relevant findings include the following:

(1) "PREDICTING FREEWAY WORK ZONE CAPACITY DISTRIBUTION BASED ON LOGISTIC SPEED-DENSITY MODELS"[37]

This research paper provides a helpful overall understanding of what happens when work zone capacity is exceeded. The researchers developed an operational capacity prediction method, which they compared with field data and other software analysis methods. The charts summarize the data for both the speed-volume and speed-density relationships. The scatter diagrams present actual field sampled data, with the red dots and line representing non-work zone conditions and the blue dots and line representing work zone data. The black line represents how well the authors' model predicted the actual field data, which is not relevant to the point of this discussion related to the I-84 work zone. The non-work zone capacity



[37] Journal of Advanced Transportation, Volume 2018, Article ID 9614501.

is almost 2000 vehicles/hour/lane, while the work zone capacity is approximately 1400 vehicles/hour/lane. It should be noted that, for both the "Before Work Zone" and "Work Zone" curves, once approaching volume exceeds capacity, the actual throughput volume drops considerably. When approach volume exceeds capacity (i.e., level of service F condition), it results in an unstable condition with the red and black lines being conceptual rather than precise. When approach volume exceeds capacity, the throughput volume drops and is referred to as queue discharge rate. This condition results in a queue developing because the approach volume exceeds capacity, resulting in an even lower throughput than theoretical capacity. The queue doesn't begin to dissipate when this happens until the approach volume falls below the queue discharge rate.

When the work zone approach volume exceeds the theoretical capacity, in addition to the lower volume throughput, the traffic density (representing the queue in vehicles/mile/lane) increases dramatically.

(2) AN ANALYSIS OF FATAL WORK ZONE CRASHES IN TEXAS[38]

This research found that:

- "[L]arge truck-involved crashes were more likely to involve more than two vehicles. . . . These crashes were predominantly occasions where a large truck failed to stop in time to avoid queued traffic at a work zone transition or activity area. This seems reasonable because the energy that a large truck can transfer to other vehicles in a crash make[s] it

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[38]Schrock, Ulmman et al, Texas Transportation Institute, October 2004.

more likely to hit multiple vehicles than if the out-of-control vehicle were an automobile." (p. 24)

- "Several fatal crashes occurred during the study at the work zone activity area and/or merge area where traffic slowed down, a queue formed, and subsequent traffic rammed the back of the queue. In every instance of this type of crash, the traffic control was installed according to current standards and following the project traffic control plans, which provides an indication that more warning is needed to alert traffic of slow or stopped traffic ahead." (p. 43)

It was noted that in every crash of this type in the Texas study "traffic control was installed according to current standards and in accordance with the project traffic control plans . . ." which was not the case in the Idaho crash. The I-84 Project TCP called for two open lanes, which were not provided. Also, prior to this fatal crash, both contractors were aware that the queue extended beyond the advance warning area, but did not extend the warning signs sufficiently far upstream to provide the necessary warning. Based on the Texas research, even when the traffic control was installed correctly, the research concludes that "more warning is needed to alert traffic of slow or stopped traffic ahead."

(3) FATAL AND INJURY CRASH CHARACTERISTICS IN HIGHWAY WORK ZONES[39]

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[39] Li and Bai, Fatal and Injury Crash Characteristics in Highway Work Zones, TRB 2008 Annual Meeting.

This research found that rear-end crashes were the most common work zone crashes with other vehicles with 46% of injury crashes. Rear-end crashes also accounted for 16% of fatal crashes with other vehicles. (page 9)

(4) SAFETY BY DESIGN – OPTIMIZING SAFETY IN HIGHWAY WORK ZONES[40]

This research reported the following:

"The prevalence of rear-end crashes at work zones has led several state DOTs to establish policies to avoid unduly contributing to back-ups and queues created by lane closures. Often, work zone lane closures will be restricted from certain roadways during peak periods in an attempt to minimize the number and severity of traffic queues created." (p. 20)

ITD must be given credit for implementing this procedure; however, Penhall and Specialty failed to ensure that the number of lanes required by the TCP remained open. As a result, Penhall and Specialty lost much of the benefit of reducing back-up and queue length associated with performing night work.

(5) ANALYSIS OF FATAL CRASHES IN GEORGIA WORK ZONES[41]

Some of the findings of this research include (page 22):

- Rear-end crashes represent a high proportion of work zone crashes.

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[40] Daniel Murray, American Transportation Research Institute, September 2005.
[41] Daniel et al, Analysis of Fatal Crashes in Georgia Work Zones, Transportation Research Record 1715.

- Trucks are involved in a higher proportion of fatal crashes in work zones than in non-work zones.
- A higher proportion of fatal crashes occurred during dark conditions than at non-work-zone locations.
- A higher proportion of fatal crashes in Georgia work zones occurred on rural principal roadways, urban principal roadways, and urban interstate roadways.
- There is a higher proportion of rear-end crashes associate with work zones in progress compared with idle work zones.
- A higher proportion of fatal crashes occurred during dark conditions when compared with nonfatal crashes.

(6) EVALUATION OF REAR-END CRASH RISK AT WORK ZONE USING WORK ZONE TRAFFIC DATA[42]

Findings of this research include:

- "Rear-end crash risk at work zone activity area increases with heavy vehicle percentage and lane traffic flow rate." (Abstract)
- "A truck has much higher probability involving in a rear-end accident than a car. Further, the expressway work zone activity area is found to have much larger crash risk than arterial work zone activity area." (Abstract)

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[42] Meng, Qiang et al, "Evaluation of rear-end crash risk at work zone using work zone traffic data," *Accident Analysis and Prevention*, July 2011.

(7) DETERMINING MAJOR CAUSES OF HIGHWAY WORK ZONE ACCIDENTS IN KANSAS[43]

Some of the key findings of this research include:

- "It has been widely agreed that heavy trucks contribute significantly to work zone fatalities. So far, various studies have been conducted to identify the most effective traffic control strategies to prevent trucks from being involved in fatal collisions." (p. 11)
- "[C]ommon characteristics of work zone crashes were identified, which include: 1) the work zones on interstate highways had the highest crash rate; 2) the most common type of work zone crashes was rear-end; 3) commercial trucks had higher probability involving in work zone fatal crashes; and 4) high speed in work zones was one of the predominant causes of crashes." (p. 57)
- "Improved traffic control is the most direct method to reduce highway work zone fatalities. More effective and sufficient work zone traffic controls should be installed. In particular, there is an urgent need to develop speed control methods that can be strictly enforced in the work zone areas." (p. 126)

(8) ANALYSIS OF LARGE TRUCK OVERREPRESENTATION IN FATAL WORK ZONE CRASHES[44]

Some of the findings of this research include:

- "For principal arterials in both rural and urban areas, rear-end collisions are the predominant type or collision resulting in a fatality when a large truck is involved. . ..

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[43] Determining Major Causes of Highway Work Zone Accidents in Kansas, June 2006.
[44] Ulmann et al, Analysis of Large Truck Overrepresentation in Fatal Work Zone Crashes, paper submitted for 2017 TRB Meeting.

Countermeasures to reduce rear-end crashes in work zones, such as avoiding lane closure times when queues will form and the use of smart work zone technologies to warn approaching motorists when queues are present, may be especially beneficial to reducing large truck-involved rear-end collision in work zones." (page 15)

Although ITD required night work to avoid higher volume times of the day, Penhall and Specialty lost much of the benefit of that by allowing only one open lane (in violation of the contract), which did not have the capacity to accommodate the experienced traffic volume.

(9) TRUCK DRIVERS' CONCERNS IN WORK ZONES: TRAVEL CHARACTERISTICS AND ACCIDENT EXPERIENCES[45]

The findings of this research include:

- "[Truck d]rivers want to see more signs before the work zones, and they want to see these signs sooner. A few drivers suggested that work zone notification begin 5 to 8 km (3 to 5 mi) before the work zones. Several drivers think merge signs are placed too close to the work zones, and there is not enough time to merge." (p. 61)

(10) HIGHWAY ACCIDENTS IN CONSTRUCTION AND MAINTENANCE WORK ZONES[46]

This research includes some findings particularly relevant to the subject crash, including:

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[45] Benekohal et al, "Truck Drivers' Concerns in Work Zones: Travel Characteristics and Accident Experiences," *Transportation Research Record* 1509, 1995.
[46] Pigman et al, "Highway Accidents in Construction and Maintenance Work Zones," *Transportation Research Record* 1270, 1990.

- "A high percentage of accidents occurred in work zones involving trucks . . . The percentage of work zone accidents involving trucks was 25.7 percent compared with 9.6 percent of all accidents." (p. 17)
- "The severity of accidents involving trucks in work zones was higher than statewide truck accidents. The percentage of injury or fatal accidents was about 29 percent for work zone accidents compared with 19 percent for all truck accidents." (p. 17)
- "The percentage of work zone accidents involving rear end or same-direction sideswipe was almost three times the statewide percentage." (p. 21)
- "A separate analysis of factors contributing to work zone accidents revealed congestion as the most common factor." (p. 21)

(11) DYNAMIC LATE MERGE CONTROL CONCEPT FOR WORK ZONES ON RURAL INTERSTATE HIGHWAYS[47]

Although the authors performed this research for rural interstate highways, the following finding is relevant in the subject crash:

- "Conventional traffic control plans for lane closures of rural Interstate highways normally work well as long as congestion does not develop. However, when the traffic demand exceeds the capacity of the work zone, queues may extend back past the advance

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[47] McCoy et al, "Dynamic Late Merge Control Concept for Work Zones on Rural Interstate Highways," 80th Annual Meeting of Transportation Research Board, 2001.

warning signs, often surprising approaching traffic and increasing the accident potential." (Abstract)

(12) GUIDELINES FOR DESIGN AND OPERATION OF NIGHTTIME TRAFFIC CONTROL FOR HIGHWAY MAINTENANCE AND CONSTRUCTION[48]

This NCHRP research publication provides relevant guidance for the subject crash, as follows:

- "[A] full-time traffic control crew . . . should be prepared to identify and correct operational problems, such as long queues extending past the advance warning signs . . ." (p. 78)

Although Specialty had a full-time Traffic Control Manager ostensibly to do what this research recommends, Specialty had not trained him to be aware of the danger of long queues extending upstream of the advance warning signs. Indeed, the personnel provided by Specialty to act as TCMs on this Project had rather limited experience in the position.

(13) WORK ZONE TRAFFIC CONTROL[49]

This is a work zone manual prepared by the New York State DOT, which addresses the need for advance warning well before drivers encounter the end of the queue. Although this specific guidance relates to what New York State calls a "Rolling Road Block," the need to warn drivers of slowed or stopped vehicles is relevant to this case. Its guidance includes the following:

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[48] Bryden et al, *Guidelines for Design and Operation of Nighttime Traffic Control for Highway Maintenance and Construction*, NCHRP Report 476, 2002.

[49] *Work Zone Traffic Control* Manual, New York State DOT, Revised Feb. 2015.

- "Advance warning signs or portable VMS (SLOW TRAFFIC AHEAD/BE PREPARED TO STOP) should be on the right side of the roadway one mile upstream of the initial position of road block vehicles. Permanent VMS controlled by the TMC can also be used, if appropriate." (page 29)
- "An additional portable VMS either on a trailer hitched to a truck or mounted on the truck should be located on the right shoulder 1500 feet upstream of the initial roadblock location and should move as necessary to remain approximately 1500 feet upstream of the queue." (p. 29)

ALTERNATIVES AVAILABLE TO PENHALL AND SPECIALTY TO ADDRESS AND ACCOMMODATE LANE CLOSURES WITHOUT COMPROMISING SMOOTH TRAFFIC TRANSIT

A. FHWA WORK ZONE OPERATIONS BEST PRACTICES GUIDE[50]

35. The importance of proper work zone planning and operations is recognized by the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO), who in 1999 initiated the referenced guide. Now in its Third Edition, AASHTO and FHWA have continued to cooperate in the publication of the Guide. "AASHTO provides subject matter expertise and access to practitioners, while FHWA provides national coordination, research, and publication support." (page i) Thirty-four states and the FHWA have submitted Best Practices for consideration of publication in the Guide; Idaho is not

[50] *Work Zone Operations Best Practices Guidebook,* FHWA, Third Edition, August 2013

one of them. (page 3) Additional Best Practices are provided in online updates to the Third Edition.

Narrowing Lanes and/or Reinforcing Shoulders to Maintain the Existing Number of Travel Lanes" (Best Practice A1-9, page 19)

36. Shoulder use combined with narrow lanes would have provided an alternative to keep two lanes open instead of closing three lanes if Penhall thought the additional work area width was necessary for worker safety. An FHWA guide, related explicitly to the potential of part-time shoulder use in various applications, says:

> "Part-time shoulder use is primarily used on freeways. There are multiple examples of how highway agencies have used the shoulders of roadways to address congestion and reliability needs and to improve overall system performance."[51]

This Best Practice has been successfully used in Europe and by many highway agencies in the U.S.

37. An example of this application on the I-84 project would have been to take advantage of the shoulders to provide space for the open lanes in the immediate vicinity of work using channelizing devices.

Queue Warning Systems (Best Practice J1-6)

38. Queue warning systems represent another of the FHWA Work Zone Best Practices and are described as follows:

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[51] "Use of Freeway Shoulders for Travel – Guide for Planning, Evaluating, and Designing Part-Time Shoulder Use as a Traffic Management Strategy", https://ops.fhwa.dot.gov/publications/fhwahop15023/ch1.htm.

"Queue Warning Systems typically consist of roadside sensors downstream of Portable Changeable Message Signs (PCMS). When stopped or slowing vehicles are detected by the sensors, warning messages are displayed in the upstream PCMS alerting motorists of the impending traffic conditions."

B. LAW ENFORCEMENT AT END OF QUEUE

39. It is widely recognized that a marked law enforcement vehicle near or at the end of a queue is helpful in warning and slowing traffic approaching a work zone. Both Penhall and Specialty were aware of this additional traffic control device. This approach has the advantage of being mobile and able to accommodate changing traffic conditions so as to preserve the safety of motorists and workers. FHWA provides guidelines for such use in some of its documents. According to one of those publications, "A Guide for Law Enforcement in Work Zones":

"The presence of work zone enforcement is also believed to raise driver awareness and overall level of alertness, further improving work zone safety. . .. Highway agencies and/or contractors can typically supplement normal enforcement efforts through overtime employment of off-duty officers."[52]

40. This publication continues:

". . . Federal regulations (23 CFR 630 Subpart K) do require all State highway agencies to have a policy in place regarding enforcement use in work zones on Federal-aid projects."

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[52] https://www.workzonesafety.org/files/documents/training/courses_programs/rsa_program/RSP_Guidance_Documents_Download/RSP_Law_Enforcement_Download.pdf; page 1.

41. The I-84 Project was a Federal-Aid project based on the cover sheet of the plans referring to it as Federal Aid Project No. A019(289). As such, the publication referenced enumerates several enforcement points that Penhall and Specialty could and should have requested.

42. This publication also provides law enforcement techniques in work zones, including the following:

> "Traffic queue warning – Another example of stationary enforcement use in work zones is to position the officer in a vehicle with its lights flashing approximately 0.25 miles upstream of lane closures where traffic queues are anticipated. The enforcement vehicle and officer serve a traffic-calming and attention-getting function to reduce the likelihood of high-speed rear-end crashes at the upstream end of the queue. Although considered a stationary enforcement technique, ***the officer does move the vehicle along the shoulder as needed to remain approximately 0.25 miles upstream of the queue if it grows or dissipates over time*** (emphasis added)."[53]

43. Had Penhall or Specialty requested this technique, an ISP officer would have placed a squad car such that motorists approaching the end of the queue would have encountered the law enforcement vehicle before the queue and approached the queue more cautiously. As drivers, we all know that the presence of a law enforcement vehicle with flashing lights gains more respect and caution than any other activity or device on the roadway.

44. Under the Arizona Department of Transportation (ADOT) direction, I have prepared temporary traffic control plans, including an off-duty law enforcement officer to be positioned near the end of the queue as a paid traffic control technique. The officer and vehicle were included

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[53] https://www.workzonesafety.org/files/documents/training/courses_programs/rsa_program/RSP_Guidance_Documents_Download/RSP_Law_Enforcement_Download.pdf, page 3.

in the bid price and paid for by ADOT to the contractor, just as other temporary traffic control devices.

