Evaluating Roadway Subsurface Drainage Practices

Final Report
May 2013

IOWA STATE UNIVERSITY
Institute for Transportation

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Iowa Highway Research Board
(IHRB Project TR-643)
Iowa Department of Transportation
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The preparation of this report was financed in part through funds provided by the Iowa Department of Transportation through its "Second Revised Agreement for the Management of Research Conducted by Iowa State University for the Iowa Department of Transportation" and its amendments.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Iowa Department of Transportation.

Technical Report Documentation Page

1. Report No. IHRB Project TR-643	**2. Government Accession No.**	**3. Recipient's Catalog No.**

4. Title and Subtitle Evaluating Roadway Subsurface Drainage Practices	**5. Report Date** May 2013
	6. Performing Organization Code
7. Author(s) Halil Ceylan, Kasthurirangan Gopalakrishnan, Sunghwan Kim, and Robert F. Steffes	**8. Performing Organization Report No.** InTrans Project 12-428
9. Performing Organization Name and Address Institute for Transportation Iowa State University 2711 South Loop Drive, Suite 4700 Ames, IA 50010-8664	**10. Work Unit No. (TRAIS)**
	11. Contract or Grant No.
12. Sponsoring Organization Name and Address Iowa Highway Research Board Iowa Department of Transportation 800 Lincoln Way Ames, IA 50010	**13. Type of Report and Period Covered** Final Report
	14. Sponsoring Agency Code IHRB Project TR-643

15. Supplementary Notes

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16. Abstract

The bearing capacity and service life of a pavement is affected adversely by the presence of undrained water in the pavement layers. In cold winter climates like in Iowa, this problem is magnified further by the risk of frost damage when water is present. Therefore, well-performing subsurface drainage systems form an important aspect of pavement design by the Iowa Department of Transportation (DOT). However, controversial findings are also reported in the literature regarding the benefits of subsurface drainage.

The goal of this research was not to investigate whether subdrains are needed in Iowa pavements, but to conduct an extensive performance review of primary interstate pavement subdrains in Iowa, determine the cause of the problem if there are drains that are not functioning properly, and investigate the effect of poor subdrain performance due to improper design, construction, and maintenance on pavement surface distresses, if any.

An extensive literature review was performed covering national-level and state-level research studies mainly focusing on the effects of subsurface drainage on performance of asphalt and concrete pavements. Several studies concerning the effects of a recycled portland cement concrete (RPCC) subbase on PCC pavement drainage systems were also reviewed. A detailed forensic test plan was developed in consultation with the project technical advisory committee (TAC) for inspecting and evaluating the Iowa pavement subdrains. Field investigations were conducted on 64 selected (jointed plain concrete pavement/JPCP and hot-mix asphalt/HMA) pavement sites during the fall season of 2012 and were mainly focused on the drainage outlet conditions. Statistical analysis was conducted on the compiled data from field investigations to further investigate the effect of drainage on pavement performance.

Most Iowa subsurface drainage system outlet blockage is due to tufa, sediment, and soil. Although higher blockage rates reduce the flow rate of water inside outlet pipes, it does not always stop water flowing from inside the outlet pipe to outside the outlet pipe unless the outlet is completely blocked. Few pavement surface distresses were observed near blocked subsurface drainage outlet spots. More shoulder distresses (shoulder drop or cracking) were observed near blocked drainage outlet spots compared to open ones. Both field observations and limited performance analysis indicate that drainage outlet conditions do not have a significant effect on pavement performance. The use of RPCC subbase in PCC pavements results in tufa formation, a primary cause of drainage outlet blockage in JPCP. Several useful recommendations to potentially improve Iowa subdrain performance, which warrant detailed field investigations, were made.

17. Key Words drainage—outlet—pavement performance—pavement subdrains—recycled PCC—roadway—sediment—subdrain performance—subsurface drainage—tufa	**18. Distribution Statement** No restrictions.

19. Security Classification (of this report) Unclassified.	**20. Security Classification (of this page)** Unclassified.	**21. No. of Pages** 106	**22. Price** NA

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

EVALUATING ROADWAY SUBSURFACE DRAINAGE PRACTICES

Final Report
May 2013

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Sponsored by
the Iowa Highway Research Board
(IHRB Project TR-643)

Preparation of this report was financed in part
through funds provided by the Iowa Department of Transportation
through its Research Management Agreement with the
Institute for Transportation
(InTrans Project 12-428)

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ACKNOWLEDGMENTS

The authors would like to thank the Iowa Highway Research Board (IHRB) and the Iowa Department of Transportation (DOT) for sponsoring this research. The project technical advisory committee (TAC) members from the Iowa DOT, including Robert (Bob) Younie, Mark Dunn, Roger Boulet, Chris Brakke, Fereidoon (Ben) Behnami, Todd Hanson, Matthew Trainum, Steve Megivern, and Jason Omundson are gratefully acknowledged for their guidance, support, and direction throughout the research. The authors would also like to thank the District maintenance engineers for their timely assistance with the site selection. The efforts of Iowa State University Civil, Construction, and Environmental Engineering graduate and undergraduate researchers, Di Ma and Liang Zhong, toward the field investigations and the data organization are greatly appreciated.

EXECUTIVE SUMMARY

The bearing capacity and service life of a pavement is affected adversely by the presence of undrained water in the pavement layers. In cold winter climates like in Iowa, this problem is magnified further by the risk of frost damage when water is present. Therefore, well-performing subsurface drainage systems form an important aspect of pavement design by the Iowa Department of Transportation (DOT). However, controversial findings are also reported in the literature regarding the benefits of subsurface drainage.

The goal of this research was not to investigate whether Iowa pavements need subdrains, but to conduct an extensive performance review of primary interstate pavement subdrains in Iowa, determine the cause of the problem if there are drains that are not functioning properly, investigate the effect of poor subdrain performance due to improper design, construction, and maintenance on pavement surface distresses, if any, and make recommendations on alternatives that will improve subdrain performance.