45. The publication "*Guidelines on Use of Law Enforcement in Work Zones*" includes possible conditions for enforcement consideration, including the following:

- "night work operations that create substantial traffic safety risks for workers and road users; . . .
- high-speed roadways where unexpected or sudden traffic queuing is anticipated, especially if the queue forms a considerable distance in advance of the work zone or immediately adjacent to the work space... ."[54]

46. Law enforcement agencies typically don't have sufficient human resources to provide the high levels of enforcement needed on a multi-night project such as the I-84 project. An excellent way to accomplish such enforcement is to provide project funds for off-duty law enforcement officers to perform the needed services. Federal-aid projects (as this project was) can include the costs for these enforcement services as part of the construction contract[55]. Penhall and/or Specialty should have requested ITD to take advantage of this enforcement opportunity to improve safety for both motorists and workers.

47. The previous discussion includes possible treatments that Penhall and Specialty should have considered/implemented to improve the operation of a single-lane work zone.

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[54] https://www.workzonesafety.org/files/documents/training/courses_programs/rsa_program/RSP_Guidance_Documents_Download/RSP_Law_Enforcement_Download.pdf; page 4.
[55] https://www.workzonesafety.org/files/documents/training/courses_programs/rsa_program/RSP_Guidance_Documents_Download/RSP_Law_Enforcement_Download.pdf; page 10.

However, I must emphasize that the real solution was *to follow the contract requirements to keep two lanes open*. A later section of this report analyzes the single-lane operation on the night of the crash and compares it with the contract-required two-lane operation. It demonstrates that if the required two open lanes had been in place on the night of the crash, no queue would have developed, meaning no crash would have occurred, and meaning Lawrence P. Manlapit, III. Carlos Johnson and Karlie Westall would not have been killed.

48. Understandably, Penhall was concerned about worker safety. It is not understandable or acceptable, however, to ignore the TCP and Special Provisions prepared specifically for this project. Other alternatives available to Penhall and Specialty included:

- Retain a consulting engineering firm to revise the TTCP to provide adequate roadway capacity to submit for ITD approval. Penhall and Specialty had more than enough time (roughly 7 months) to develop an alternate TTCP and obtain approval from the ITD given the break in construction activities between November 2017 and the project restart in May 2018. It is inexcusable Penhall and Specialty did not utilize this time to develop an alternate TTCP if they intended to again deviate from the approved TTCP and Special Provisions upon the restart.
- Reduce the lane width and use shoulder running as described previously in this report while retaining two open lanes in the four-lane section.
- Adjust the location of signage on I-84 East so as to provide motorists with adequate warning.
- Request the stationing of police presence on scene to act as additional traffic control.

49. The knowing failure of Penhall and/or Specialty to implement any of these well-known and understood alternatives so as to provide the necessary work zone capacity and/or provide adequate notice to motorists, contributed to the fatal crash on June 16, 2018.

50. Knowing and intentional failure by Penhall and Specialty to follow the TCP's requirement for two open lanes in a four-lane section of I-84 resulted in inadequate capacity to accommodate the traffic. In developing the TCP, it was understood that one lane was insufficient for safe operations. For days before the accident, the TCM saw that forcing traffic at that location into a single lane caused a dangerous traffic queue that extended to Locust Grove, well beyond the advance warning area. Our Highway Capacity Software analysis (detailed below) quantifies the huge difference in the traffic operations occurring with only one open lane compared to the required two open lanes. The contract required two open lanes in that section. Penhall and Specialty intentionally refused to comply. A written request from Penhall to ITD to close three of four lanes, sealed by a traffic engineer, was a prerequisite if Penhall wished to change the TCP. Penhall and Specialty knowingly violated (1) the explicit contract requirement for two open lanes and (2) the contract requirement for a written request for any revision from the approved traffic control plan. This action by Penhall and Specialty constitutes an extreme deviation from reasonable standards of conduct for traffic control contractors. Both firms knew the TCP and Special Provisions required two of four open lanes; both firms should have known that reducing the roadway capacity by fifty percent could create severe and hazardous queues; both firms saw, in the three days before the accident, and on the night of the accident itself, that their unapproved decision to reduce four lanes of traffic to a single open lane without a revised traffic study and/or

an engineer-approved revised TCP had caused severe and dangerous traffic backups on I-84 Eastbound.

PENHALL "REQUEST" FOR MODIFIED TRAFFIC CONTROL PLAN

51. The documents produced in this case show that Penhall never made a proper request, in writing, to modify the TCP so as to permit a three-lane closure. They knew such a formal written request was required by the contract; understood that it required an engineer's approval; and either did not reach out to an engineer (or have Specialty do it) or could not find a registered engineer who was willing to stand behind their dangerous decision to revise the TCP. Instead, Penhall and Specialty developed a hazardous revised TCP and decided to use their unilaterally adopted alternate method without engineering oversight, review and/or approval. A massive traffic backup and the tragic crash here discussed was the direct and foreseeable result. The following summarizes the sequence of events:

- Dave Statkus (ITD) sent an email on August 22, 2017, to Vincent Coletta (Penhall) asking if Penhall had submitted the revised TCP showing their proposed work sequence.
- Mr. Coletta (Penhall) forwarded the email to Eric Blackburn (Penhall) asking about the process to revise the TCP.
- Mr. Blackburn (Penhall) replied to Mr. Coletta (Penhall), appearing not to know that a written request sealed by an engineer was required and suggesting that Specialty should be able to assist.
- Mr. Coletta (Penhall) forwarded the email to Daniel Kircher (Specialty), asking if Specialty could do that.

- Mr. Kircher (Specialty) replied that they did not have a staff engineer to stamp the plans.
- The logical action at that time was for either Specialty or Penhall to retain a traffic engineer to prepare the alternate TCP for submittal to ITD. That may have happened, and the engineer declined to seal the desired plan. Since ITD required a sealed set of plans and evaluation of lane capacity in that proposal,[56] a traffic engineer may have determined that there was inadequate capacity and refused to approve the plans.
- There was pressure on Penhall to complete the Project on time, so as to avoid adverse financial consequences. Reducing the traffic lanes was one way to facilitate the completion of the Project, so Penhall decided to proceed with what they thought was a time-saving plan without written ITD approval, instead taking the position that an ITD inspector (who was not an engineer, was not authorized to revise the TCP, and was completely unfamiliar with the TCP), had given verbal consent to closing three of four lanes.
- It is noteworthy that Specialty stated when they submitted their bid to Penhall and other contractors that their price was based on implementing the TCP included in the plans. Daniel Kircher testified in his deposition that he sent an email May 23, 2017, to all contractors to whom they sent bids saying:

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[56] Deposition transcript of Dave Statkus, page 120.

"We are anticipating using the traffic control plans provided in the bid. If the prime contractor would like to revise the staging and phasing plans, an engineer's services would need to be retained."[57]

52. The lack of a budget for engineering analysis may have been why Penhall or Specialty did not retain an engineer to analyze the proposed plan and subsequently implemented it (without written ITD approval so as to complete the Project on time and without penalty). Another reason for the lack of an engineer-sealed alternate plan could be that an engineer reviewed the proposed alternate plan and refused to approve it because there was inadequate capacity in only one lane.

SELECTED DEPOSITION TESTIMONY

BRYON BREEN (ITD)

53. Bryon Breen was the Resident Engineer for the I-84 project.[58] Mr. Breen attended the project's kickoff meeting.[59] The minutes of that meeting reflect that ITD was possibly open to going down to one lane if traffic volumes were sufficiently low. According to Mr. Breen, ITD never gave the authority to go down to one lane in a four-lane section.[60] That subject came up again in the second season's "restart" meeting.[61]

54. Mr. Breen testified that on this project, the Traffic Control Manager was ". . . solely responsible to make sure it was right".[62]

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[57] Deposition transcript of Daniel Kircher, page 122.
[58] Deposition transcript of Bryon Breen, page 21.
[59] Deposition transcript of Bryon Breen, page 34-35.
[60] Deposition transcript of Bryon Breen, page 35-36.
[61] Deposition transcript of Bryon Breen, page 36.
[62] Deposition transcript of Bryon Breen, page 46.

55. According to Mr. Breen, ITD's primary interest in minimizing queues in a work zone is to minimize motorist delay.[63] He did, however, acknowledge that ". . . if a queue goes back beyond that advanced signing, then I can see that's a hazard."[64] Mr. Breen testified, ". . . in my mind, we wouldn't let them operate outside the traffic control plans"[65] when asked about applying the penalty for the extra closed lane.

56. Mr. Breen testified that if he had found out the contractors had reduced a four-lane section to one lane, he would have stopped it.[66]

57. Mr. Breen disagreed that the presence of a traffic queue poses a more significant hazard to motorists than no queue at all ". . . as long as you're alerting the motorists with proper signing. . . ."[67] As shown in the studies outlined above, Mr. Breen is simply and tragically incorrect in this unfounded assumption. Mr. Breen was told by Jason Brinkman that the traffic control complied with ". . . both the mandatory and suggested provisions".[68] If that is true, Mr. Brinkman flatly lied to Mr. Breen. Mr. Breen also said, ". . . I would have never wanted the traffic to be backing up beyond where the warning signs – the advanced warning signs were in place".[69] At times traffic backed up past Locust Grove Road, which was well upstream of the advance warning signs.

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[63] Deposition transcript of Bryon Breen, page 51.
[64] Deposition transcript of Bryon Breen, page 52-53.
[65] Deposition transcript of Bryon Breen, page 63.
[66] Deposition transcript of Bryon Breen, page 78.
[67] Deposition transcript of Bryon Breen, page 105-106.
[68] Deposition transcript of Bryon Breen, page 108-109.
[69] Deposition transcript of Bryon Breen, page 111.

58. Mr. Breen testified that Specialty's Traffic Control Manager made a mistake by allowing only a single open lane in a four-lane section.[70] He also opined that it was a mistake for Penhall to operate outside of the approved TCP.[71]

59. To a question, "Did any inspector or project managers who may have been on site have the authority to make a verbal change order to the traffic control plan" Mr. Breen replied, "No, they did not."[72]

DAVE STATKUS (ITD)

60. Mr. Statkus was the on-site Project Engineer assigned to this job by ITD. He testified that he has experience in the development of temporary traffic control plans.[73] According to Mr. Statkus, ITD strives for free-flowing traffic and to avoid the development of lengthy queues in work zones "[a]s much as one can do."[74]

61. Mr. Statkus is unaware of Penhall ever submitting a request for a change in the traffic control plan. If Penhall had submitted such a request, it would have gone to Mr. Breen. Mr. Statkus thinks Mr. Breen would have asked Mr. Colson of Parametrix to review a request for an alternate TCP if one had been submitted.[75] There is no evidence that such a request was ever made of ITD. Neither was such a request ever approved by an ITD engineer.

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[70] Deposition transcript of Bryon Breen, page 122.
[71] Deposition transcript of Bryon Breen, page 123-124.
[72] Deposition transcript of Bryon Breen, page 135-136.
[73] Deposition transcript of Dave Statkus, page 17-18.
[74] Deposition transcript of Dave Statkus, page 20.
[75] Deposition transcript of Dave Statkus, page 55-56.

62. Mr. Statkus agreed that there is a risk of rear-end collisions with even moderate queues.[76]

63. Mr. Statkus agreed that "inadequate traffic control and queue management procedures employed by Penhall and Specialty" was a contributing cause of the tragic accident.

64. Mr. Statkus was asked if it is possible that Penhall made a verbal or written request to him to permit one open lane in a four-lane section, to which Mr. Statkus responded, "No." He said that a written proposal along with "a set of stamped plans" was required for ITD consideration of such a request. He further testified that along with the set of stamped plans there would have to be an evaluation of lane capacity.[77]

65. In response to a question, Mr. Statkus testified that ". . . with the traffic control set up in such a way that there was four lanes and they went down to one lane, it would be inadequate.[78] Mr. Statkus testified that, to his knowledge, ITD never allowed any of its inspectors to make a change to the TCP throughout this project.[79]

BRUCE KIDD (PENHALL)

66. Mr. Kidd was a project superintendent for Penhall on the I-84 project and had been employed by Penhall only from June, 2017 to December, 2018.[80] Prior to his employment with Penhall, Mr. Kidd had *never* been involved in any highway construction project.[81] That

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[76] Deposition transcript of Dave Statkus, page 92.
[77] Deposition transcript of Dave Statkus, page 119-120.
[78] Deposition transcript of Dave Statkus, page 123.
[79] Deposition transcript of Dave Statkus, page 148.
[80] Deposition of Bruce Kidd, pages 19-20, 29.
[81] Deposition of Bruce Kidd, pages 20-21.

notwithstanding, Mr. Kidd was involved in the changes made to the I-84 TCP in the Spring of 2018.[82]

67. He never reviewed the Penhall/State contract; he never asked to receive, nor did he review, the TCP or Special Provisions for the I-84 Project.[83] He does not know whether Specialty was ever given the TCP and its Special Provisions.[84] When he began on the Project in 2017, he was not aware that there were occasions when four lanes of open highway had been reduced to a single open lane during the Project.[85] He understood that the original TCP only allowed for a four-lane stretch of Highway to be reduced to two open lanes.[86] He believes the revision of the TCP to allow for a single open lane in a four-lane stretch of highway did not occur until 2018.[87] During the Spring of 2018, he interacted with the Traffic Control Manager on a nightly basis, telling him what lanes needed to be closed.[88]

68. The change in the TCP to reduce four open lanes to a single open lane was made upon an oral direction; he was given that instruction a few days before the Project started in the Spring of 2018, during a meeting attended by Scott Reed and Bob Bleeker, as well as a handful of unidentified ITD employees.[89] No one from Specialty was present.[90] Scott Reed/Penhall was the individual who raised the issue of restricting lanes down to a single lane in an otherwise four-lane

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[82] Deposition of Bruce Kidd, page 26.
[83] Deposition of Bruce Kidd, page 28.
[84] Deposition of Bruce Kidd, page 29.
[85] Deposition of Bruce Kidd, page 30.
[86] Deposition of Bruce Kidd, pages 31-32.
[87] Deposition of Bruce Kidd, pages 30, 33.
[88] Deposition of Bruce Kidd, pages 32-33.
[89] Deposition of Bruce Kidd, pages 34-38.
[90] Deposition of Bruce Kidd, pages 37-38.

stretch of highway.[91] Mr. Kidd did not know then what needed to be done to revise the TCP for the project.[92] He did not become aware of those requirements until the day before his deposition.[93]

69. Mr. Kidd did not know what evaluations went into the creation of a TCP in terms of lane capacity and traffic volume.[94] He did not discuss that issue with the TCM regarding the decision to restrict four lanes of highway down to a single open lane.[95] He does not believe that anyone from Penhall had such a discussion with Specialty.[96] He does not know who advised Specialty in the Spring of 2018 to reduce four open lanes down to a single open lane, but it was not him; he is not aware of any time when any representative of Specialty raised any concern with him about the decision to restrict four open lanes of highway down to a single open lane.[97]

70. It is his understanding that a TCP provides for the safety of both workers and the motoring public through a highway construction zone.[98] It is also his understanding that the purpose of the TCP is to reduce the occurrence of unexpected traffic stoppages and the development of traffic queues.[99] He recognizes that the existence of a traffic back-up in the area of highway construction zones presents the risk that traffic will back up, causing a rear-end collision and further that such a risk is particularly acute at night.[100] Mr. Kidd also recognized that

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[91] Deposition of Bruce Kidd, page 38.
[92] Deposition of Bruce Kidd, page 39.
[93] Deposition of Bruce Kidd, page 39.
[94] Deposition of Bruce Kidd, page 41.
[95] Deposition of Bruce Kidd, page 41.
[96] Deposition of Bruce Kidd, pages 44-48.
[97] Deposition of Bruce Kidd, pages 44-48.
[98] Deposition of Bruce Kidd, page 48.
[99] Deposition of Bruce Kidd, pages 48-49.
[100] Deposition of Bruce Kidd, pages 48-49.

the purpose of the advanced warning area of the TCP is to provide adequate notice to drivers about an upcoming potential hazard, for example a traffic back-up.[101]

71. It is Mr. Kidd's impression that the decision to go from four open lanes of highway to a single open lane was between Penhall and the State.[102] He is aware that during the Spring of 2018, Scott Reed was the Penhall representative who would go to the eastbound lanes to see how work was progressing.[103] He recalls receiving a telephone call from the State Communications operator on June 15, 2018; during that conversation, the operator told him of public complaints about the traffic congestion in the eastbound section of the I-84 Project that was being worked on that night.[104] Mr. Kidd told the operator that he would call "his people."[105] There were no Penhall workers on the eastbound side of I-84 on June 15.[106] By "his people," he meant that he would contact a Diamond Drilling representative, probably Gerald Johnson.[107] Mr. Kidd testified that he did not call the TCM because "I saw no reason to."[108] *He did not expect Diamond to do anything*. He just informed Diamond of the communication from the State operator so that Diamond could tell his personnel, "Y'all be on the lookout."[109] He never saw a written proposal to change four open lanes of highway to a single open lane before Penhall's decision was implemented.[110]

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[101] Deposition of Bruce Kidd, page 49.
[102] Deposition of Bruce Kidd, pages 56-57.
[103] Deposition of Bruce Kidd, page 56.
[104] Deposition of Bruce Kidd, pages 57-58.
[105] Deposition of Bruce Kidd, page 58.
[106] Deposition of Bruce Kidd, page 58.
[107] Deposition of Bruce Kidd, page 60.
[108] Deposition of Bruce Kidd, page 61.
[109] Deposition of Bruce Kidd, page 61.
[110] Deposition of Bruce Kidd, page 32.