An extensive literature review was performed covering national-level and state-level research studies mainly focusing on the effects of subsurface drainage on performance of asphalt and concrete pavements. Several studies concerning the effects of recycled concrete aggregate (RCA) or recycled portland cement concrete (RPCC) subbase on PCC pavement drainage systems were also reviewed.

A detailed forensic test plan was developed in consultation with the project technical advisory committee (TAC) for inspecting and evaluating the Iowa pavement subdrains. Field investigations were conducted on 64 selected (jointed plain concrete pavement/JPCP and hot-mix asphalt/HMA) pavement sites during the fall season of 2012 and were mainly focused on the drainage outlet conditions. Statistical analysis was conducted on the compiled data from field investigations to further investigate the effect of drainage on pavement performance.

Based on extensive literature review as well as field investigations, the conclusions and recommendations from this study are presented in terms of answers to the main questions raised by the research objectives:

Q.1. How are subdrains performing on Iowa pavements?

- Most Iowa subsurface drainage system outlet blockage is due to tufa, sediment, and soil.
- More than 80 percent of drainage outlets in JPCP were not damaged while less than 20 percent were damaged. For HMA pavements, less than 10 percent of drainage outlets were broken.
- About 35 percent of outlets in JPCP and 60 percent of outlets in HMA pavements were not blocked by any materials. About 35 percent of outlets in JPCP were blocked by tufa, about 17 percent were blocked by sediment, and about 14 percent were blocked by soil deposits. However, most of the blocked outlets in HMA pavements were blocked by soil deposits. Only 2 percent of outlets in HMA pavements were blocked by sediment.

- Higher blockage rates reduce the flow rate of water inside outlet pipes. However, higher blockage rates do not always stop water flowing from inside the outlet pipe to outside the outlet pipe unless the outlet is completely blocked (100 percent blockage).

Q.2. Are pavements in Iowa exhibiting moisture-related distress or failure that can be attributed to poor subdrain performance?

- Little pavement surface distress was observed near subsurface drainage system showing poor performance.
- Both field observations and performance analysis indicate that drainage outlet conditions do not have a significant effect on pavement performance.
- Rather than surface distresses, more shoulder distresses (shoulder drop or cracking) were observed near blocked drainage outlet spots. Among blocked drainage outlet spots, more than 10 percent have shoulder distresses while, among opened drainage outlet spots, only 2 percent have shoulder distresses.

Q.3. Is poor subdrain performance due to improper design, construction, or maintenance? Are there alternatives that will improve the performance, such as more maintenance-free outlet designs, contract maintenance, etc.?

Is the poor subdrain performance due to improper design, construction, or maintenance of pavements/subdrains?

- Use of RPCC as a subbase material results in tufa formation, which is the primary cause of drainage outlet blockage in JPCP. However, those JPCP spots that utilized blended RPCC and virgin aggregate materials (10 spots on US 151/S/MP 67.57 to MP 67.57 and 9 spots on US 151/N/MP 62.55 to MP 67.48) as subbase materials experienced fewer outlet blockages due to tufa formation.
- The use of gate/mesh screen-type rodent guards has the potential to cause outlet blockage. Considering that very little rodent evidence was observed in Iowa subdrainage outlets during field investigations, it is highly recommended that these rodent guards not be used to cover the drainage outlets in Iowa.

Are there alternatives that will improve the performance, such as more maintenance-free outlet designs, contract maintenance, etc.?

- It is expected that the use of a drain outlet protection mechanism, such as a headwall mechanism used in nearby states, will be highly helpful in protecting and improving the performance of Iowa subdrains.
- Although selective grading (to eliminate fines) or blending with virgin aggregates will reduce the precipitation potential significantly, they will not eliminate it completely.
- The potential for accumulation of fine material deposits in and around pavement drainage systems can be reduced by washing the RPCC before using it in pavement foundation layers.

INRODUCTION

Problem Statement

The bearing capacity and service life of a pavement is affected adversely by the presence of undrained water in the pavement layers. The various sources of moisture in a typical pavement structure are shown in Figure 1.

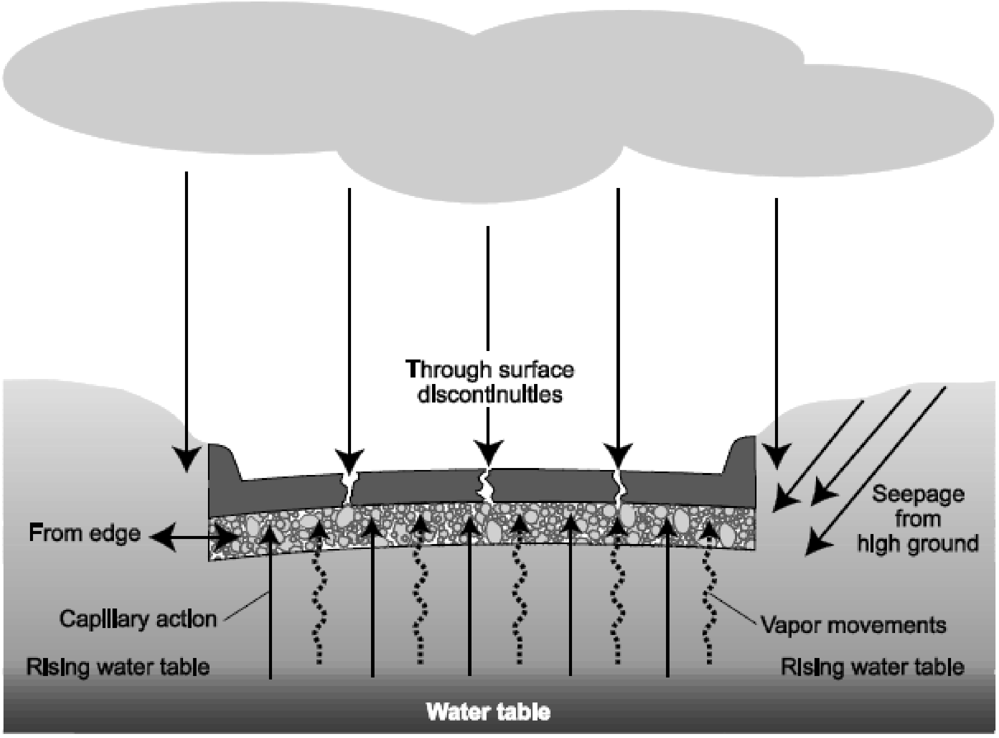


Figure 1. Various sources of moisture in pavement systems (FHWA-NHI 2004)

In cold winter climates like in Iowa, this problem is magnified further by the risk of frost damage when water is present. Therefore, well-performing subsurface drainage systems form an important aspect of pavement design by the Iowa Department of Transportation (DOT).