SCOTT REED (PENHALL)

72. Mr. Reed was another project superintendent for Penhall on the I-84 Project, along with Bruce Kidd and Bob Bleeker.[111] Mr. Reed was the Penhall representative in Idaho (boots on the ground) with the highest authority,[112] but he was not in any way familiar with the Penhall/State construction contract or, more particularly, the TCP or Special Provisions with respect thereto.[113] Mr. Reed never looked at the Special Provisions for the TCP.[114] He was never told that there were explicit procedures that had to be followed in order to amend the TCP.[115] He never reviewed the State/Penhall contract because he says he didn't need to, there was no need for him to be involved in the TCP.[116]

73. He understood that the purpose of the TCP was to facilitate the safe passage of motorists through a highway construction zone and reduce the occurrence of unexpected stoppages or queues.[117] He realized that it is particularly important during night construction to avoid sudden traffic stoppages or the development of a traffic back up.[118] He also understood that an advance warning area serves the purpose of giving warning to drivers of upcoming traffic hazards.[119] When he was on site, he would not interact with the TCM.[120] He testified Penhall's project manager was

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[111] Deposition of Scott Reed, pages 49-50.
[112] Deposition of Scott Reed, page 139.
[113] Deposition of Scott Reed, pages 91, 94-95.
[114] Deposition of Scott Reed, page 95.
[115] Deposition of Scott Reed, page 94.
[116] Deposition of Scott Reed, page 95.
[117] Deposition of Scott Reed, page , 46-47.
[118] Deposition of Scott Reed, page 47-48.
[119] Deposition of Scott Reed, pages 47-48.
[120] Deposition of Scott Reed, page 29.

responsible for overseeing Specialty's work as TCM on the project.[121] After the accident, he contacted the TCM, who informed Mr. Reed that the TCP had been set according to plan that evening.[122] On June 16, 2018, there was a Penhall work zone on the eastbound lanes, but a subcontractor was working those lanes.[123]

74. He recalls a meeting with ITD representatives a few days before the restart of the Project in the Spring of 2018. During that meeting, he had discussions with ITD about reducing four open lanes of highway to a single open lane and to leave the shoulder open as an emergency "escape route."[124] His proposed change to the TCP was not accompanied by a traffic volume or traffic capacity evaluation to support the request.[125] He does not recall ITD telling Penhall to submit their request in writing.[126] He has no idea how the TCM was advised of the revision to the TCP.[127] He does not know how Penhall determined that a single lane of traffic during working hours on eastbound I-84 could accommodate the anticipated traffic volume.[128] He assumes that that if such a determination was made, it would have been made by ITD.[129] That determination was not done.

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[121] Deposition of Scott Reed, page 172.
[122] Deposition of Scott Reed, pages 83-84.
[123] Deposition of Scott Reed, page 85.
[124] Deposition of Scott Reed, pages 102-103.
[125] Deposition of Scott Reed, page 104.
[126] Deposition of Scott Reed, page 85.
[127] Deposition of Scott Reed, page 85.
[128] Deposition of Scott Reed, page 106.
[129] Deposition of Scott Reed, pages 106-107.

75. He became aware during May 2018 for the first time that the plans and specifications prohibited the reduction of four open lanes of highway to a single open lane.[130] After he made the proposal to ITD about reducing four open lanes to a single open lane on eastbound I-84, he did nothing to inform himself about the requirements of the TCP.[131] He denies all knowledge about Specialty ever raising any concerns about revising the TCP.[132]

76. Before his involvement in the Project in 2018, he never spoke with any Penhall representative regarding the operation of the Project in 2017.[133] He was not involved in any way in monitoring the TCP because he never reviewed the plan and would have no way of evaluating whether the TCP was being properly implemented.[134] Even if he had known anything about traffic backups as a result of the reduction of four open lanes down to a single open lane, he would not have done anything. "It's not my responsibility as to what needs to happen."[135]

77. Significantly, in a post-accident email, Mr. Reed acknowledges that he was not authorized to deviate from the approved TCP. He bemoans the fact that after the accident, they were being forced to comply with the contract as written. Tellingly, he warns his fellow Penhall employees that the requirement to comply with the TCP means they will not complete the Project on time.[136]

JEROMY MAGILL (PENHALL)

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[130] Deposition of Scott Reed, pages 107-108.
[131] Deposition of Scott Reed, pages 108.
[132] Deposition of Scott Reed, pages 110-112.
[133] Deposition of Scott Reed, page 114.
[134] Deposition of Scott Reed, page 116.
[135] Deposition of Scott Reed, page 132.
[136] Robbins Declaration, Ex 26; PENHALL007519, produced after deposition of Scott Reed.

78. Magill was the Project Manager for Penhall on this Project.[137] There had been three to four Project Managers for the Project, because there was a high rate of turnover at Penhall. He was the only one left available to act as Project Manager for this job.[138] He never received any instruction or training from Penhall regarding the TCP.[139] Prior to going to the job, he had no discussions with either Vince Coletta or Henry "Shields" Sullivan regarding what the job requirements were.[140] When he took over the Project from Pat Nordberg (the first Project Manager), he only skimmed the State/Penhall contract and never really read its requirements.[141] Neither did he ever review or form an understanding of the Project's TCP or its Special Provisions.[142] Bruce Kidd and Scott Reed were the superintendents for Penhall and Penhall's representatives on the site on a nightly basis. Magill never had any discussions with either Bryon Breen or any other representative of ITD regarding the TCP.[143] Although he never reviewed the contract, his "impression" from discussing operations with either Penhall personnel on site was that two lanes were to remain open in a four-lane stretch.[144] His only discussions with the TCM had to do with invoicing; he never had any discussions with him about the TCP.[145]

79. He knew that a purpose served by the TCP was to facilitate the smooth transition of traffic through a construction zone and to provide for the safety of workers and motorists in the

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[137] Deposition of Jeromy Magill, page 16.
[138] Deposition of Jeromy Magill, page 18.
[139] Deposition of Jeromy Magill, pages 20-22.
[140] Deposition of Jeromy Magill, page 19-20.
[141] Deposition of Jeromy Magill, page 21.
[142] Deposition of Jeromy Magill, page 21.
[143] Deposition of Jeromy Magill, page 27.
[144] Deposition of Jeromy Magill, page 28.
[145] Deposition of Jeromy Magill, page 30.

work zone, as well as to avoid the development of traffic queues.[146] He understood that a traffic queue in a construction zone presents a safety hazard to both motorists and to workers.[147]

80. When the Project restarted in the spring of 2018, he understood Penhall had only a limited number of days to finish the Project.[148] Time was tight for Penhall to do the job required under the contract, so Penhall had to bring in another contractor (Diamond Drilling) to do part of the job that Penhall had originally contracted to perform.[149] This was done in order for Penhall to avoid being assessed liquidated damages under the terms of the contract (if it fell behind schedule).[150] When the Project restarted in the Spring of 2018, there was an urgency to get the Project done on an expedited basis.[151] It was Penhall's intent to finish the Project on time and on an expedited basis in order to avoid penalties.[152] Magill developed a schedule for the restart that was presented to and approved by ITD. It was developed by him to show the shortest period practicable to get the job done. Penhall wanted the Project done as soon as possible.[153] Neither Kidd nor Reed ever advised him that there were any alterations to the TCP.[154] As the incoming Project Manager, he acknowledged he would want to know about any prior deviations to the TCP, but again he was never advised of the deviations to the TCP in the fall of 2017.[155] He would expect

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[146] Deposition of Jeromy Magill, pages 33-35.
[147] Deposition of Jeromy Magill, pages 33-35.
[148] Deposition of Jeromy Magill, pages 41, 44.
[149] Deposition of Jeromy Magill, pages 41, 44.
[150] Deposition of Jeromy Magill, pages 41, 44.
[151] Deposition of Jeromy Magill, page 43.
[152] Deposition of Jeromy Magill, page 44.
[153] Deposition of Jeromy Magill, pages 43-44.
[154] Deposition of Jeromy Magill, page 92.
[155] Deposition of Jeromy Magill, page 93.

that his superintendents (Kidd and Reed) would know the contract documents and the TCP and would follow the requirements of the TCP.[156] His take from the handoff of this Project to him was the import of avoiding liquidated damages.[157] He acknowledged that one way to speed up work on this Project was to close more lanes than was called for in the contract, thus affording the ability to do more work, faster.[158] It seems clear that getting the job done quickly and avoiding financial penalties trumped highway safety for Penhall. As noted above, Scott Reed was concerned that following the TCP would mean they could not finish on time.

Vincent Coletta (Penhall)

81. Mr. Coletta worked with Penhall for approximately 11 months and served as Penhall's project manager on the project in the fall of 2017.[159] According to Mr. Coletta, Penhall understood that if there was going to be a change to the TCP and special provisions there would have to be a written change stamped by an engineer approved by the State of Idaho.[160]

Eric Blackburn (Penhall and Diamond Drilling)

82. Mr. Blackburn worked for Penhall for 19 ½ years in various capacities, including project manager, superintendent and estimator.[161] He served as estimator for Penhall on the project.[162]

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[156] Deposition of Jeromy Magill, page 93.
[157] Deposition of Jeromy Magill, page 94.
[158] Deposition of Jeromy Magill, page 94.
[159] Deposition of Vincent Coletta, page 19.
[160] Deposition of Vincent Coletta, pages 52-53.
[161] Deposition of Eric Blackburn, pages 18-19.
[162] Deposition of Eric Blackburn, page 43.

83. Mr. Blackburn left Penhall and joined Diamond Drilling in December 2017 as senior project manager of national contracts.[163] Again, per Jeromy Magill, Penhall's project manager at the time of the fatal collision, Penhall was behind schedule and wanted to avoid being assessed liquidated damages so had to bring in Diamond Drilling to do part of the job that Penhall had originally contracted to perform. Per Mr. Blackburn, the directive to close three out our four eastbound I-84 travel lanes on June 16, 2018 "wouldn't have come from [his] crew."[164] Prior to the fatal collision, Mr. Blackburn had not been advised by Penhall or Specialty that there had been a change in the TCP whereby four open lanes had been reduced to one open lane.[165] He did not anticipate that four open lanes would be reduced to one open lane because he had a general knowledge of the TCP, understood two lanes were to remain open and that would translate to his crew "doing the inside [two] lanes or the outside [two] lanes . . ."[166] Mr. Blackburn did not perceive of any need to reduce four open lanes to a single open lane in order for Diamond Drilling to do its work on the evening of June 16, 2018.[167] Although he does not know who made the request to reduce four open lanes down to a single open lane on I-84 eastbound, he testified the request did not come from Diamond Drilling.[168]

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[163] Deposition of Eric Blackburn, page 18.
[164] Deposition of Eric Blackburn, page 51.
[165] Deposition of Eric Blackburn, pages 49-50.
[166] Deposition of Eric Blackburn, page 54.
[167] Deposition of Eric Blackburn, pages 61-62.
[168] Deposition of Eric Blackburn, page 63.

84. Mr. Blackburn acknowledged the more lanes that are closed the greater the probability a traffic queue will develop.[169] He also acknowledged a traffic queue presented a risk to the motoring public and to the construction workers.[170]

JOSH ROPER (SPECIALTY)

85. Josh Roper started with Specialty in 2013 and received his TCS certificate in 2015.[171] Roper was not the original choice for TCM on this Project; however, the original TCM left Specialty and the job fell to him.[172] Mr. Roper did not have the required five-year traffic control experience mandated by the Special Provisions.[173] *The Project was Roper's first as TCM.*[174] He began on the Project in the Fall of 2017 and was reassigned to the Project when it restarted in early June 2018.[175] When Roper left the Project, Mason Garling took over for him. It was never Roper's understanding that Garling took over as TCM.[176]

86. Daniel Kircher was Roper's direct supervisor on the Project.[177] Kircher was involved with all traffic control operations for Specialty.[178] Roper received and reviewed the TCP and Special Provisions for the Project from Mr. Kircher and discussed them with him. Roper said he wanted extra help on the Project because of his lack of experience.[179] He was assigned an

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[169] Deposition of Eric Blackburn, page 62-63.
[170] Deposition of Eric Blackburn, page 63.
[171] Deposition of Josh Roper, pages 19-20.
[172] Deposition of Josh Roper, pages 25-26.
[173] Deposition of Josh Roper, pages 158-159.
[174] Deposition of Josh Roper, page 22.
[175] Deposition of Josh Roper, pages 22-23.
[176] Deposition of Josh Roper, pages 23-24.
[177] Deposition of Josh Roper, page 25.
[178] Deposition of Josh Roper, page 25.
[179] Deposition of Josh Roper, pages 25-28.

experienced traffic control supervisor to assist.[180] Roper and Kircher discussed not only the plans and specifications, but also that TCM diaries needed to be detailed and submitted to ITD by 6:00 a.m. the day following the work performed.[181]

87. Roper understood that if the TCP was to be revised, it would have to be in writing and approved by the ITD engineer on the Project before any change could be implemented.[182] During the course of the Project, the TCP was changed.[183] He talked about those changes with Penhall in 2017 regarding reducing four open lanes of traffic down to a single open lane.[184] There was never a formal proposal submitted to or approved by ITD.[185] He never saw an ITD-approved plan to revise the TCP.[186] If there had been an approved revised plan, as TCM, he would have received such a document.[187] Roper never asked for a change to be approved in writing by ITD before he implemented changes in the TCP even though he knew it was required by the TCP and Special Provisions.[188] He allowed reductions of four open lanes to a single open lane in 2017.[189]

88. He understood that it was his job as TCM to implement, as approved, the written TCP plans.[190] Roper never spoke with the ITD engineer for the Project (Breen), or with the ITD Project manager (Statkus) about any proposed change to the TCP.[191]

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[180] Deposition of Josh Roper, page 28.
[181] Deposition of Josh Roper, pages 30-31.
[182] Deposition of Josh Roper, page 32.
[183] Deposition of Josh Roper, pages 33-34.
[184] Deposition of Josh Roper, page 34-37.
[185] Deposition of Josh Roper, page 35.
[186] Deposition of Josh Roper, page 35.
[187] Deposition of Josh Roper, page 41.
[188] Deposition of Josh Roper, page 41-42.
[189] Deposition of Josh Roper, page 42.
[190] Deposition of Josh Roper, page 41-42.
[191] Deposition of Josh Roper, pages 46-47.

89. He understood that one purpose of the TCP was to facilitate traffic flow and reduce unexpected changes in traffic in the speed of traffic flow.[192] Another purpose of the TCP was to preserve the safety of workers and motorists traveling in the area of the construction zone and to reduce, as much as possible, the development of traffic queues.[193] He understood that traffic queues in construction areas on highways are a hazard to motorists, including the risk of rear-end collisions.[194]

90. He recalls a conversation he had with Penhall, where Penhall asked why they did not have police presence at the construction Project.[195] Mr. Roper replied that Specialty "typically didn't have ISP on our Projects."[196] The Penhall representative replied that they typically have a police presence on site on most projects.[197] Penhall never asked that such a request be made to ITD on this Project.[198] He recognized that a police presence on site is an additional form of traffic control.[199]

91. When he returned to the Project in the Spring of 2018, he did not review the specifications or the TCP itself, but met with Mason Garling (also with Specialty), who was new to the Project and was to be trained in traffic control management.[200]

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[192] Deposition of Josh Roper, page 62.
[193] Deposition of Josh Roper, page 64.
[194] Deposition of Josh Roper, page 65.
[195] Deposition of Josh Roper, pages 84-85.
[196] Deposition of Josh Roper, page 85.
[197] Deposition of Josh Roper, page 85.
[198] Deposition of Josh Roper, page 85.
[199] Deposition of Josh Roper, page 86.
[200] Deposition of Josh Roper, pages 95, 99-100.