Previous studies have reported that properly designed, constructed, and maintained pavements that incorporate positive subsurface drainage features can greatly extend the life of a pavement. However, controversial findings are also reported in the literature regarding the benefits of subsurface drainage. For instance, the Indiana DOT (INDOT) subdrainage experience was summarized by Hassan et al. (1996) as follows:

“An improperly designed, constructed, or maintained subdrainage system can cause more problems than it solves, including pavement failure. INDOT made the decision to use drainage layers and edge drains only where those systems will be maintained; the decision was based on five recent pavement failures that were directly attributed to compromised drainage systems."

In addition, the use of recycled portland cement concrete (RPCC) as a granular subbase is a prevalent pavement construction practice by the Iowa DOT. A previous study by Steffes (1999) showed that excessive fines in RPCC can cause deposits to form on the subdrain rodent guards, blocking the outlet. Although RPCC material specifications were revised following this study to reduce the formation of these deposits and subsequent blockage, no follow-up studies have been conducted to verify the effectiveness of the revised specifications.

In light of the recent Iowa DOT field maintenance staff reductions and budget cuts, and the implications on subdrain outlet maintenance, there is a need to determine the impacts of not maintaining the subdrain outlets on pavement performance in Iowa. The goal of this research was to address the following important questions pertaining to Iowa roadway subsurface drainage practices:

- How are subdrains performing on Iowa pavements?
- Are pavements in Iowa exhibiting moisture-related distress or failure that can be attributed to poor subdrain performance?
- Is the poor subdrain performance due to improper design, construction, or maintenance?
- Are there alternatives that will improve the performance, such as more maintenance-free outlet designs, contract maintenance, etc.?

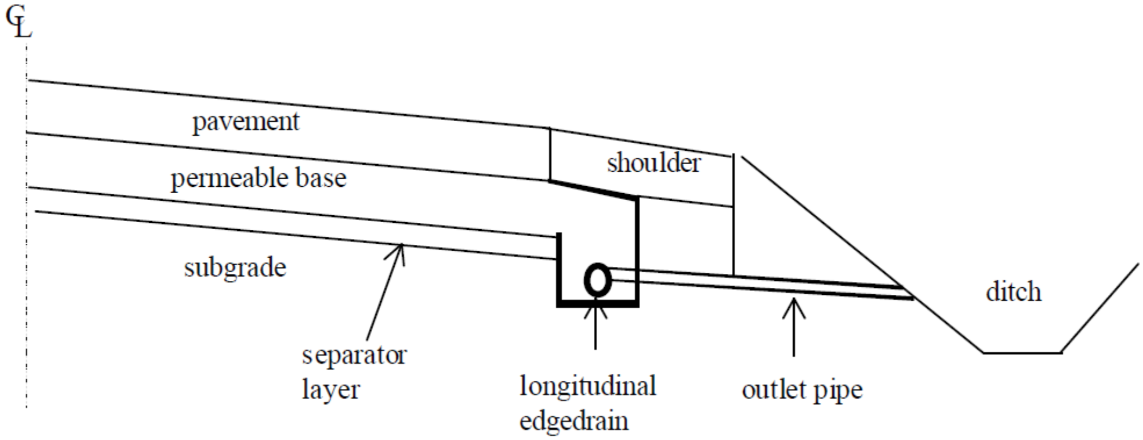
Background

The detrimental effects of water in pavement structures are known to cause and/or accelerate the following distresses:

- Asphalt concrete (AC) pavements: stripping of asphalt, rutting, fatigue cracking, separation of pavement layers, and increased roughness
- PCC pavements: pumping, faulting, fatigue cracking, D-cracking, shrinkage cracking, reactive aggregate distress, increased roughness

Iowa subgrade soils, in general, are fine-grained and have low permeability and poor drainage quality by American Association of State Highway and Transportation Officials (AASHTO) standards: less than 10 ft per day (< 5 in./hr). Iowa also receives more than 20 in. of precipitation a year and is considered a wet climate. Considering all this, lack of subsurface drainage systems in Iowa pavements can lead to potential saturation of subgrades and subbases for long periods of time (SUDAS 2010).

The presence of subsurface drainage systems (including granular bases, open-graded granular or treated layers and longitudinal edge drains and outlets) is generally believed to be beneficial to the performance of both AC and PCC pavements. Figure 2 displays components of a typical roadway subsurface drainage system.



Notes: not to scale; the drainage design used in Iowa is slightly different

Figure 2. Components of a roadway subsurface drainage system (Mallela 2000)

In Iowa, edged rain installations reached a total of nearly 3,000 miles by 1989 (Steffes et al. 1991). The Iowa DOT Design Manual (3D-3), Chapter 3: Cross-Sections – Pavement Drainage and Strength Layers, provides the following information regarding the use of drainage layers in Iowa roadways:

"The drainage layer includes a permeable granular layer and a subdrain. The drainage layer is located immediately below the pavement. The two possible granular materials are Granular Subbase and Modified Subbase. Granular subbase is typically used under PCC and Modified Subbase is used under HMA or when the base needs to be driven on during staging and/or paving… Drainage, typically with longitudinal subdrains, is mandatory with Granular Subbase and Modified Subbase, but not with Special Backfill."

The general design considerations for whether or not to include subsurface drainage systems in concrete pavements were summarized by Mallela et al. (2000):

- Site conditions
  - Subgrade permeability
  - Site freezes or not?
  - Pavement section is at grade or a cut section?
- Traffic conditions
  - High traffic loads have the greatest need for subsurface drainage
- Design conditions

Past experience, anticipated paving quality, and the cost implications of including drainage are some other factors recommended for considering drainage feasibility (Mallela et al. 2000). However, the previous studies reported in the literature do not demonstrate the benefits of subsurface drainage systems conclusively on pavement performance, as summarized in the National Cooperative Highway Research Program (NCHRP) Mechanistic-Empirical Pavement Design Guide (MEPDG) (NCHRP 2004): "The current state of the art is such that conclusive remarks regarding the effectiveness of pavement subsurface drainage or the need for subsurface drainage are not possible."

The NCHRP Synthesis of Highway Practice 239: Pavement Subsurface Drainage Systems (TRB 1997) identified maintenance as one of the most important factors in realizing the benefits of drainage in maintaining or even extending the design life of a road. As an extension of NCHRP Synthesis 239, the NCHRP Synthesis of Highway Practice 285: Maintenance of Highway Edgedrains (TRB 2000) described the state of the practice for the maintenance of highway edged rain systems (i.e., outlet, headwall, connection, longitudinal/mainline pipe) and procedures to reduce and facilitate the maintenance of edge drains. The significant conclusions from both NCHRP Synthesis 239 and Synthesis 285 are reproduced verbatim below for clarity (TRB 1997, TRB 2000):

- "Pavement subsurface drainage is a major factor in extending the life of a pavement.
- Although performance indicators to qualify the benefits of pavement subsurface drainage systems have not been established, use of a permeable base with a free-draining outlet system generally has demonstrated the best performance of all subsurface drainage strategies.
- The cost of pavement drainage systems is high in terms of materials, construction, and maintenance, but the extended pavement life anticipated appears to make these systems cost-effective.
- There is a significant cost in terms of poor performing pavements to agencies that use edge drains and do not have an effective preventive maintenance program.
- A plugged subsurface drainage system may be worse than having no drainage system at all because the pavement system becomes permanently saturated.
- Edge drain failures have occurred where the water could not get out of the base fast enough (e.g., no pipe outlets, plugged outlets, crushed outlets, clogged filters, or clogged drains). Many drainage system failures are traced to poor construction and inspection.
- There is an apparent disconnect between maintenance, design, and construction in many state agencies."

Another related Federal Highway Administration (FHWA) study (HR-317) documented the results of 287 video inspections of highway edged rain systems in 29 states (not including Iowa) and reported that only one-third of the inspected edge drain systems were found to be performing as intended. One-third of the inspected systems had non-functional outlets and another one-third had non-functional mainlines or the mainlines could not be inspected due to physical obstructions (Daleiden 1999). The report also presented a Draft Guide for Video Edgedrain Inspection and Acceptance.

In general, the following reasons have been attributed as to why drained pavements do not perform consistently better than undrained pavements and why many state highway agencies (SHAs) are not so enthusiastic about subsurface pavement drainage (Hall and Crovetti 2007):

- Inadequate design
- Improper construction

- Inadequate maintenance
- Usage in locations where they are not needed (e.g., places with low amounts of rainfall)
- Usage in pavements where they are not needed
- Concerns about construction difficulties
- Need to conduct frequent maintenance of edge drains
- Scant evidence of performance benefits that justify the installation and maintenance costs

As mentioned previously, there is a need to determine the impacts of not maintaining the subdrain outlets on pavement performance in Iowa in light of the recent Iowa DOT field maintenance staff reductions and budget cuts and the implications on subdrain outlet maintenance.

Objectives and Scope

The specific objectives of this project were as follows:

- Conduct an extensive performance review of primary interstate pavement subdrains in Iowa
- Include the condition of the drains and a determination of whether they are functioning as designed
- Evaluate a corresponding pavement to determine if pavement deterioration is occurring at the drain locations
- Determine the cause of the problem if there are drains that are not functioning properly
- Make recommendations for improvements to the pavement drainage system, when appropriate

It is important to note that this research project was not intended to investigate whether or not Iowa pavements need subdrains, but to evaluate the subsurface drainage practices in Iowa.

The project team met with the Iowa DOT engineers even before the research began to understand the specific research needs relevant to this project. According to the Iowa DOT Office of Maintenance, there is an important need to research the impact of not maintaining the pavement subdrainage outlets on pavement performance in Iowa using state-of-the-art and state-of-the-practice evaluation methods adopted by nearby states. While the goal is to move toward maintenance-free outlet designs eventually, the Office of Maintenance is also interested in receiving recommendations related to improved construction practices and outlet design based on the research outcomes. The edged rain outlet failure is one of the primary concerns of the Office of Maintenance and whether or not it has a significant impact on pavement performance is a big question that needs to be answered through this research.

According to the Iowa DOT Office of Soils Design, the subdrains in Iowa have been performing well in general with some exceptions. There are a multitude of circumstances (soil regime, new or retrofits, etc.), which can govern the subdrain performance and its impact on pavement performance. For instance, the presence of subdrains has sometimes helped to correct faulting problems in PCC pavements whereas, in other cases, it has not. In addition, even if the edge drains are crushed by construction mowers, the water can still find a way to drain out through the backfill material. However, the general experience has been that subdrains tend to prolong the service life of the pavement and it is wise to include it in new projects. Although the Office of Soils Design is also interested in moving towards maintenance-free design, it is interested in cost-effective, feasible solutions such as the use of headwall as a protection against the construction equipment, etc.

The Iowa DOT Office of Pavement Design is mainly interested in evaluating the subsurface drainage performance and practices in Interstate highways and primary roads. A large portion of Iowa Interstate and primary roads are either PCC (especially the new ones) or composite pavements. It has been observed that if the pavement is already experiencing some form of distress due to other factors, the lack of drains or non-functional drains tend to accelerate the problem in terms of freeze/thaw durability, PCC joint problems, etc. Tufa formation or calcium carbonate deposits (when recycled PCC is used as a subbase), vegetation formation, and forming of deposits/silts are some major causes of blockage of subdrain outlets. Most often, a solution as simple as shoveling near the outlets will remove some of the major obstacles. However, in other cases, issues like topology, soil type, etc. complicate the drainage issues.