92. Roper recalls a discussion in May 2018 with a Penhall representative wherein Penhall expressed displeasure at Specialty not setting up a triple-lane closure on a four-lane stretch of highway.[201] Mr. Roper advised that it was his understanding that in 2018 they would not be using triple-lane closures anymore.[202] Penhall's insistence on a triple-lane closure in 2018 took him by surprise, but Roper did not raise any concern about such a violation of the contract requirements.[203] That said, Roper admitted the concept of reducing four open lanes of highway down to a single lane caused him concern when traffic was heavy.[204] He did not understand why Penhall was making the request; he is not sure if he was satisfied with Penhall's explanation for the triple closure.[205] The inexperienced Mason Garling took over as TCM on June 8, 2018. Garling had discussions about traffic control management with Roper before he took over.[206] His discussions with Garling on the request by Penhall for a triple-lane closure was that Roper would follow the direction of Penhall.[207]

93. Roper understood that the TCM had the authority to open up a closed lane of travel if he saw a traffic queue form into the advance warning area.[208] If he had seen traffic back up to such an extent, he would have brought out a moveable sign to advise of triple-lane enclosures ahead of the traffic back up, or he would have instituted what is known as a "cattle chute," where

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[201] Deposition of Josh Roper, page 97.
[202] Deposition of Josh Roper, pages 100-103.
[203] Deposition of Josh Roper, pages 100-103.
[204] Deposition of Josh Roper, page 44.
[205] Deposition of Josh Roper, pages 105-107.
[206] Deposition of Josh Roper, pages 119-120.
[207] Deposition of Josh Roper, page 123.
[208] Deposition of Josh Roper, pages 162-163.

traffic is allowed to proceed on each side of construction activities (thus allowing two open lanes).[209] If he had seen a traffic backup form as a result of an unauthorized lane closure, he would have gone straight to the ITD inspector and advised him that changes had been made and that was the result.[210]

MASON GARLING (SPECIALTY)

94. Mr. Garling was the TCM on this Project on June 16, 2018. He began working for Specialty as a setup maintenance laborer in 2014, and ultimately obtained his traffic control supervisor certification.[211] He had only worked as TCM on two jobs before this Project.[212] He had no experience in revising, designing or approving a TCP.[213] It is noteworthy that Mr. Garling did not have the ITD-required five-year traffic control experience for this Project.[214]

95. Mr. Garling agreed that the purposes of a TCP include facilitating the smooth flow of traffic through a work zone area and avoiding long traffic queues.[215] But, when asked if a traffic queue presented a hazard to motorists, he answered:

> "I would almost say that a traffic queue would be itself a warning sign of the construction area. The brake lights alone would tell you that there's something going on ahead of you."[216]

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[209] Deposition of Josh Roper, page 164.
[210] Deposition of Josh Roper, pages 164-165.
[211] Deposition transcript of Mason Garling, page 20.
[212] Deposition of Mason Garling, page 22.
[213] Deposition of Mason Garling, page 22.
[214] Deposition transcript of Mason Garling, pages 60-61.
[215] Deposition transcript of Mason Garling, pages 33-34.
[216] Deposition transcript of Mason Garling, pages 34-35.

96. I have never seen any such opinion stated in the MUTCD or any other authoritative publication related to work zone traffic control. It directly contradicts the MUTCD regarding the need to warn of conditions not readily apparent to motorists. Although his response is troubling coming from the person charged with the traffic control operations of the project, he did agree that a traffic queue extending into the advance warning area is a potential hazard to motorists, especially at night, and presents a risk of rear-end crashes. He also agreed that the risk is higher with a large volume of tractor-trailer traffic. He further agreed that it is important to follow the TCP (which he did not do).[217]

97. Mr. Garling understood that ITD written approval was required for any modification of the TCP.[218] When he took over as TCM from Josh Roper, he was told about Penhall's request to close three of four lanes in 2017. Mr. Garling did not inquire if ITD had approved that change, nor did he ask to see the written approval.[219] He agreed that it would be reasonable for an engineer to evaluate fewer open lanes than shown in the approved TCP to know that sufficient roadway capacity existed under the revised plan. He further agreed that a reason for an engineer's review and approval of the revised plan is to avoid queue build-up into the advance warning area.[220]

98. Mr. Garling understood that Byron Breen was the person at ITD who would have to review and approve a change to the TCP.[221]

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[217] Deposition transcript of Mason Garling, pages 35-36.
[218] Deposition transcript of Mason Garling, page 39.
[219] Deposition transcript of Mason Garling, pages 43-44.
[220] Deposition transcript of Mason Garling, pages 49-50.
[221] Deposition transcript of Mason Garling, page 57.

99. It was Mr. Garling's understanding that Penhall was responsible for the "safety aspect; making sure that we, as the subcontractor, are adhering to the traffic control plan."[222] Although this is a logical understanding for a Specialty employee (an employee of the subcontractor) would think (that they would take direction from the prime) it was not ITD's stated intent on the I-84 project, which was that the TCM had ultimate responsibility for implementing the TCP.

100. Mr. Garling testified that "At our first meeting before operations in June, they (Penhall) instructed us to close three lanes." He also said that he received Penhall instructions "almost nightly" and that the ITD inspectors did not monitor the traffic control much.[223] He testified that he attempted to engage the ITD inspectors to see if they had any concerns or comments, but that the ITD inspectors didn't have substantive responses to his inquiries or any concern about a queue forming and extending into the advance warning area due to the improper decision to restrict traffic to a single lane.[224]

101. Mr. Garling testified that at a meeting in June, 2018, Bruce Kidd of Penhall approached him, asking if Specialty was prepared for the three-lane closure. Mr. Garling replied that they were not because he was new to the project and was not aware of it.[225]

102. Mr. Garling testified that although closing three of four lanes would extend the beginning of the advance warning (due to the additional lane merge and tangent) and lengthen the

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[222] Deposition transcript of Mason Garling, pages 64-65.
[223] Deposition transcript of Mason Garling, pages 67-68.
[224] Deposition transcript of Mason Garling, pages 70-73.
[225] Deposition transcript of Mason Garling, pages 93-94.

queue from the original TCP, they didn't discuss moving the portable message board because its location was based on the distance to the ROAD WORK AHEAD sign. His reason for that was, "It was a stationary object that was on the plan, supposed to be there."[226] As noted above, Specialty should have moved all of the advance warning signs upstream because of the additional merge of the third closed lane and the additional signs to accommodate that merge. Doing so is consistent with the MUTCD recommendation that "These distances should be adjusted for field conditions, by increasing or decreasing the recommended distances."[227] The presence of a queue extending beyond the advance warning was a clear indication, based on MUTCD recommendations, that the warning signs should have been moved to the west beyond the end of the queue.

103. But more importantly, it was foolhardy to allow a change to the TCP without input from a licensed engineer. Failing to obtain a traffic capacity analysis before reducing to a single lane, at night, during a period of increased traffic volume, allowed a dangerous traffic queue to form that contributed to this tragic crash.

104. Mr. Garling testified that his usual practice would have been to inform his supervisor, Mr. Kircher, of the single open lane because it violated the contract.[228] He had no reason to believe that he did not follow this custom and practice. Kircher had previously been informed of this request by Penhall. He testified that Penhall "claimed that they had already obtained approval from ITD" to close three of the four lanes. As I read the ITD contract, the TCM was responsible for any

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[226] Deposition transcript of Mason Garling, pages 108-109.
[227] *Manual on Uniform Traffic Control Devices*, Federal Highway Administration, 2009 Edition, Section 6C.04 paragraph 06, page 552.
[228] Deposition transcript of Mason Garling, pages 110-111.

change in the TCP and should have insisted on seeing the required written approval rather than merely expressing concern.[229] Specialty never insisted on such proof. Penhall also violated the Special Provisions of the contract by closing three of four lanes without the required engineer's seal of an alternate plan and ITD written approval. These failures by Penhall and Specialty represent a knowing and flagrant violation of the contract requirements, making them all responsible for the horrific crash that was caused, in part, by the lengthy traffic queue that resulted.

105. Mr. Garling testified that Bruce Kidd of Penhall instructed him to use the same three-lane closure used in the westbound lanes in 2017.[230] He testified that the plan called for a "cattle chute" that would put traffic on both sides of the Penhall work, which Penhall opposed, and that they were "discussing whether or not to do the triple-lane closure eastbound." (The TCP allowed for no such thing.) Mr. Garling testified that he and Mr. Kidd did not discuss that a three-lane closure was a violation of the contract.[231] This was not a decision for Penhall and Specialty to make unilaterally; the contract required a registered professional engineer to propose a modified TCP for ITD review and potential approval in advance of implementation. However, common sense should have told him that going from the required two lanes to one lane needed an engineer's analysis and recommendation and ITD written approval. According to Mr. Garling, he observed that traffic began to flow freely between 11:30 p.m. and midnight. Apparently, severe congestion and a long queue for an hour and a half before 11 p.m. were acceptable to Mr. Garling.

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[229] Deposition transcript of Mason Garling, page 117.
[230] Deposition transcript of Mason Garling, page 123.
[231] Deposition transcript of Mason Garling, pages 123-125.

106. On June 2, 2018, Specialty placed "a triple," with Josh Roper reporting in his diary that "Traffic was heavy but manageable." Mr. Garling, then working as a laborer under Mr. Roper's direction, testified that traffic was backed up approximately half a mile.[232] Specialty placed a similar "triple" on June 3, 2018, with Mr. Roper documenting that "traffic responds better to the double than the triples." Mr. Garling agreed with that statement.[233] Since Mr. Roper and Mr. Garling agreed that a four-lane section with two open lanes performs better than with only one open lane and both understood that the contract prohibited only one open lane in a four-lane section, it is inconceivable that they would have agreed to only one open lane. Providing two open lanes in a four-lane section was a contract requirement, but not ***just*** a contract requirement; only one open lane created a hazardous condition for motorists. Penhall and Specialty knew this before June 16, 2018, and yet they both intentionally allowed this dangerous condition to persist.

107. On June 14, 2018, three eastbound lanes of four lanes were again closed. Mr. Garling's diary reported that "traffic EB was backed up to the Locust Grove overpass due to the lane closures."[234] Mr. Garling said that the queue existed between 10:00 and 11:30 pm. He testified that about 11:30, "traffic had started to thin out and was merging nicely at the second lane closure."[235] When asked if he had considered placing a changeable message board further west to advise eastbound traffic before they reached the congestion, he responded that he didn't. He explained that they "don't typically move our devices per congestion. We keep them at their certain

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[232] Deposition transcript of Mason Garling, page 141.
[233] Deposition transcript of Mason Garling, pages 142-143.
[234] Traffic Control Maintenance Diary for June 14, 2018 prepared by Mason Garling. Specialty00347.
[235] Deposition transcript of Mason Garling, pages 152-153.

distance that they're called out on the plans".[236] That practice does not conform with the MUTCD's recommendation that the "distances should be adjusted for field conditions, if necessary, by increasing or decreasing the recommended distances."[237]

108. Certainly, the existence of a queue beyond the advance warning signs qualifies as "necessary." When asked how traffic would be informed of such congestion, Mr. Garling replied, "The only way they would have been notified, to answer your question, would be the brake lights and the congestion itself would be its own warning."[238] This kind of thinking not only violates the previous MUTCD guidance regarding adjusting warning device placement, but also the more basic MUTCD stated function of warning signs, which is: "Warning signs call attention to unexpected conditions on or adjacent to a highway, street, or private roads open to public travel and to situations that might not be readily apparent to road users. Warning signs alert road users to conditions that might call for a reduction of speed or an action in the interest of safety and efficient traffic operations."[239] Certainly, stop-and-go traffic on a freeway late at night is an "unexpected condition . . . that might not be readily apparent to road users." It ***does*** call for advance warning and a reduction of speed. It is not consistent with the standard of care to rely on "brake lights and the congestion itself. . ." to be its own warning. Such thinking exhibits an extreme deviation from the above-referenced standard.

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[236] Deposition transcript of Mason Garling, pages 154-155.
[237] MUTCD, Section 6C.04, paragraph 6, page 552.
[238] Deposition transcript of Mason Garling, page 155.
[239] MUTCD, Section 2C.01, page 103.

109. On June 15, 2018, traffic eastbound was, for the second night in a row, backed up to Locust Grove Road and was at a standstill[240], which Mr. Garling testified was about two miles.[241] He testified that he remembered being concerned "about the fact that traffic wasn't moving at all."[242] However, he did nothing to remedy this known dangerous condition.

110. On June 16, 2018, the night of the subject crash, Specialty placed another triple left closure on the four-lane freeway. Again, for the third night in a row, eastbound traffic was backed up past Locust Grove Road.[243] Mr. Garling testified that he did not have any discussions with Penhall or the ITD inspector before the crash; however, he did have a conversation with Bruce Kidd of Penhall after the crash. Mr. Kidd inquired if the traffic control was set up the same as before and what the traffic was like to which Mr. Garling replied that the set-up was the same and traffic was backed up the same as the previous two or three nights.[244]

111. Mr. Garling testified that, after the crash, Mr. Kircher had contacted Penhall "trying to get them to agree to not setting another triple. . . because we didn't want to risk it . . . We were instructed to set the triples in the first place, and after an incident like this, we did not want to continue to go against the plans."[245] Penhall and Specialty should never have closed three lanes in a four-lane section of I-84 in violation of the Special Provisions in the first place. They should not have waited until after this horrific crash to insist on following the contract. This exchange between

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[240] June 15, 2018 Traffic Control Maintenance Diary, Specialty00348.
[241] Deposition transcript of Mason Garling, pages 158-159.
[242] Deposition transcript of Mason Garling, pages 159-160.
[243] Deposition transcript of Mason Garling, pages 160-162.
[244] Deposition transcript of Mason Garling, page 163.
[245] Deposition transcript of Mason Garling, pages 168-169.

Specialty and Penhall demonstrates that both were aware of the contract requirement and that both were actively in clear and direct violation of the contract by reducing lanes beyond that approved in the project's temporary traffic control plan, without the required written modified TCP sealed by a professional engineer and ITD approval. As noted, this constitutes an extreme deviation from the recognized standard, as well as the explicit contract provisions.

112. Mr. Garling expressed concern to Mr. Kircher about traffic volume and speed on Friday and Saturday night before the crash.[246] Interestingly, his concern was not heightened by the reduction to one lane. His concern wasn't heightened by the fewer lanes, because "With traffic having fewer lanes, that gives a bigger buffer space for the workers and for us to work as well. . . So it was never an outright concern of, "oh, we're backing up traffic. I did note on the nights that it backed up to Locust Grove because that is excessive."[247] This statement demonstrates conscious disregard and a lack of concern for the safety of the motorists. A lengthy traffic queue, on a highway late at night, is a well-recognized hazard. To allow that condition to persist, even for a single night, is unconscionable. Here, it persisted and disrupted traffic for at least three nights before this horrific crash. A TCP and the manager of that plan must be concerned for the safety of both motorists and workers and act to preserve the safety of both.

JAKE LOUX (SPECIALTY)

113. Mr. Loux was the Traffic Control Supervisor who was assigned to assist the inexperienced Josh Roper and Mason Garling. In October 2017, he was involved placing traffic

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[246] Deposition transcript of Mason Garling, page 175.
[247] Deposition transcript of Mason Garling, page 176.

control devices on I-84 which reduced the number of open lanes from four lanes to one lane on more than one night.[248] On those nights traffic was slow, but never stopped.[249] On June 14, 2018, he participated in setting up the traffic control to reduce eastbound I-84 from four open lanes to one open lane.[250] He testified that Mason Garling had been instructed by "Somebody at Penhall" to do that.[251] Mr. Loux only worked the June 14, 2018 shift and didn't return to work until the Monday after the subject crash.[252] After the crash Specialty employees were instructed to be sure any changes in the TCP were documented in writing.[253]

114. When Mr. Loux returned after the June 16, 2018 crash, he reviewed the TCP to "see what we were setting up east of the incident . . ." to make sure Specialty was complying with the traffic control plan.[254] He expressed concern to Mr. Garling that the traffic control setup requested by Penhall was in violation of the approved plans. Mr. Loux testified that Mr. Garling's response was "what are our options of doing what is requested from Penhall?"[255]

DANIEL KIRCHER (SPECIALTY)

115. Mr. Kircher is the Traffic Control Administrator for Specialty. He was Mason Garling's and Josh Roper's supervisor at the time of the crash and in charge of all Traffic Control jobs for Specialty. He testified regarding implementing the TCP in place at the time of the crash

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[248] Deposition transcript of Jake Loux, pages 41-42.
[249] Deposition transcript of Jake Loux, page 46.
[250] Deposition transcript of Jake Loux, page 63.
[251] Deposition transcript of Jake Loux, pages 64-66.
[252] Deposition transcript of Jake Loux, pages 65-66
[253] Deposition transcript of Jake Loux, page 66.
[254] Deposition transcript of Jake Loux, pages 80-81.
[255] Deposition transcript of Jake Loux, page 82.

and Specialty's considerations in reducing the number of open lanes beyond that included in the approved TCP.[256] Specialty does not have engineers on staff to develop traffic control plans but instead contracts those out.[257] On previous projects with a requirement for reducing the number of lanes, Specialty called upon an engineer for the needed traffic volume and capacity analysis for a traffic control plan.[258]

116. Mr. Kircher testified that a TCP is developed so as to avoid development of dangerous traffic queues, to not have abrupt traffic speed changes through a work zone and to facilitate the smooth flow of traffic through a work area. It is important for a TCP to be implemented as designed.[259] He further testified that if a change is required in the traffic control plan, it depends on "The situation and the engineer having representation on the site and being a part of the operations on a nightly or daily basis."[260] I don't disagree with that position except where the Special Provisions for this Project specifically prohibit a change unless an alternate plan, sealed by a professional engineer, is presented and receives written ITD approval. It appears that Mr. Kircher is saying that the decision can be made by field staff even when the contract expressly requires a written proposal sealed by an engineer, 14 calendar days for ITD review and written ITD approval. Such a position is contractually prohibited, well below the standard of care as well as unsafe.