LITERATURE REVIEW

National-Level Research Studies

NCHRP Project 1-34: Performance of Subsurface Pavement Drainage

This was one of the first national-level extensive studies undertaken to evaluate the overall effect of subsurface drainage of surface infiltration water on the performance of flexible (AC) and rigid (PCC) pavements as well as the specific effectiveness of permeable base and associated edge drains, traditional dense-graded bases with and without edge drains and retrofitted surface drainage on existing pavements (Hall 2002). Based on an extensive body of field data obtained through 1998, the following key questions were addressed through this research:

- Do the various subsurface drainage design features contribute to improved flexible and rigid pavement performance?
- Are the subsurface drainage design features cost-effective, and under what conditions?

The research was carried out in three phases with the first phase focusing on an extensive literature survey and documentation of state drainage practices while the second phase utilized the field performance database to compare the performance of all drained and non-drained sections at a given location. The final phase analyzed all the performance data using the mechanistic-empirical pavement performance prediction models, which were under development at that time through NCHRP Project 1-37A (NCHRP 2004). These research efforts were followed by life-cycle cost analyses to illustrate the relative cost-effectiveness of various subsurface drainage features. The performance data were limited to visual distress survey results, examination of the existing under-drain outlets, and some deflection data for 91 pavement sections at 22 project sites in 10 US states and the province of Ontario (Hall 2002).

Based on the previous studies on the impact of subsurface drainage, performance comparisons between drained and non-drained experimental sections included in NCHRP Project 1-34, and distress predictions from mechanistic-empirical models, several findings were drawn of which the important or controversial ones are noted here:

- The addition of edge drains in conventional AC pavement with an unbound aggregate base appears to reduce fatigue cracking, but not rutting.
- Compared with unbound dense-aggregate bases, asphalt-stabilized permeable bases were effective in reducing rutting.
- Better fatigue performance was noted for AC pavements with day lighted permeable base sections (without edge drains) than all other types of evaluated AC pavements.
- The effect of clogged edged rain outlets on the performance of flexible pavements with a permeable base is detrimental leading to increased fatigue cracking and rutting.
- Although a permeable base has a significant effect in reducing joint faulting for non-doweled JPCP, it has a relatively small effect on reducing joint faulting for properly designed, doweled JPCP.

- Concrete slabs with permeable bases appear to be effective in reducing D-cracking significantly, possibly because they are less saturated than slabs with dense-graded bases, resulting in a lower amount of freeze-thaw during saturation.
- Based on the limited data obtained under this study to evaluate retrofitted edge drains, it could not be concluded if they had a truly positive effect.
- In terms of cost-effectiveness of subsurface drainage features for flexible and rigid pavements, the limited study conducted under NCHRP Project 1-34 indicated that the occurrence of rutting and fatigue cracking in flexible pavements and non-doweled joint faulting in JPCP may be decreased with the proper design and construction of subsurface drainage features, thus increasing the initial lives of pavements and delaying rehabilitation activities.
- Depending on the design situation and local conditions, permeable bases (or edge drains by themselves) could potentially increase the pavement service life and thus may be cost-effective.
- The overall findings from the life-cycle cost analyses indicated that there exist certain design features (e.g., widened lane with a dens-graded base for JPCP and thicker-layers of asphalt-bound aggregates and full-width paving) that can outweigh positive subsurface drainage features in terms of cost-effectiveness in reducing the effects of excess free water in the pavement structure.

The benefits of subsurface drainage must be considered along with the potential of design-, construction-, or maintenance-related problems associated with it. Although the life-cycle cost analysis conducted in NCHRP Project 1-34 did not consider this, some previous studies shed light on this issue. For instance, the positive effect of the drainage feature may become negated if the subsurface drainage system fails to function properly over the pavement service life. In addition, if the maintenance of edge drains or day lighted sections is neglected, it could lead to rapid pavement failure (Christopher 2000).

While they merit consideration by highway agencies seeking to improve the design, construction, and maintenance activities, the findings of NCHRP Project 1-34 were limited by a number of conditions including small sample size, the young age of the majority of the test sections considered in the analysis, and lack of data regarding the functional condition of the subsurface drainage systems (because the project resources did not permit coring, trenching, detailed pavement evaluation, or video inspection of edge drains). To evaluate the "unexpected findings" reported by NCHRP Project 1-34 further, the NCHRP panel established subsequent projects 1-34B, 1-34C, and 1-34D, which are summarized briefly here.

NCHRP Project 1-34B: Effectiveness of Subsurface Drainage for HMA and PCC Pavements

As noted previously, the NCHRP Project 1-34 included relatively small samples of HMA and PCC pavement sections with subsurface drainage features and only those for which control sections were available for comparison. For instance, the Long-Term Pavement Performance (LTPP) SPS-1 (flexible) and SPS-2 (rigid) experimental pavement sections were not included in the analysis because they were not of sufficient age at that time.

The NCHRP panel concluded that the unexpected findings from project 1-34 might have been influenced at least partially by the operational performance of different subsurface drainage features rather than their inherent design limitations. Consequently, following the completion of NCHRP Project 1-34, NCHRP Project 1-34B was undertaken to review the final report and supporting information developed in Project 1-34 critically as well as to develop a detailed experimental test plan to evaluate and test key findings from that report through condition studies of subsurface drainage features in selected HMA and PCC pavement sections. The NCHRP Project 1-34B was completed in 1999 and the selected portions of the unpublished final report from both projects, 1-34 and 1-34B, were published in the NCHRP Research Results Digest No. 268 (Hall 2002).

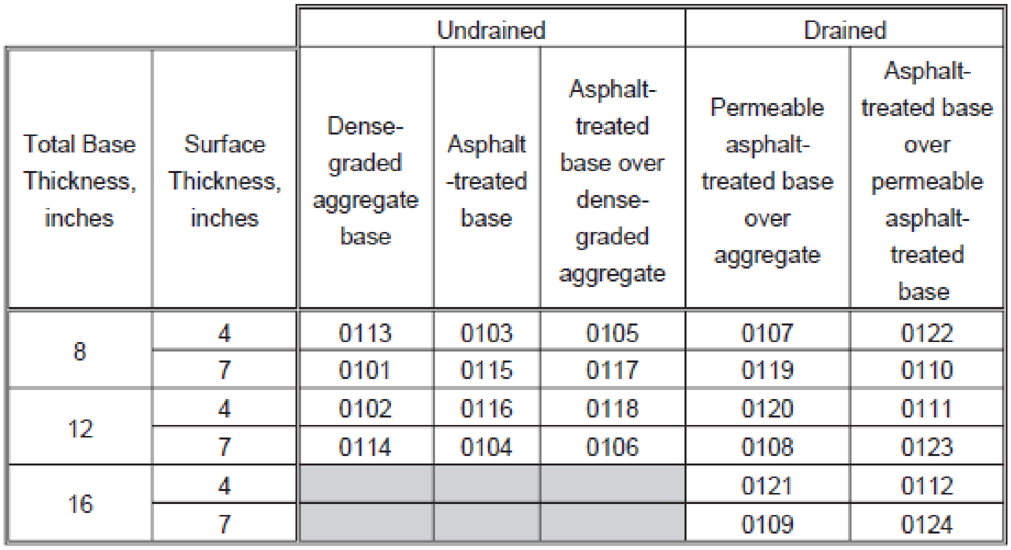
NCHRP Project 1-34C: Effects of Subsurface Drainage on Performance of Asphalt and Concrete Pavements

The main goal of NCHRP Project 1-34C was to carry out the experimental plan developed under Project 1-34B to address the following questions:

- How feasible is it use the data collected in the LTPP SPS-1 and SPS-2 experiments to evaluate the effects of subsurface drainage on asphalt and concrete pavement performance?
- Are there recommendations on additional field data collection to supplement the existing data from LTPP SPS-1 and SPS-2 experiments to fully address the first question?

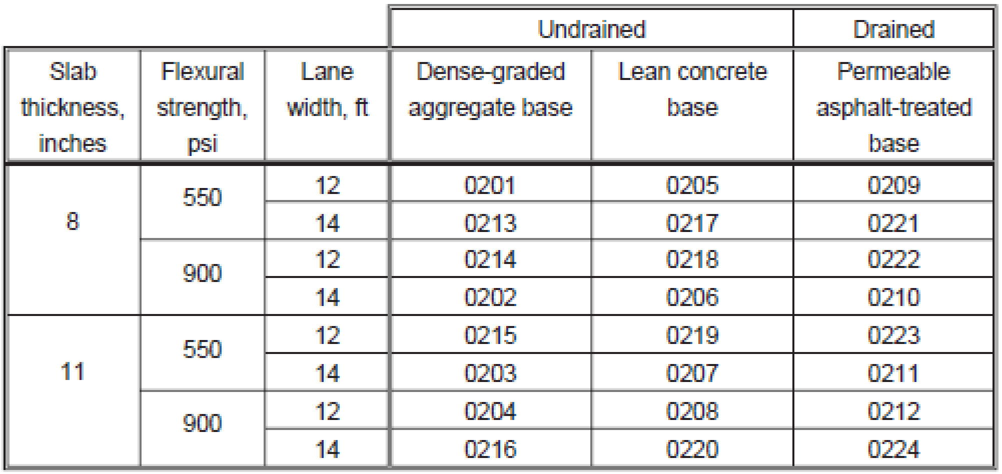
A detailed plan was developed to quantify the effects of subsurface drainage on pavement performance based on statistical analyses of LTPP SPS-1 and SPS-2 data and the extensive results and findings were published as NCHRP Report 499 (Hall and Correa 2003). Apart from the data from the LTPP SPS-1 and SPS-2 experiments, the findings from the video inspection of edge drains at the SPS-1 and SPS-2 sites conducted during the course of the project to determine their functionality were also included in the analysis.

Note that the SPS-1 experiment (Strategic Study of Structural Factors for Flexible Pavements) was originally designed to assess the influence of subdrainage as well as several other factors, including asphalt core thickness, base type, base thickness, climate, subgrade, and truck traffic level, on AC pavement performance. Similarly, the SPS-2 experiment was designed to assess the influence of concrete thickness, concrete flexural strength, base type, lane width, climate, subgrade, truck traffic level, as well as subdrainage on jointed concrete pavement performance. The design factorials for the SPS-1 and SPS-2 experiments are shown in Figure 3 in terms of undrained and drained sections. These include AC test sections (SPS-1) from Lee County near Burlington, Iowa on US 61 (latitude: 40.42, longitude: 91.25) and PCC test sections (SPS-2) from Polk County near Des Moines, Iowa on US 65 (latitude: 41.65, longitude: 93.47).



		Undrained			Drained	
Total Base Thickness, inches	Surface Thickness, inches	Dense-graded aggregate base	Asphalt-treated base	Asphalt-treated base over dense-graded aggregate	Permeable asphalt-treated base over aggregate	Asphalt-treated base over permeable asphalt-treated base
8	4	0113	0103	0105	0107	0122
	7	0101	0115	0117	0119	0110
12	4	0102	0116	0118	0120	0111
	7	0114	0104	0106	0108	0123
16	4				0121	0112
	7				0109	0124

(a)



			Undrained		Drained
Slab thickness, inches	Flexural strength, psi	Lane width, ft	Dense-graded aggregate base	Lean concrete base	Permeable asphalt-treated base
8	550	12	0201	0205	0209
		14	0213	0217	0221
	900	12	0214	0218	0222
		14	0202	0206	0210
11	550	12	0215	0219	0223
		14	0203	0207	0211
	900	12	0204	0208	0212
		14	0216	0220	0224

(b)