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[256] Deposition transcript of Daniel Kircher, pages 21-22.
[257] Deposition transcript of Daniel Kircher, page 28.
[258] Deposition transcript of Daniel Kircher, pages 31-36.
[259] Deposition transcript of Daniel Kircher, page 37.
[260] Deposition transcript of Daniel Kircher, pages 39-41.

117. Mr. Kircher does agree that "traffic backups in construction zones creates a risk of rear-end collisions," particularly at night.[261]

118. Mr. Kircher was aware that Penhall had instructed Specialty to reduce the roadway from four open lanes to one open lane in 2017.[262] Accordingly, Specialty was clearly aware that the contract was being violated and the approved TCP was not being followed on this Project. Mr. Kircher is unaware if there was a written proposal or approval for that reduction.[263] Mr. Kircher was also aware that Penhall was insisting on the same four-to-one open lane reduction in 2018.[264] Mr. Kircher testified that he had safety concerns about the four-to-one lane reduction. He was worried whether the traffic volume on the stretch of eastbound I-84 could handle such a reduction; nonetheless, his response was "to proceed because the State approved it," although he never received, and I have not seen any evidence of, a written ITD approval for such a dangerous change in the TCP.[265]

119. Mr. Kircher appears to be under the impression that if they follow MUTCD guidance for the traffic control devices shown in the plans at the distances provided in the MUTCD, everything is compliant. The fact that the contract requires two open lanes seems to be irrelevant to Mr. Kircher in that discussion. It is not; if congestion occurs, the MUTCD says:

120. "The distances contained in Table 6C-1 are approximate, are intended for guidance purposes only, and should be applied with engineering judgment. These distances should be

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[261] Deposition transcript of Daniel Kircher, pages 42-43.
[262] Deposition transcript of Daniel Kircher, page 58-60.
[263] Deposition transcript of Daniel Kircher, pages 59-61.
[264] Deposition of Daniel Kircher, page 64.
[265] Deposition of Daniel Kircher, pages 68-69.

adjusted for field conditions, if necessary, by increasing or decreasing the recommended distances."[266]

121. If Penhall and Specialty improperly reduce the required two lanes in the TCP to one lane in the field, the "distances should be adjusted."

122. Mr. Kircher acknowledged that "traffic backups in construction zones creates a risk of rear-end collisions. . . and that it is particularly acute at night."[267] Specialty did not take any action to correct the situation leading up to the June 16, 2018, crash and showed no concern about the safety of the motorists placed in jeopardy by a long queue developing late at night.

CAPACITY OF THE I-84 WORK ZONE ON THE NIGHT OF THE ACCIDENT

123. Traffic engineering analysis can be used to evaluate a freeway work zone and predict, for example, whether a queue will form on its approach, and if so, how long the queue will extend in advance of the work zone. The following discussion documents an analysis of the work zone on eastbound I-84 as it was configured on the night of the subject crash, i.e., with only one lane open to traffic.

Highway Capacity Principles

124. The ***capacity*** of a freeway work zone is the maximum number of vehicles that can pass through it in a fixed amount of time. By contrast, ***demand*** is the number of vehicles actually approaching the work zone in a fixed time period. Capacity and demand are expressed in units of vehicles per hour (vph).

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[266] MUTCD, Section 6C.04, paragraph 5, page 552.
[267] Deposition transcript of Daniel Kircher, page 42-43.

125. When the demand approaching a work zone is less than its capacity—for example, if the capacity of a work zone is 1000 vph and the demand is 500 vph—then acceptable traffic operations are expected. In this situation, known as ***under-capacity*** or ***undersaturated*** conditions, persistent queues are not expected to develop on the approach to the work zone.

When demand exceeds capacity—for example, if the capacity is 1000 vph and demand is 1500 vph—then poor traffic operations are expected. In these ***over-capacity*** or ***oversaturated*** conditions, the excess demand would not be able to pass through the work zone and would result in a queue on its approach.

126. A work zone where one or more lanes are closed is somewhat analogous to an hourglass, where the narrowest point of the hourglass represents the restricted-capacity portion of the work zone and grains of sand represent individual vehicles. The sand grains in the top half of an hourglass are like vehicles in a queue approaching a work zone. The number of sand grains that can pass through the bottleneck of an hourglass during a given time is limited, the same way the number of vehicles that can pass through a work zone is limited by its capacity. Excess sand must wait in the top half of the hourglass until the queue dissipates.

127. Another similarity between a work zone and an hourglass relates to the speeds of sand and vehicles: Sand passing through the bottleneck of the hourglass is moving relatively quickly compared to sand waiting in the top half of the hourglass, which is barely moving. There is a sudden increase in the speed of sand as soon as individual grains enter the bottleneck. The same principle applies to work zones. Vehicles in a queue approaching a work zone are typically traveling at slow speeds, often stop-and-go conditions, but once vehicles enter the restricted-capacity segment, their speeds increase considerably.

128. It is easy to see the entirety of an hourglass and observe all the sand at a glance. However, a work zone and its approaching queue can spread over many miles, as was the case on the night of this horrific crash. Unlike an hourglass, an observer on the ground cannot see the entirety of the work zone and its approaching queue. An observer within the restricted-capacity segment of a work zone may observe vehicles traveling at reasonable speeds and conclude that the work zone is operating acceptably. However, this observer may not be able to see the extent of the queue *approaching* the work zone. The queue is a key indicator that the work zone is over capacity. If an observer can see only the bottleneck of an hourglass, there is no way for that observer to know how much sand is stuck in the top half of the hourglass.

Highway Capacity Manual

129. It is possible to estimate the capacity of a freeway work zone using a methodology provided in the *Highway Capacity Manual* (HCM), a publication of the Transportation Research Board that is widely accepted as the state-of-the-practice resource on highway capacity. The most recent edition of the HCM is the 6th edition, published in 2016.

130. The HCM bases its estimate of a work zone's capacity on empirical studies of many other work zones. Research has shown that the capacity of a work zone depends on factors such as the number of open lanes, the width of the lanes, the lateral clearance on either side of the lanes, the grade of the roadway, and others.

131. Empirical studies have further documented that once a queue forms approaching a freeway bottleneck, the roadway can no longer operate at its full capacity. According to the HCM: "Once the breakdown takes place and queues begin to form, the flow rates discharging from the

queue at the bottleneck are generally lower than the prebreakdown capacity."[268] The HCM further notes: "Research shows an average queue discharge drop of 7% in non-work zone conditions and an average value of 13.4% in freeway work zones."[269]

132. This principle suggests that if a freeway work zone has a capacity of 1000 vph prior to the formation of a queue, its ***queue discharge capacity*** would be about 866 vph, which is 13.4 percent less than 1000 vph.

133. Highway capacity is also affected by the fraction of heavy vehicles, such as buses and tractor-trailers, in the traffic stream. Heavy vehicles accelerate and brake more slowly than passenger cars, which negatively affects capacity. To account for the presence of large vehicles, the HCM methodology converts traffic volume measures to ***passenger car equivalents***. "Passenger car equivalency (PCE) factors are used to convert heavy vehicles to passenger cars such that the capacity of a mixed flow of heavy and light vehicles is equivalent to the capacity of a traffic stream consisting entirely of passenger cars."[270] After a traffic volume is converted to passenger car equivalents, the measure is sometimes expressed in units of passenger cars per hour (pcph) rather than vehicles per hour (vph).

134. Parametrix, the designer of the I-84 work zone traffic control plan, used the HCM methodology to evaluate the capacity of the work zone. The Parametrix analysis determined a heavy-vehicle adjustment factor of 0.954, based on vehicle classification data from ITD. Worded

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[268] HCM 6th edition, p. 10-14.
[269] HCM 6th edition, p. 10-43.
[270] HCM 6th edition, p. 7-31.

another way, Parametrix estimated the I-84 volume in pcph to be about 4.6 percent above the volume in vph. Parametrix estimated the capacity of the I-84 work zone to be approximately 1450 pcph per lane.[271]

135. A performance measure often used to evaluate the effectiveness of a freeway segment is the ***density*** of traffic on the segment. Traffic density is measured in units of passenger cars per mile per lane. A freeway with very low density indicates that traffic is flowing smoothly, and drivers can mostly travel at their preferred speeds. As density increases, drivers are more frequently limited by the speeds of leading vehicles. When density reaches very high levels, it is an indication that traffic is stopped or very nearly stopped in a slow-moving queue.

136. For freeway segments, the HCM translates density into a parallel measure called ***Level of Service (LOS).*** LOS is indicated by a single letter that ranges from A through F, intended as an easily-understood indication of a freeway's performance. LOS A indicates very good freeway operations, and LOS F indicates very poor operations. Table 1, an excerpt from the HCM, indicates how density relates to LOS.

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[271] Email from Ken Colson, Parametrix, to Jason Brinkman, ITD, Sep. 5, 2018, 3:57 p.m., PARAMETRIX00001959.

Table 1: LOS Criteria for Urban and Rural Freeway Facilities

LOS	Freeway Facility Density (pc/mi/ln)	
	Urban	Rural
A	≤11	≤6
B	>11–18	>6–14
C	>18–26	>14–22
D	>26–35	>22–29
E	>35–45	>29–39
F	>45 or any component segment v_d/c ratio > 1.00	>39 or any component segment v_d/c ratio >1.00

Source: HCM 6th edition, Exhibit 10-6, p. 10-15.

Highway Capacity Software

137. Because the HCM methodology is complex, Highway Capacity Software (HCS) is available to compute the capacity and traffic operational performance of a multitude of roadway conditions, including work zones. The software is sophisticated enough to predict features such as the length of the queue (if any) approaching a work zone and the speeds of vehicles at various points within the work zone and its approaching queue. The software can also consider changes in vehicular demand over time; for instance, traffic volume approaching a work zone between 10:00 and 11:00 p.m. may be lower than between 9:00 and 10:00 p.m.

138. I engaged Lee Engineering to conduct an HCS analysis of the subject work zone on I-84. I founded Lee Engineering in 1988, and although I retired from the firm, it remains a highly-respected traffic engineering firm with offices throughout the southwestern U.S. Lee Engineering is highly qualified to conduct the HCS analysis.

139. The analysis divided eastbound I-84 into 12 individual segments based on the characteristics in place on the night of the subject crash. Table 2 provides a summary of the

segment definitions used in the HCS analysis. (The milepost designations were determined from the NTSB report.[272])

Table 2: Eastbound I-84 HCS Analysis Segments

Segment	Milepost		Distance		Lanes Open	Speed (mph)	Lanes closed	Lateral Offset (ft)	Notes
	From	To	Mi	Ft					
1			1	5280	4	75.4	None	default	75.4 mph default Base Free Flow Speed
2	45.885	46.885	1	5280	4	65	None	default	65 mph freeway to 55 MPH sign
3	46.885	47.262	0.377	1991	4	55	None	default	55 MPH sign to Merge Right Sign
4	47.262	47.451	0.189	1000	4	55	Shoulder Closed	2	Merge Right Site to Left Lane Taper (#1 Lane)
5	47.451	47.622	0.171	900	3	55	1 lane closed	6	
6	47.622	47.811	0.189	1000	3	55	1 lane closed	2	
7	47.811	47.934	0.123	650	2	55	2 lanes closed	6	
8	47.934	48.124	0.19	1000	2	55	2 lanes closed	2	
9	48.124	48.247	0.123	650	1	55	3 lanes closed	6	
10	48.247	48.398	0.151	800	1	55	3 lanes closed	2	
11	48.398	*	*	*	1	55	3 lanes closed	2	Work zone proper
12	*	*	*	*	4	75.4	None	default	Normal freeway operations following work zone

* = Milepost designation not provided in NTSB Report.

140. To further illustrate the segment definitions, Figures 1 and 2 are excerpted from the NTSB report and annotated with the segment boundaries in Table 2.

141. Specific boundaries were not used for some segments. For segment 1, a one-mile segment was assumed for analysis purposes. For segments 11 and 12, specific milepost boundaries were not provided in the NTSB report, but approximate lengths were assumed for analysis based on the available information. (The analysis results are not dependent upon the lengths of these segments.)

[272] National Transportation Safety Board Highway Factors Group Chairman's Factual Report, Figures 5 and 6, pp. 15 - 17 of 24.

142. It should be noted that the subject crash occurred at approximately milepost 47.0 in analysis segment 3.

Figure 1: HCS Analysis Segments Annotated on NTSB Report Figure 15

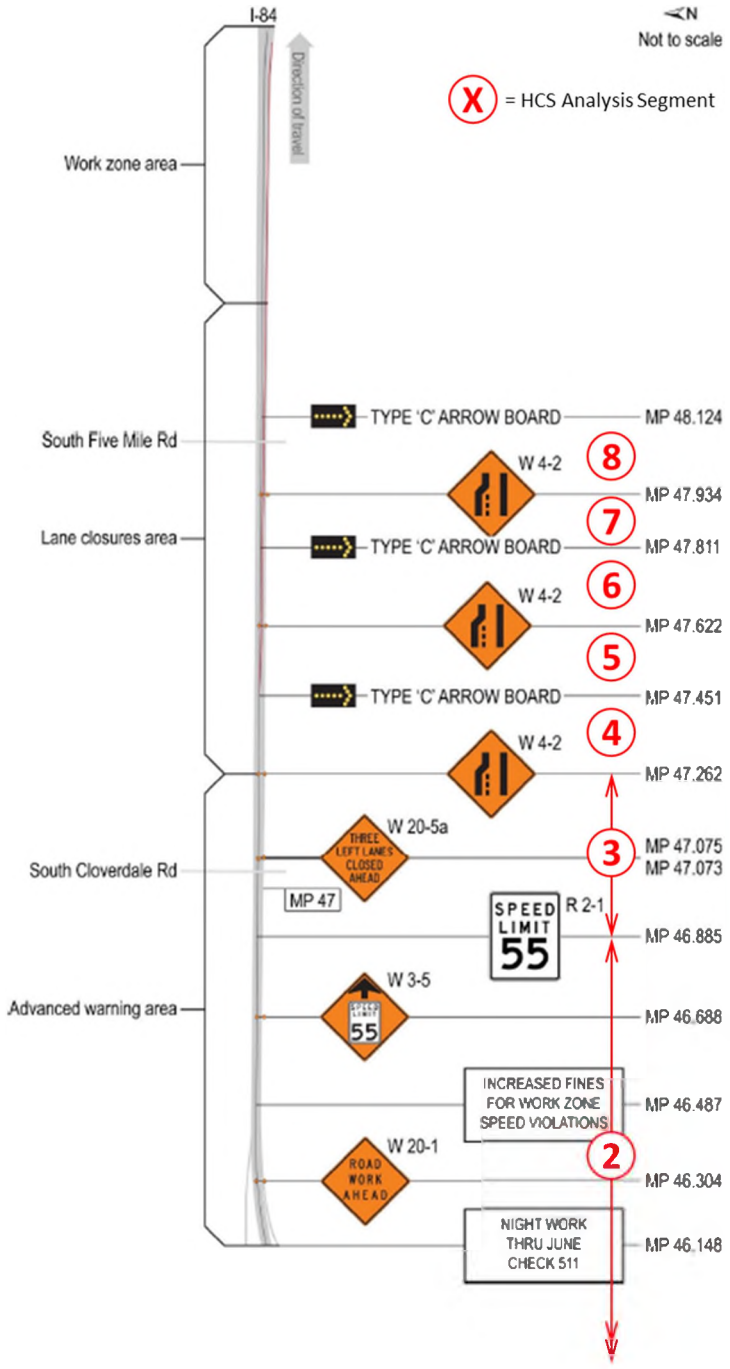
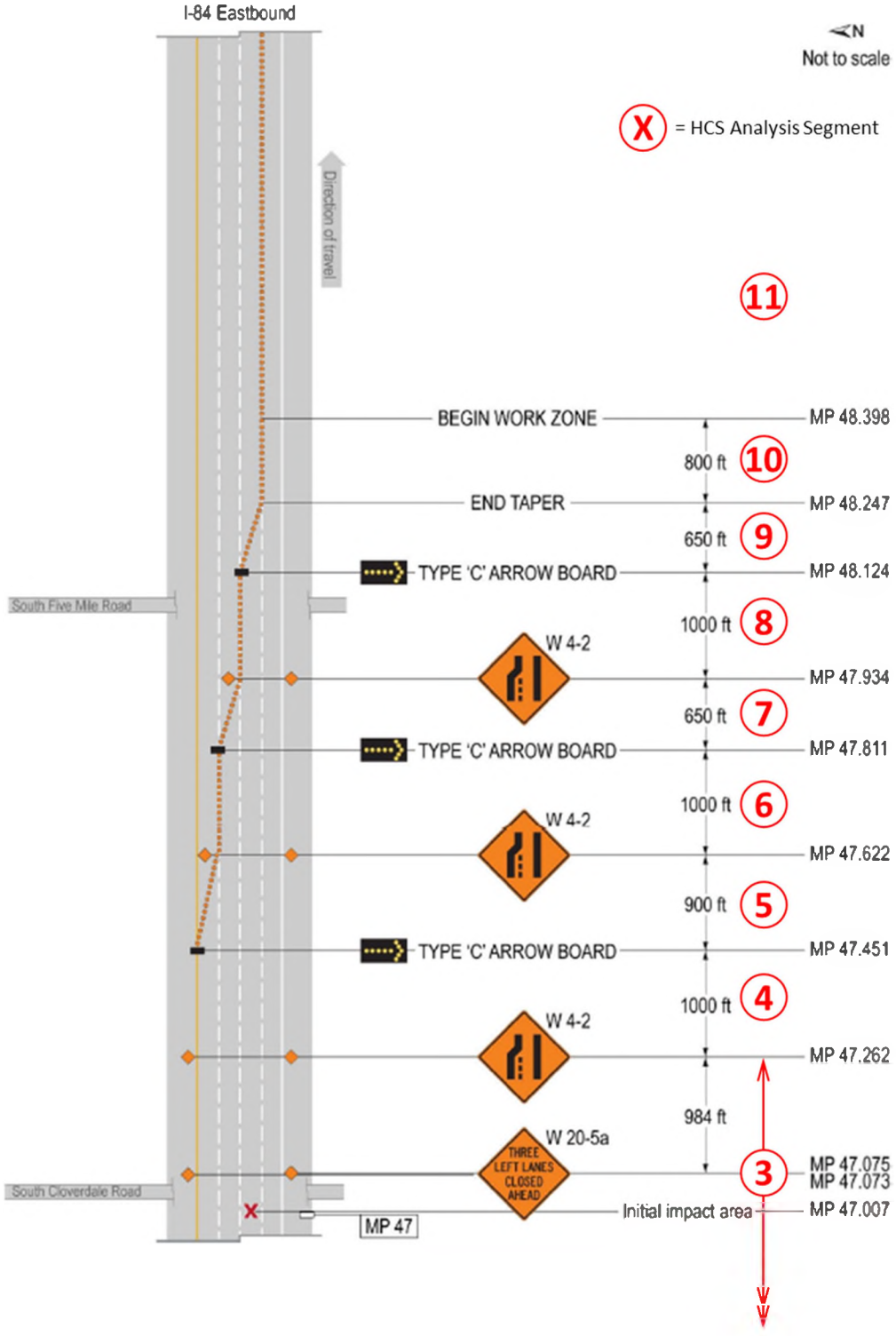