Figure 3. Test sections considered in NCHRP Project 1-34C: (a) SPS-1 design factorial and (b) SPS-2 design factorial (Hall and Correa 2003)

The statistical analyses focused on determining whether or not the mean difference between undrained and drained test section pairs was significant with respect to flexible and rigid pavement performance indicators and the following significant conclusions were drawn (Hall and Correa 2003):

- In terms of flexible pavement International Roughness Index (IRI) and cracking, pavement sections with undrained dense-aggregate bases performed more poorly than sections with drained permeable asphalt-treated bases. Flexible pavement sections with undrained dense-graded asphalt-treated bases showed better performance (in terms of IRI and cracking) than sections with drained permeable asphalt-treated bases.
- The comparisons were inconclusive for flexible pavement rutting performance in all cases.
- In terms of rigid pavement IRI, transverse cracking, and longitudinal cracking, pavement

sections with undrained dense-graded aggregate bases showed poorer performance than sections with drained permeable asphalt-treated bases.
- Rigid pavement sections with undrained lean concrete bases showed poorer performance (in terms of IRI, transverse cracking, and longitudinal cracking) than sections with drained permeable asphalt-treated bases.
- No consistent trends were observed with respect to rigid pavement faulting given that the faulting magnitudes were so low, precluding the possibility of any analysis.

NCHRP Project 1-34D: Effects of Subsurface Drainage on Performance of Asphalt and Concrete Pavements - Further Evaluation and Analysis of LTPP SPS-1 and SPS-2 Field Sections

In an effort to better define the effect of subsurface drainage on pavement performance following Project 1-34C, NCHRP Project 1-34D was undertaken with the following specific objectives: quantitatively test the functionality of the subsurface drainage features in the LTPP SPS-1 and SPS-2 pavement sections and refine the relationships between subsurface drainage and pavement performance that were developed originally through projects 1-34 and 1-34C. The final report documenting the entire research effort was published as NCHRP Report 583 (Hall and Crovetti 2007).

NCHRP Project 1-34D made use of the more recent performance data from LTPP Data Release 19.0 (January 2005), analysis of FWD deflection data to assess the relative structural contributions of different base types, and subdrainage system flow time measurements to assess how well the subsurface drainage systems function. In addition, data from the Minnesota Road (MnRoad) Research Project and Wisconsin DOT (WisDOT) drainage studies were included in the analysis. The field testing procedure for determining the flow rate of water through the subsurface drainage systems in the SPS-1 and SPS-2 sites involved locating and clearing the outlets, measuring longitudinal grade, and coring to the top of the permeable base layer, measuring inflow and outflow with the flow meter (see Figure 4), and patching the core hole.

Regression analysis was employed to address the larger question of “how much does the base/subbase drainage factor of the SPS-1 and SPS-2 experimental designs influence performance compared with other experimental factors and site features?” The regression models used to assess the significance of subdrainage and other experimental factors to the development of pavement roughness distress are shown in Figure 5 (left) for SPS-1 (flexible) and in Figure 5 (right) for SPS-2 (rigid) test sections.

The overall conclusion from NCHRP Project 1-34D seemed to indicate that the presence of subsurface pavement drainage did not improve the performance of AC (LTPP SPS-1) and PCC (LTPP SPS-2) pavement structures. It is not the drainability of the base layers, but the stiffness, which, according to the authors, influenced deflection response, roughness, rutting, faulting, and cracking. However, the authors do recommend considering the need for a subsurface drainage system at sites with wet climates and poorly draining soils, particularly for pavement designs that are more vulnerable to moisture-related distress such as thin asphalt and thin concrete pavements on untreated aggregate base layers.