Figure 2: HCS Analysis Segments Annotated on NTSB Report Figure 16



143. The I-84 work zone's performance depends on the freeway demand on the night of the crash. ITD maintains a series of permanent traffic count stations along its state highway system. Permanent count stations continuously collect traffic volume in each direction along a roadway, and reports showing traffic volume by lane can be extracted for specific days in 15-minute (or other) time intervals.

144. Two permanent count stations are located on I-84 eastbound in the vicinity of the subject crash: Station 122 is near milepost 47.9, just west of the Five Mile Road overpass. This station is situated near the boundary between HCS analysis segments 7 and 8. On the night of the crash, this station was in a portion of the roadway with two lanes closed. Station 279 is at milepost 44.9, just west of the Locust Grove Road overpass. This station is situated prior to any lane closures or advance work zone signing on the night of the subject crash.

145. Data from both stations were produced by ITD and were reviewed for this report. Of the two count stations, Station 279 is a better representation of the demand on the night of the subject crash. Because station 122 is within a portion of the roadway where lane closures were in effect, the results from this station are impacted by the reduced capacity of the work-zone bottleneck. Station 279 is an indication of traffic demand *approaching* the work zone and its associated queue but not yet having reached either.

146. ITD provided traffic volume data at Station 279 on the night of the subject crash in 15-minute intervals by lane.[273] Six time periods were evaluated as part of the HCS analysis, starting

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[273] ATR 279 Reports, ITD004664 – ITD004752

at 10:00 p.m., when traffic control diaries indicate that all three lane closures were in place, and extending through 11:30 p.m., just prior to the subject crash. Table 3 summarizes these volumes.

Table 3: 15-Minute Traffic Volume on June 18, 2018, at Count Station 279

Time Period No.	*Start time*	*End time*	*Lane 1**	*Lane 2*	*Lane 3*	*Lane 4*	*Total*
1	10:00 p.m.	10:15 p.m.	148	137	129	61	475
2	10:15 p.m.	10:30 p.m.	139	96	106	57	398
3	10:30 p.m.	10:45 p.m.	135	104	109	34	382
4	10:45 p.m.	11:00 p.m.	121	80	84	35	320
5	11:00 p.m.	11:15 p.m.	112	73	77	23	285
6	11:15 p.m.	11:30 p.m.	106	68	62	26	262

* = Lanes are numbered from right to left across the interstate.

147. Since 15 minutes is one-fourth of an hour, the 15-minute volumes can be multiplied by 4 to determine an equivalent hourly traffic flow rate. For the 10:00 to 10:15 p.m. period, the volume of 475 vph translates to an hourly rate of 1900 vph. The hourly rate declines to 1048 vph by the 11:15 to 11:30 p.m. time period.

148. The demand volumes in Table 3 can be converted to passenger car equivalents using the same 0.954 heavy-vehicle adjustment factor computed by Parametrix in its earlier analysis. For example, the 10:00 to 10:15 p.m. flow rate of 1900 vph divided by the 0.954 factor results in a passenger-car equivalent flow rate of 1992 pcph. The flow rate drops to 1100 pcph by the 11:15 to 11:30 p.m. period.

149. Even prior to conducting any analysis using HCS, a problem is already evident. As noted earlier, Parametrix computed the capacity of the work zone as 1450 pcph, and yet vehicles were approaching the work zone at a rate of 1992 pcph starting at 10:00 p.m. It is virtually inevitable that a queue would form in these conditions, because the approaching demand significantly exceeded capacity. (During the time from 10:00 to 10:15 p.m., traffic demand exceeded the Parametrix-computed capacity by about 37 percent.)

150. While it is clear even without an HCS analysis that a queue would form, the application of HCS can quantify the length of the queue and better document the operational performance of the freeway approaching and through the work zone.

HCS Analysis Results: One Lane Open

151. The HCS analysis computed freeway performance measures for each of the 12 segments and for each of the six 15-minute time periods, a total of 72 analyses. The analyses consider the queues cumulatively. For instance, if a queue is present at the end of a time period, the same queue is assumed to be present at the beginning of the next time period, during which the queue may grow or shorten depending on the traffic demand in the subsequent period.

152. One way to illustrate the results of the analysis is to present the LOS for each roadway segment (Seg) during each time period (TP), as shown in Table 4.

Table 4: HCS Results: LOS by Segment and Time Period

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	Seg 9	Seg 10	Seg 11	Seg 12
TP 1	A	A	A	A	B	F	F	F	F	F	F	A
TP 2	A	A	A	A	F	F	F	F	F	F	F	A
TP 3	A	A	A	F	F	F	F	F	F	F	F	A
TP 4	A	A	F	F	F	F	F	F	F	D	D	A
TP 5	A	A	F	F	F	F	F	F	F	D	D	A
TP 6	A	A	A	F	F	F	F	F	F	D	D	A

153. Table 4 illustrates that at the end of the 10:00 to 10:15 p.m. period (TP 1), the freeway flows with excellent LOS A conditions in segments 1 through 4, dropping slightly in segment 5 before abruptly reaching LOS F conditions in segment 6. It should be noted that there is nothing about segment 6 per se that causes LOS conditions to occur there. Rather, the queue extending from the work-zone bottleneck in segment 11 is so long by 10:15 p.m. that the queue reaches as far upstream as segment 6.

154. In subsequent time periods, LOS F conditions occur farther and farther upstream from the work zone, reaching as far as segment 3 by 11:00 and 11:15 p.m. By 11:30 p.m., the queue has started to dissipate somewhat because the demand during the last time period has dropped below the queue discharge flow rate. However, the queue accumulated during prior periods is still present.

155. Another way to look at the HCS results is by considering the average speed on each roadway segment for each time period, as determined by the analysis and shown in Table 5.

Table 5: HCS Results: Average Speed (mph) by Segment and Time Period

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	Seg 9	Seg 10	Seg 11	Seg 12
TP 1	73.5	63.4	53.6	53.6	53.6	7.4	6.8	4.7	17.9	35.6	38.2	53.4
TP 2	73.5	63.4	53.6	53.6	2.8	2.5	4.2	4.2	17.6	35.5	38.3	53.4
TP 3	73.5	63.4	53.6	2.0	2.5	2.5	4.1	4.2	17.6	35.5	38.3	53.4
TP 4	73.5	63.4	6.5	1.8	2.5	2.5	4.2	4.2	17.7	35.5	38.3	53.4
TP 5	73.5	63.4	5.5	1.8	2.5	2.5	4.2	4.2	17.7	35.5	38.3	53.4
TP 6	73.5	63.4	53.6	1.8	2.5	2.5	4.2	4.2	17.7	35.5	38.3	53.4

156. Table 5 illustrates that the speed results follow a pattern similar to the LOS results, with high speeds ranging from 50 to 70 mph suddenly dropping to less than 10 mph at the tail of the queue. Average speeds within the queue are consistently less than 5 mph during all time periods, and these conditions persist throughout the entirety of segments 4 through 8 at the end of time period 5, when the peak queue is likely to be observed. Based on the segment lengths shown earlier, this indicates a peak queue length of at least 4,550 feet, just short of one mile. The peak queue is expected to extend upstream to approximately milepost 46.885, the upstream boundary of segment 3.

157. As noted earlier with the hourglass analogy, speeds following the last lane closure and within the work zone itself (segments 10 and 11) are relatively high—36 to 38 mph—compared with the much lower speeds in the queue on the approach to the work zone. Work zone staff observing traffic flowing at 36 to 38 mph may not have associated these reasonable speeds with the very long upstream queues.

158. By considering both the average speeds in Table 5 and the segment lengths in Table 2, it is possible to determine the amount of time required for vehicles to traverse the study area. This analysis is presented in Table 6 for peak queue conditions. The table only includes segments 1 through 10, because exact lengths are not provided for segments 11 and 12.

Table 6: Travel Time for Peak Queue Conditions (11:15 p.m.)

Segment	*Length (ft)*	*Speed (mph)*	*Travel Time (min)*
1	5280	73.5	0.8
2	5280	63.4	0.9
3	1991	5.5	4.1
4	1000	1.8	6.3
5	900	2.5	4.1
6	1000	2.5	4.5
7	650	4.2	1.8
8	1000	4.2	2.7
9	650	17.7	0.4
10	800	35.5	0.3
Total			**26.0**

159. Results indicate that during peak queue conditions, motorists are likely to spend about 26 minutes traversing segments 1 through 10, a distance of about 3.5 miles. Under normal conditions without a work zone, motorists could expect to traverse this distance in about 3 minutes, which shows that the work zone and its associated queue caused a peak delay of at least 23 minutes per vehicle, based on the known traffic demand on the night of the subject crash.

160. The HCS analysis supports field conditions that were observed on the night of the subject crash. Based on the location of the crash at about milepost 47.0, it is clear that the tail of the queue extended to this location at 11:32 p.m. The HCS analysis showed a queue extending to milepost 47.262 at 11:30 p.m. and peak queue extending to about milepost 46.885 at 11:15 p.m. These values very closely correspond to the location of the crash, which occurred at the tail of the queue that had formed on the night of the crash due to the improper lane reductions.

HCS Analysis Results: Two Lanes Open

161. For comparison with the analysis of actual conditions on the night of the crash, when the work zone was limited to one open eastbound travel lane, HCS was also used to evaluate a hypothetical case with two lanes open through the work zone. This analysis used the same segment boundaries, time periods, and other assumptions. The only change made in the hypothetical analysis was to assume that two lanes were open rather than one.

162. Tables 7 and 8 present LOS and speed results for the two-lane analysis in the same format as the one-lane analysis.

Table 7: HCS 2 Lanes Open Results: LOS by Segment and Time Period

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	Seg 9	Seg 10	Seg 11	Seg 12
TP 1	A	A	A	A	B	B	C	C	C	C	C	A
TP 2	A	A	A	A	A	A	B	B	B	B	B	A
TP 3	A	A	A	A	A	A	B	B	B	B	B	A
TP 4	A	A	A	A	A	A	B	B	B	B	B	A
TP 5	A	A	A	A	A	A	B	B	B	B	B	A
TP 6	A	A	A	A	A	A	A	A	A	A	A	A

Table 8: HCS 2 Lanes Open Results: Average Speed (mph) by Segment and Time Period

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8	Seg 9	Seg 10	Seg 11	Seg 12
TP 1	73.5	63.4	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6
TP 2	73.5	63.4	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6
TP 3	73.5	63.4	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6
TP 4	73.5	63.4	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6
TP 5	73.5	63.4	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6
TP 6	73.5	63.4	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6

163. The analysis confirms very different operating conditions with two open lanes than with one open lane. If two lanes had been open, LOS would have dropped no lower than C at any point in the work zone or on its approaches, and average speed never would have dropped below 50 mph in any time period or segment.

164. Likewise, the travel time results in Table 9 indicate that motorists could have traversed the study area in about 3.5 minutes, only a short increase in travel time compared to a night without a work zone. Furthermore, the absence of a queue would have allowed the travel time to remain relatively constant during all six study time periods.

Table 9: 2 Lanes Open EB I-84 Travel Time

Segment	*Length (ft)*	*Speed (mph)*	*Travel Time (min)*
1	5280	73.5	0.8
2	5280	63.4	0.9
3	1991	53.6	0.4
4	1000	53.6	0.2
5	900	53.6	0.2
6	1000	53.6	0.2
7	650	53.6	0.1
8	1000	53.6	0.2
9	650	53.6	0.1
10	800	53.6	0.2
Total			**3.5**

165. Conceptually, it is clear why the HCS analysis shows such a stark difference between the two conditions. With capacity of a single lane at about 1450 pcph, a second lane can approximately double the freeway's capacity to about 2900 pcph. The demand volume reaches a peak of 1992 pcph, which is well within the capacity limits of a two-lane facility.

166. This analysis clearly shows that if a second lane had remained open on the night of the subject crash, *as required*, a persistent queue would not have formed, which more probably than not would have prevented the subject crash. Had Penhall and Specialty followed the TCP,

rather than intentionally deviating from it, Lawrence Manlapit, III, and his two friends would not have died a horrible death on I-84 East that night.

SUMMARY

1. ITD retained Parametrix to develop the traffic control plans and Special Provisions for the I-84 Project. After evaluating traffic volume/capacity, Parametrix required at least two lanes on a four-lane section of I-84 to be open to traffic at all times during this Project.

2. If Penhall wanted to deviate from the approved traffic control plan, the TCP and Special Provisions (ITD00060) required that an alternate plan be submitted in writing, prepared and sealed by an Idaho professional engineer for consideration by ITD engineers. The amended plan had to be submitted to the ITD for approval at least 14 days in advance of the implementation of any intended change. Moreover, the special provisions stated provided that the existing traffic control plan must remain in place until the ITD engineers approved a proposed change to the existing plan.

3. The contract provided for a Traffic Control Manager ("TCM") to ensure that the TCP was correctly implemented. The TCM position required specific minimum qualifications and was to be provided by the contractor. The two Specialty TCMs assigned to the Project did not have the minimum qualifications. Penhall did nothing to determine whether either Specialty TCM possessed the minimum qualifications.

4. In flagrant violation of the contract requirements, Penhall and Specialty knowingly and intentionally closed three of the four lanes on I-84 in October 2017 and June 2018. The deviation was not supported by an engineer's approval and/or a traffic volume/capacity

evaluation Penhall claimed to have ITD "verbal approval" but did not have written (or indeed any) approval from an ITD *engineer* as required by the Special Provisions.

5. Because Penhall's improper deviation could not accommodate expanded capacity with only a single open lane, traffic backed up into and past the advance warning area during the June 14 to June 16, 2018, timeframe.

6. For days prior to the crash, both Penhall and Specialty were aware that their decision to violate the TCP and close three of four lanes on I-84 East was causing severe traffic backups. Both Penhall and Specialty were aware that such traffic backups on a highspeed interstate highway, late at night, created a dangerous condition and exposed motorists to the risk of rear-end collisions. Such collisions are particularly dangerous to motorists when they involve large commercial tractor/trailer combinations. The presence of such tractor trailer combinations on I-84 East during the nighttime hours was foreseeable to both Penhall and Specialty, given past historical usage of that highway segment.

7. On the nights before this tragic fatal crash, the Idaho State Police notified Penhall and Specialty of callers complaining about long queues, which extended about three miles upstream of the start of the first lane closure, although the traffic control plan's advance warning area was only 1.3 miles long. Callers also complained about traffic driving around the closed lane in the median and the lack of advance warning of the hazard. Neither Penhall nor Specialty did anything to remedy the extreme traffic hazard caused by their improper lane reduction on June 16, 2018.

8. ITD relied on the TCP which Parametrix developed. The approved TCP required two open lanes and if the plan as approved had been implemented traffic would not have backed

up on the night of the fatal crash. The plan in use on June 16, 2018, also did not conform to the MUTCD, because the longer queues extended beyond the advance warning devices.

CONCLUSIONS

Based upon the foregoing, the following conclusions are held to a reasonable degree of engineering probability:

1. Penhall knowingly and intentionally violated the TCP and Special Provisions by instructing Specialty to close three lanes of the four-lane section. The evidence shows that its upper management did not assure that the on-site managing employees (Project Superintendent and Project Manager) were adequately trained in and/or informed about the importance of compliance with the Project's approved TCP unless and until a properly designed and approved alternative had been prepared and presented to the State's Project Engineer for review and approval. This amounted to an extreme deviation from industry practice. These upper- and on-site managerial lapses directly caused an inherently dangerous, unapproved alteration to the TCP to be implemented on this Project without adequate evaluation, oversight and/or approval. This resulted in the creation of an extremely hazardous condition in the traffic lanes of eastbound I-84 for two nights before June 16, 2018, as well as on the night of the fatal crash itself. Defendants' on-site management (Project Superintendent and Project Manager) were aware of the traffic backups caused by their outrageous and reckless decision to alter the TCP, and yet did absolutely nothing to warn motorists of its existence, and/or remedy the condition that contributed to the deaths of three young airmen.

2. Specialty did not take its TCM responsibilities seriously. It knowingly and intentionally violated the TCP and Special Provisions by closing three of four lanes. The evidence shows that its upper management did not assure that the managing employees (TCM, Traffic Control Supervisor and Traffic Control Administrator) were adequately trained in and/or informed about the importance compliance with the Project's TCP unless and until a properly designed and approved alternative had been prepared and presented to the State's Project Engineer for review and approval. This also amounted to an extreme deviation from industry practice. Upper management also utterly failed to train the on-site managing employees concerning how to recognize and respond to lengthy traffic queues through construction work zones, a well-known hazard as discussed above, and thereby protect the motoring public, another extreme deviation from industry practice. These upper- and on-site managerial lapses directly caused an inherently dangerous, unapproved alteration to the TCP to be implemented without adequate evaluation, oversight and/or approval. This resulted in the creation of an extremely hazardous condition in the traffic lanes of eastbound I-84 for two nights before June 16, 2018, as well as on the night of the fatal crash itself. Defendants' management (TCM, Traffic Control Supervisor and Traffic Control Administrator) were aware of the traffic backups caused by this outrageous and reckless decision to alter the TCP, and yet did absolutely nothing to warn motorists of its existence, and/or remedy the condition that contributed to the deaths of three young airmen on the evening of June 16, 2018.

3. The actions of Penhall and Specialty's on-site managers in closing three of four lanes, rather than providing the contract-required two open lanes, and in failing to provide

adequate warning of the lane closures and resultant traffic queue were in flagrant and egregious disregard for the safety of I-84 motorists. They knew and/or should have known (with adequate training) that providing only half of the contract-required capacity would and did result in long queues and the described dangerous condition on I-84 East with its associated hazards.

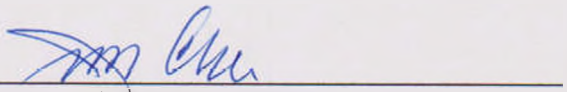
4. Because of the intentional violations of the Project's TCP and Special Provisions by the Penhall and Specialty on-site management, a dangerous lengthy traffic queue was created late at night in the eastbound lanes of I-84 in Boise on the night of this crash, and at least two nights prior thereto. This hazardous condition was caused by and known to both Penhall and Specialty prior to the crash. Although timely steps could and should have been taken to remedy this hazard that would have avoided the crash, nothing was done by either Penhall or Specialty and this horrendous fatal crash resulted.

5. The flagrant, egregious, outrageous, and conscious failure to comply with the applicable standards and the clearly explicit contract provisions on the part of Penhall and Specialty have been detailed above. It is my further opinion, based upon the facts as described herein, that the conscious failure of Penhall and Specialty to use reasonable care in training the on-site management on, and the actual implementation of, the TCP and Special Provisions, amounted to an extreme deviation from reasonable standards of conduct under the circumstances and evinces a complete disregard or indifference on the part of both Penhall and Specialty for the well-established safety principles and practices in the construction industry designed to ensure the life and/or safety of the general motoring public. Based on my review of the documents provided to me, including the depositions

referred to herein, it is my opinion that neither Penhall nor Specialty came close to meeting the industry standard of care applicable to them, and they each flagrantly and grossly violated the contract they each reviewed and agreed to honor. These deviations, under the circumstances outlined above, are so dangerous in nature as to be fairly characterized as egregious and outrageous. It is my opinion, based upon the facts as described herein, that the conscious decision on the part of Penhall and Specialty to violate the TCP and Special Provisions that created a known dangerous condition that they each allowed to persist amounted to an extreme deviation from reasonable standards of conduct and is evidence of a complete disregard for or indifference on the part of both Penhall and Specialty for well-established safety principles and practices in the industry designed to ensure the life and/or safety of the general motoring public. If Penhall and Specialty had merely exercised reasonable care in discharging their responsibilities under the subject contract and training their on-site management personnel, the traffic backup that occurred on June 16, 2018, (and the nights prior thereto) would not have been created, this horrific fatal crash would not have occurred, and three young airmen would not have died in the traffic lanes of I-84 East in the late-night hours of June 16, 2018.

I declare under penalty of perjury under the laws of the State of Idaho that the foregoing is true and correct.

Executed this 24th day of June, 2021, at Rociada, New Mexico.



Jim C. Lee, Ph.D., P.E., PTOE

EXHIBIT A

JIM C. LEE, PhD, PE, PTOE

TRAFFIC ENGINEERING LITIGATION CONSULTANTS, LLC
17692 E CHEVELON CANYON CIRCLE
RIO VERDE, AZ 85263

SUMMARY

Dr. Jim C. Lee has over 50 years of experience in the field of traffic engineering including 14 years as a public sector traffic engineer. His hands-on experience is complemented by three civil engineering degrees, with two specializing in traffic engineering. Jim retired from Lee Engineering, LLC, the firm he founded, and now exclusively provides traffic engineering litigation consulting and expert witness services.

EDUCATION

Ph.D, Civil Engineering, University of Oklahoma, 1979
M. Eng., Civil Engineering, Pennsylvania State University, 1969
B.S. Civil Engineering, University of New Mexico, 1967

REGISTRATIONS

Professional Engineer in Arizona #19418
Professional Traffic Operations Engineer: #2655

PROJECTS

Right-of-Way Litigation, Arizona Dept. of Transportation; City of Phoenix, City of Tempe
Served as litigation consultant and expert witness for ADOT and Arizona Attorney General's Office on transportation issues relating to multiple right-of-way condemnation acquisitions for freeway construction.

Traffic Engineering Expert for Traffic Accidents for State, City and County Agencies
Served as litigation consultant and expert witness for multiple agencies in Arizona relating to traffic engineering issues.

City of Scottsdale Photo Enforcement Evaluation
Project Manager on this statistical design and analysis of the safety effect of photo enforcement in Scottsdale. Scottsdale has used both red light and speed enforcement at crash-prone locations since 1996 with periods of deactivation during that time. This study evaluated the safety effects of camera activations, deactivations, and equipment removal of this photo enforcement program. A set of control locations (locations with similar geometric configuration and traffic volumes without photo enforcement cameras) were selected to account for temporal trends in the City.

City of Chandler Transportation Master Plan Update
Subconsultant project manager responsible for the Roadway Element of the Transportation Master Plan update. Reviewed 2018 and 2040 MAG travel demand model population and employment data and developed growth factors for regions of the city based on projected volumes. Developed 2040 traffic projections from a combination of 2018 traffic counts and

regional growth factors. Developed priority planning roadway segments in five-year increments between 2020 and 2040.

Alma School Road Design Concept Study
Project Manager on a traffic assessment and schematic design of Alma School Road from Chandler Boulevard to Queen Creek Road under projected 2040 AM and PM peak-hour design year volumes. Used 2019 and 2040 MAG SE data combined with 2019 traffic counts to develop 2040 projections. The corridor design is to provide a target level of service (LOS) D or better for all intersections and roadway segments. Additionally, Lee Engineering was tasked to define and prioritize three project sections (phases) based on anticipated development and assess corridor improvements that can logically be placed into each of the three improvement sections.

Strategic Transportation Safety Plan, Maricopa Association of Governments
Project Manager on the MAG STSP, which identifies trends in serious injury and fatal crashes in the MAG region and, working with the MAG Transportation Safety Committee (TSC) looks for ways to reduce those crashes. The project also identifies programs and funding resources for road safety planning and implementation. A visioning workshop with the TSC and the Transportation Safety Steering Group (TSSG) established a regional transportation safety vision statement and broad transportation safety goals for the region. Emphasis areas, potential strategies and performance measures were developed. The STSP reviewed the current MAG network screening methodology and evaluated similar methods used by states or metropolitan regions for network screening. Methods to incorporate safety in the Regional Transportation Plan was also evaluated. The STSP also developed strategies to incorporate safety enhancements in regional road infrastructure projects. Methods to improve safety via traffic operations and technology solutions were also evaluated. An implementation plan was developed identifying emphasis areas, regional initiatives and roles and responsibilities of the various agencies.

West Side Traffic Adaptive Study and Design, City of Mesa, AZ
Project Manager for a traffic adaptive signal system near Fiesta Mall. It included a Project Assessment, selection of intersections, systems engineering and design for 18 intersections. The systems engineering process was done consistent with the FHWA requirements when federal funds are used for ITS projects.

Bell Road Adaptive Signal Control Technology Systems Engineering Assistance, Maricopa County Dept. of Transportation
Project Manager for a Lee Engineering-facilitated two-day workshop of FHWA Model Systems Engineering for Adaptive Signal Control Technology in three study areas which included interactions with FHWA and participating cities, field review of intersections and gathering of controller/system details. Lee Engineering worked with the participating agencies to prepare the Concept of Operations and System Requirements for the Systems

Engineering Document. Lee Engineering also prepared a successful $2.5 million TIP application to the Maricopa Association of Governments.

Comprehensive Bicycle Master Plan, City of Phoenix, AZ

Project Manager on this project whose goal was to have a City-Council adopted 20-year Bicycle Master Plan for the City of Phoenix that will update and supplement the current "bicycling Element" of the City's General Plan. The development of the plan was guided by the City's mission to make bicycling safer, more convenient, and more comfortable so that a greater number of City of Phoenix residents and tourists have the opportunity to use a bicycle for transportation purposes. The final product is a working document that can be used for reference during transportation and transit project development as well as related items such as plat and development site plan reviews.

I-10 Phoenix Corridor Safety Study, Arizona Dept. of Transportation

Lee Engineering Project Manager on sub-consultant with Kittelson & Associates for a traffic safety planning study for I-10, from 35th Avenue (MP 141.67) to Sky Harbor Boulevard (MP 149.30). This downtown Phoenix corridor section is one of the most heavily traveled freeways in the region and state, carrying up to 280,000 vehicles per day on a typical weekday. As might be expected, this freeway section experiences a high number of crashes each year. The crash rate for the 3-year period from 2011-2013 was 3.10 crashes per million vehicle miles travelled (crashes/mvm), compared with an average rate of 1.47 crashes/mvm on other freeways throughout the region. Given these conditions, improving the safety of this section of I-10 is a priority for ADOT. The I-10 Phoenix Corridor Safety Study is an initial step in achieving this objective. This study conducted a safety performance evaluation of the I-10 Phoenix corridor section following the urban freeway safety evaluation methodologies described in the AASHTO Highway Safety Manual (HSM). A rigorous process was conducted to calibrate the HSM freeway crash prediction models to accurately reflect conditions on Phoenix area freeways. Using these calibrated models, the study quantified the safety performance of the I-10 study section relative to other freeways in the Phoenix area, identified the primary factors contributing to the high crash frequency in the section, identified opportunities for reducing crashes, and evaluated potential countermeasures to improve safety.

Road Safety Assessments (RSAs) Program, Maricopa Association of Governments

Performed RSAs that involved a formal road safety evaluation of either planned or existing roadways, conducted by an independent, multidisciplinary RSA team. The team looked for potential safety hazards that may affect any type of road user and recommended measures to mitigate those safety issues. Under Jim's guidance, Lee Engineering organized and led RSA teams that investigated the traffic and safety conditions at five intersections. Jim was Project Manager on four of these RSAs and RSA Team Leader on three.

Non-Recurring Congestion Study, Maricopa Association of Governments

Project Manager on a study to quantify the type and magnitude of non-recurring delay on freeways and arterial streets in the MAG region. The delay on arterials was measured using anonymous wireless address matching (AWAM) which identified the MAC address of a Bluetooth® device in a vehicle and re-identified it at a downstream location. When delay beyond that, which is typical, was recognized the cause of the delay (traffic accident, work zone, signal timing, etc.) was researched. Freeway delay was obtained from system detector information.

USA/AA/SWA West Belly Air Cargo Facility and East Cell Phone Lot Relocation Analysis, City of Phoenix Aviation, AZ

Project Manager for the analysis of the traffic impacts of relocating the West Belly Cargo Facility and east cell phone lot from their current locations to the northeast side of Sky Harbor International Airport. The analysis identified existing and future traffic demand of the facilities, determined if the existing infrastructure could accommodate the additional traffic demands, and recommended improvements to achieve satisfactory traffic operations. Truck movements were analyzed in AutoTURN and weaving patterns were modeled in VISSIM.

Anonymous Re-Identification Sensors to Detect Travel Time and Traffic Incidents, City of Mesa, AZ

Project Manager to conduct a Systems Engineering Analysis and design for an ITS project involving the implementation of Anonymous Re-Identification (ARID) sensors at approximately 80 intersections within the City of Mesa to automatically detect and alert traffic operations staff of a suspected crash or other unexpected incident or condition. The purpose of providing this travel time data collection system using ARID technology for the City of Mesa is to improve the ability to manage non-recurring events (e.g., crashes) and mitigate their adverse impacts.

Before-After Evaluation of Traffic Adaptive System, City of Mesa, AZ

Project Manager on a before-after study of the City's Sydney Coordinated Adaptive Traffic System (SCATS). Traffic data including volume, travel time, side-street delay was collected and compared under time-of-day and SCATS. The study was done during high season (December) and low season (July) traffic conditions. Travel time was collected using both GPS-instrumented floating car and Bluetooth® re-identification techniques.

On-Call Services for Intersection & Freeway Data Collection & Analysis, Maricopa Association of Governments

Project Manager for a project to collect intersection movement count data at selected sites throughout the Valley over an eight-week period using an innovative video data collection technique (Miovision). This study required working closely with MAG, local agencies, and other consultants in securing needed permits for installing traffic counting equipment within agency right-of-way; in conducting pre-engineering of site locations to determine any fatal flaw issues at the identified intersection locations; and the ability to quickly adjust scheduling

as a result of poor weather conditions and other conflicts. Upon collection of the required count data, intersection movement counts were verified for accuracy and submitted to MAG in a designated format.

I-10 Work Zone Contraflow Traffic Control Evaluation & Follow Up Study, Arizona Dept. of Transportation

Project Manager for a project that applied Lee Engineering's expertise in traffic operational modeling (using VISSIM) to assess the potential impacts of a proposed construction traffic control plan on I-10. The plan implemented contraflow traffic conditions on I-10 so that the I-10/Loop 202 (Santan) HOV direct-connect ramps could be constructed in a timely fashion with minimized delay imposed on I-10 traffic. This research entailed development/ refinement of a VISSIM model, incorporation of data collected, and projection of peak season operations on I-10 from Queen Creek Road to Ray Road. A follow-up study, performed per ADOT's request, confirmed the accuracy and usefulness of the traffic model.

Arterial Traffic Data Collection & Vehicle Classification, Maricopa Association of Governments

Project Manager for a project that we collected and processed arterial traffic data (volume and classification) at 122 directional roadway segment sites throughout the MAG region over a nine-week period using automatic traffic recorders. This study required working closely with MAG, local agencies, and other consultants in securing needed permits and completing the collections within the specified schedule.

Community Anchor Initiative Fiber Design, Oklahoma Dept. of Transportation

Project Manager for a statewide project for which Lee Engineering provided field and location survey, preliminary engineering, preparation of construction plans and construction inspection duties for 163 miles of fiber optic installation and communication infrastructure to connect five anchor institutions in the northwest section of the state. Lee Engineering's design and plan development were completed so that information could be incorporated into ODOT's GIS database as part of the as-built process. Lee Engineering was also responsible for providing ESRI ArcGIS compatible data in a custom ODOT telecommunications data model. Lee Engineering will now move into construction services including as-built preparation of the project.

Variable Message Sign Designs, Arizona Dept. of Transportation

Project Manager on an ADOT contract to produce the design of eight variable message signs throughout Arizona. Project duties included coordination of work with applicable utility companies and ADOT jurisdictional leaders, design and generation of plan sheets, and development of cost estimates.

Advanced Traffic Management System Design and Implementation, City of Phoenix, AZ

Project Manager for the design of a new distributed intelligence signal system for the 900 signalized intersections in Phoenix. This concept used the intelligence of NEMA TS 2

controllers with NTCIP protocol for communication. Fiber optics cable was designed for the downtown area with CCTV cameras at four strategic locations.

ITS On-Call Design, Arizona Dept. of Transportation
Project Manager on an ADOT contract to provide design and post-design services for variable message sign design at various locations of the state highway system in Arizona.

Transportation Plan Update, City of Avondale, AZ
Project Manager on the update of the City's previous 2006 Transportation Plan. Effort included addressing the various transportation topics such as existing area roadway characteristics, crash trends, transit plan development, incorporation of a previously prepared ITS strategic plan, and an updated travel demand model of the City's planning area using the TransCAD software. GIS was used to organize and present data elements.

McQueen Road Evaluation of Leading & Lagging Left-Turn Operations, City of Chandler, AZ
Project Manager for the City's trial implementation of lagging left turn operations, evaluated traffic conditions and safety characteristics of several major arterial intersections along McQueen Road.

I-10 Traffic Operations Study: SR 51 to Deck Park Tunnel, City of Phoenix, AZ
Project Manager for a traffic operations study to evaluate options to improve capacity on this section of I-10. The study included an extensive data collection and analysis including traffic volumes on the main lanes, HOV lanes and ramps plus recent traffic crash history. In order to evaluate different roadway geometry the micro-simulation model, CORSIM was used, which presents not only the animation of vehicles on the freeway, but also detailed measures of effectiveness for each alternative.

Grand Avenue at Grade Railroad Crossing Intersection, City of Phoenix, AZ
Project Manager on a project involving the City of Phoenix, ADOT, BNSF Railroad and the Arizona Corporation Commission (ACC). The City requested that Lee Engineering complete a railroad crossing safety and improvement analysis for two intersections of highway-rail crossing on Grand Avenue at the intersection of 35th Avenue/Indian School Road and at 27th Avenue/Thomas Road. The purpose of the safety study for each location was to document the status of the crash history and to identify trends in the data. The purpose of the highway/rail grade crossing improvement analysis was to model select rail preemption solutions for the intersections and document the estimated impacts to the traffic system. The study reviewed the existing data for this intersection including lane configurations, lane markings, signal controls with corresponding advisory signs, existing volumes, existing signal timings and the existing rail detection system used by the railroad. Synchro™ and VISSIM traffic simulation models were used to evaluate various alternatives including a queue cutter (R/Y/G), a flashing queue-cutter, and a crossing "median and gate" alternative. Additionally, Lee Engineering provided planning level cost estimates for each of the alternatives presented. Follow-up work included investigating the operations of the City's preferred

mitigation measure at each intersection and the effects on signal coordination.to evaluate track clearance options for the intersections of Grand Avenue at 27th Avenue and Thomas and Grand Avenue at 35th Avenue and Indian School. The project was initiated at the request of the ACC because these two intersections had a high rate of train/motor vehicle crashes. VISSIM was used to evaluate the additional delay resulting from a pre-signal and a queue cutter.

40th Street Traffic Study, City of Phoenix, AZ
Project Manager for a project to work with city staff and the local residents to develop alternatives to address traffic concerns. Data collection, results, analysis and alternative designs through the extensive use of the Synchro™ software was conducted and presented at "open-house" meetings to discuss findings. Project sought input from a citizens' advisory committee to determine acceptable alternative measures. Analysis and recommendations were presented and discussed with the technical advisory committee before final presentation to the transportation board.

Arizona State Highway System Improvement Survey, Arizona Dept. of Administration
Project Manager for the Arizona Department of Administration study mandated by Joint Legislative Budget Committee to review the state highway system and identify locations with traffic safety improvement potential. Lee Engineering received a list of 147 lane departure sites and 162 intersection locations which had fatal or serious injury crashes. Using the ALISS database we developed a weighted ranking system including crash cost per National Safety Council, Cost Index (i.e. total cost divided by number of crashes, casualty ratio (sum of fatal and incapacitating injury crashes divided by number of crashes) and frequency. The ten worst lane departure and ten worst intersection sites were further studied by obtaining police reports for those 10 locations (approximately 1500 police reports), preparing collision diagrams and visiting each site to develop potential engineering countermeasures.

ATMS Feasibility Study, Design and Timing, City of Albuquerque, NM
Project Manager on this feasibility study, developing a master communications plan, working with the City's Technical Advisory Committee, prepare functional specifications for a new ATMS to replace the City's two Multisonics VMS 330 systems in a staged manner as funds become available. The project included design of new signals, communication, dynamic message signs, bus rapid transit priority and traffic management center hardware.

Signal System Economic/Feasibility Study and Design, City of Phoenix, AZ
Project Manager for a study to recommend a central computerized signal system to replace the City's 20-year old Urban Traffic Control System. Provided functional design specifications and led the City team through the system selection process.

ATMS Feasibility Study, Mid-America Regional Council
Project Manager on Lee Engineering subcontract with BRW to develop a phased implementation plan to achieve coordinated traffic signal operation across jurisdictional

boundaries in the Kansas City area. Worked with a Technical Committee representing 15 agencies.

Corridor Safety Improvement Research, Arizona Department of Transportation
Project Principal on a project to improve roadway safety evaluation tools and prioritize improvements. Worked with a multidisciplinary team of engineers, enforcement and emergency medical professionals to identify and improve safety-related issues.

Comparative Analysis of Leading and Lagging Left Turns, Arizona Dept. of Administration and Federal Highways Administration
Principal Investigator on a research project for ADOT and FHWA to investigate the effect on progression of changing from leading left turns to lagging left turns to the combination of leading and lagging which best fits into the time-space diagram. The project also measured intersection delay of leading and lagging left turns. It also investigated changes in accident history in Tucson, Pima County and Scottsdale with leading and lagging left turns.

I-40/Stockton Hill Road Interchange Study, Arizona Dept. of Transportation
Project Manager on Lee Engineering subcontract with Sverdrup to develop short-range and long-range improvements for this interchange in Kingman. ADOT had removed the traffic signal at an adjacent, closely-spaced signalized intersection due to queue spillback and other operational issues. Lee Engineering, using PASSER II, PASSER III and CORSIM, developed a short-range plan which would permit reinstallation of the traffic signal while long-term intersection design and construction could occur. Lee Engineering also developed a recommended interchange concept design.

Mount Rainier Paradise Road Reversal Study
Analyzed traffic engineering effect of various alternatives associated with reversing the direction of travel on the historic Valley Road to Paradise, including circulation, signing and pavement marking changes required.

Traffic Impact Studies
Performed and supervised hundreds of traffic impact studies. Sites included master planned communities, large and small shopping centers, hospitals and medical clinics, residential subdivisions, and office complexes. Utilized the latest version of ITE trip generation manual. Developed trip distributions and traffic assignments to the roadway system. Performed capacity analysis, and recommended network improvements and intersection geometry modifications.

Parking Studies
Performed and supervised parking studies. Sites included large and small shopping centers, hospitals and medical clinics, and office complexes, including shared parking analysis techniques.

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Riggs Road Corridor Improvement Study
Project Principal for 20-mile corridor study. Managed in-house and two subconsultants' work. Services included traffic engineering, transportation planning, roadway design, drainage, utilities, right-of-way, environmental overview, and cultural resources analysis. Major emphasis on public meetings and coordinating work with several municipalities and other consultant study projects.

ADOT/AZTech Grand Avenue Corridor Signal System Study
Project Principal for 26-mile corridor signal system timing project through multiple jurisdictions. Developed signal phasing and timing for three groups of signals, totaling 27 signals. Reviewed feasibility of removing two sets of LT phases at six-approach intersections. Utilized Synchro™ and PROGO system optimization computer models.

Shea Boulevard Study
Project Principal on a corridor study to determine the relationship between possible future land uses and associated transportation requirements. Land use trending projected using ARC/INFO GIS. Traffic projections developed using a regional TRANPLAN model. Coordinated work with a Technical Advisory Committee and a Citizens Advisory Committee.

Traffic Impact Analysis Manual and Workshops, Arizona Dept. of Transportation
Assisted ADOT in the preparation of Traffic Impact Analysis for Proposed Development. Also conducted workshops to present manual to ADOT personnel as well as representatives of city and county governments.

Estrella Freeway, Arizona Dept. of Transportation
Project Manager responsible for route location/preliminary design study for a 37-mile freeway corridor which later was designated as Loop 303. An extensive public participation program involved coordination with numerous communities and agencies and local interest groups. The project included traffic projections, environmental assessment report, preliminary roadway design, and hydrology report.

Evaluation of Operation Efficiencies, Cost, and Accident Experience of Four-Phase Single-Point Urban Interchanges, Arizona Dept. of Transportation
Principal Investigator on this research project for ADOT comparing the safety, operations and cost of a single-point urban interchange with frontage roads with that of a tight urban diamond interchange. Data was collected at ten interchanges (five of each) using video cameras and field observations. A comparison of the operational characteristics of the two types was made. A safety evaluation, including accident reports and conflict analysis techniques, was conducted. The project included a cost analysis comparing right-of-way costs, construction costs and road user costs.

Preliminary Tolling Feasibility Study, New Mexico Dept. of Transportation

Project Manager for this project to assess preliminary tolling opportunities throughout New Mexico. The scope of work included 1) developing guidelines detailing project selection criteria and feasibility study methodology for toll projects; 2) identifying potential statewide tolling opportunities; 3) organizing structure; and 4) evaluating required legislative changes needed to implement tolling opportunities.

Traffic Safety Studies, National Park Service, US Dept. of Interior
Project Manager investigating traffic safety concerns in Death Valley, Big Bend and Mesa Verde National Parks. Traffic accident records were analyzed to determine accident patterns and recommendations to improve safety were made.

Mount Rainier Traffic Engineering Study, National Park Service, US Dept. of Interior
Project Manager for data collection and analysis for the National Park Service. The project included accident analysis and safety recommendations and the highest crash locations within the Park.

Queen Creek Road Corridor Improvement Study
Project Manager for a six-mile corridor study. Managed in-house and two subconsultants work. Included traffic engineering, transportation planning, roadway design, drainage, utilities, right-of-way, environmental overview, and cultural resources analysis. Made modifications to the MAG freeway model to reflect planned development in the study area in 2010 and 2020. Major emphasis on public meetings and coordinating work with several municipalities and other consultant study projects.

White House/Memorial Core Traffic Engineering Study, National Park Service, US Dept. of Interior
Project Manager for extensive data collection and analysis project for the National Park Service in Washington, DC. The project included recommendations in traffic operations, signing and traffic signals and a GIS-based sign inventory.

Roundabout Research, Arizona Dept. of Transportation
Principal Investigator on this research project for ADOT to evaluate the design and operations of the roundabout at I-17 and Happy Valley Road. It included an extensive data collection effort, crash analysis, conflict analysis and public opinion survey with final products of a Design and Operation Report and Design Guidelines for roundabout use.

Signal System Feasibility Study and Design, City of Lubbock, TX
Project Manager on Lee Engineering subcontract with Kimley-Horn to recommend and design a replacement system for the City's aging Urban Traffic Control System.

Signal System Feasibility Study, Town of Gilbert, AZ
Project Manager on Lee Engineering subcontract with BRW, Inc. to recommend a distributed control/centralized monitoring traffic signal system for the Town.

Signal System Feasibility Study and Design, City of Lakewood, CO
Technical Project Manager on a study and design to replace the City's current system with state-of-the-art ITS-compatible system. Developed functional Advanced Traffic Management System specifications and a procurement method which permitted creativity and innovation of the system provider rather than a traditional bid process.

Signal System Design, City of Lubbock, TX
Project Manager on a feasibility study, design, construction observation and timing for a 135 intersection computer-controlled signal system.

Comprehensive Plan, City of Plano, TX
As Project Manager, worked with city staff, an 18-member citizens' committee and two other consulting firms to prepare a new comprehensive plan for a city of 110,000 people in the Dallas metropolitan area, which is projected to be 350,000 people by 2010. Utilized the MICROTRIPS transportation planning model to test various thoroughfare plans.

Signal System Redevelopment Project, City of Scottsdale, AZ
Project Manager for retiming the City's computerized traffic signal system. This project resulted in motorists' savings of approximately $7.5 million per year.

Thoroughfare Plan, City of Hurst, TX
As Project Manager, utilized MICROTRIPS transportation planning model to develop a new major thoroughfare plan. Performed access and circulation study for regional mall.

Yellowstone National Park, National Park Service, US Dept. of Interior
Project manager on traffic safety and operations study, including recommendation of revised Old Faithful access, parking and circulation.

Johnston Street Thoroughfare Improvement Study, Lafayette, LA
Project manager in evaluation of 5-mile section of US 167 in Lafayette, Louisiana, and recommended design to accommodate projected 2007 traffic volumes.

Vermilion River Crossing Thoroughfare Study, Lafayette, LA
Project Manager of evaluation of southwest quadrant of the City of Lafayette, Louisiana Thoroughfare System. Worked with a 40 member citizens' committee to develop a recommended plan.

Lamar University, Beaumont, TX

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As Adjunct Professor taught Transportation Engineering and Civil Engineering Management for seven semesters.

AFFILIATIONS

Institute of Transportation Engineers, Fellow
Institute of Transportation Engineers Consultants Council – Past Chair
Institute of Transportation Engineers Texas Section, Past President
American Society of Civil Engineers, Fellow- Life Member
American Society of Civil Engineers Southeast Texas Branch, Past President

PUBLICATIONS

"Computerized Traffic Signal System for Amarillo, Texas," ITE Technical Notes, July 1976.

A Cost-Effectiveness Evaluation of a Digital Computerized Traffic Signal System, Ph.D. Dissertation, University of Oklahoma 1979.

"Standards Used by City Participants in Evaluating Roadway Plans: Myth and Reality," Coauthor, ITE Journal, November 1982.

"Airport Roadway Guide Signs," ITE Recommended Practice Technical Committee 5D-1, Institute of Transportation Engineers, 1988, 1991.

Comparative Analysis of Leading and Lagging Left Turns, Arizona Department of Transportation, August 1991.

"Review of Interchange Analysis Techniques: Past and Present," Paper presented to the 71st Annual Meeting of the Transportation Research Board, January 1992.

"An Operational Comparison of Leading and Lagging Left Turns," Paper presented to the 72nd Annual Meeting of the Transportation Research Board, January 1993.

"Comparison of Two Sign Inventory Data Collection Techniques for GIS," Co-Author, Paper presented to the 73rd Annual Meeting of the Transportation Research Board, January 1994.

Evaluation of Operation Efficiencies, Cost, and Accident Experience of Four Phase Single Point Urban Interchanges, Arizona Department of Transportation, March 2002

Roundabouts: An Arizona Case Study and Design Guidelines, Arizona Department of Transportation, July 2003

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Evaluation of Off-Ramp Right Turn Control at Single Point Urban Interchanges without Frontage Roads, Arizona Department of Transportation, January 2006

"Real-Time Adaptive Traffic Control System Evaluation Superstition Springs Mall Area in Mesa, Arizona", 2012 ITE Annual Meeting Compendium of Technical Papers, Institute of Transportation Engineers, Washington, DC, August 2012