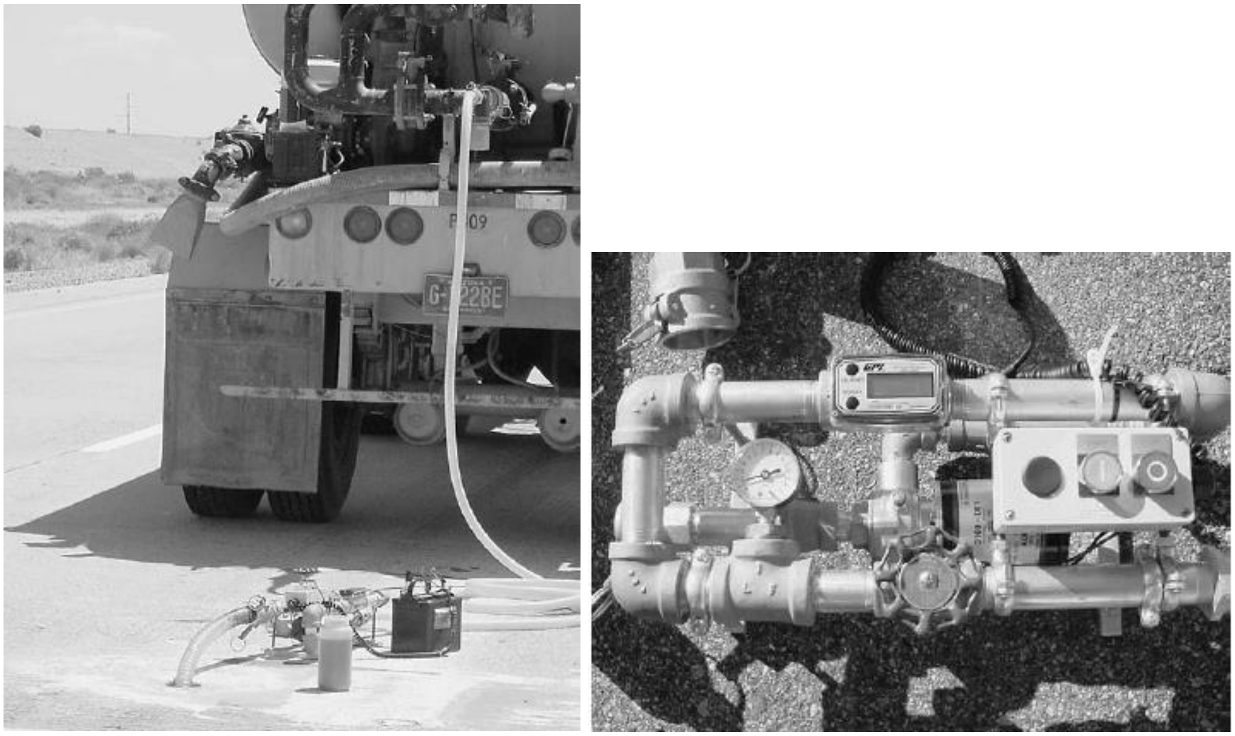
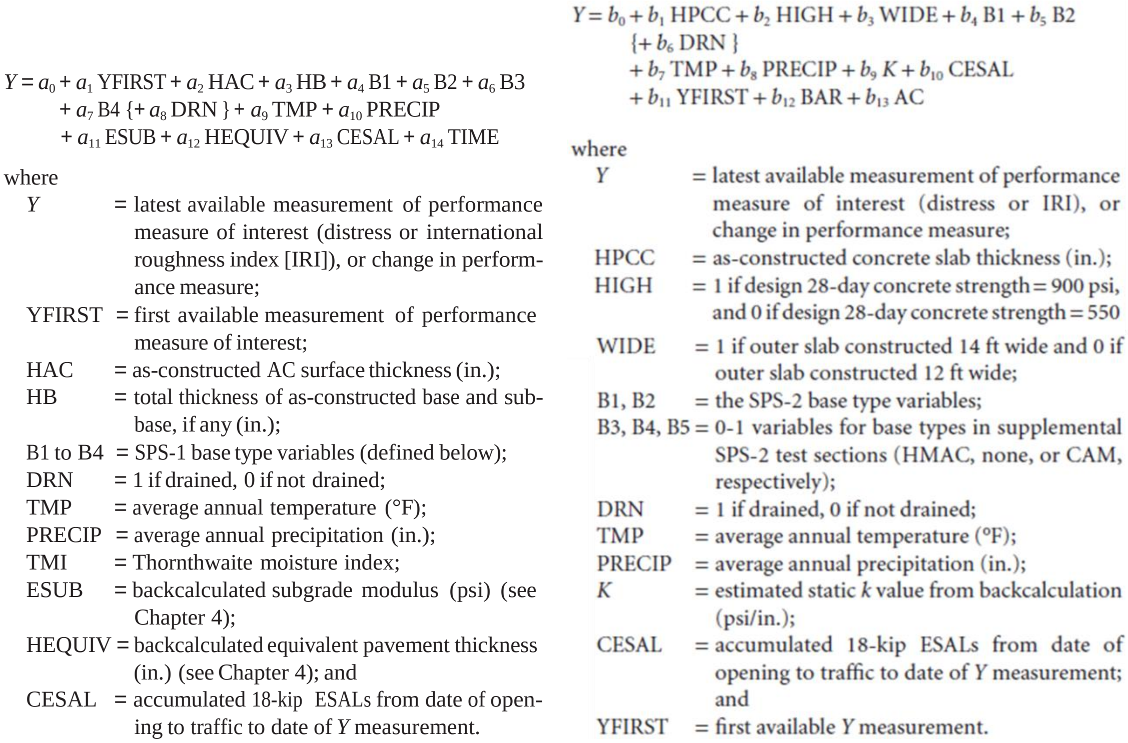


Figure 4. Equipment for determining the flow rate of water through the subsurface drainage systems in the SPS-1 and SPS-2 sites (Hall and Crovetti 2007)



$$Y = a_0 + a_1\,\text{YFIRST} + a_2\,\text{HAC} + a_3\,\text{HB} + a_4\,\text{B1} + a_5\,\text{B2} + a_6\,\text{B3} + a_7\,\text{B4}\ \{+\ a_8\,\text{DRN}\ \} + a_9\,\text{TMP} + a_{10}\,\text{PRECIP} + a_{11}\,\text{ESUB} + a_{12}\,\text{HEQUIV} + a_{13}\,\text{CESAL} + a_{14}\,\text{TIME}$$

where
Y = latest available measurement of performance measure of interest (distress or international roughness index [IRI]), or change in performance measure;
YFIRST = first available measurement of performance measure of interest;
HAC = as-constructed AC surface thickness (in.);
HB = total thickness of as-constructed base and subbase, if any (in.);
B1 to B4 = SPS-1 base type variables (defined below);
DRN = 1 if drained, 0 if not drained;
TMP = average annual temperature (°F);
PRECIP = average annual precipitation (in.);
TMI = Thornthwaite moisture index;
ESUB = backcalculated subgrade modulus (psi) (see Chapter 4);
HEQUIV = backcalculated equivalent pavement thickness (in.) (see Chapter 4); and
CESAL = accumulated 18-kip ESALs from date of opening to traffic to date of Y measurement.

$$Y = b_0 + b_1\,\text{HPCC} + b_2\,\text{HIGH} + b_3\,\text{WIDE} + b_4\,\text{B1} + b_5\,\text{B2}\ \{+\ b_6\,\text{DRN}\ \} + b_7\,\text{TMP} + b_8\,\text{PRECIP} + b_9\,K + b_{10}\,\text{CESAL} + b_{11}\,\text{YFIRST} + b_{12}\,\text{BAR} + b_{13}\,\text{AC}$$

where
Y = latest available measurement of performance measure of interest (distress or IRI), or change in performance measure;
HPCC = as-constructed concrete slab thickness (in.);
HIGH = 1 if design 28-day concrete strength = 900 psi, and 0 if design 28-day concrete strength = 550
WIDE = 1 if outer slab constructed 14 ft wide and 0 if outer slab constructed 12 ft wide;
B1, B2 = the SPS-2 base type variables;
B3, B4, B5 = 0-1 variables for base types in supplemental SPS-2 test sections (HMAC, none, or CAM, respectively);
DRN = 1 if drained, 0 if not drained;
TMP = average annual temperature (°F);
PRECIP = average annual precipitation (in.);
K = estimated static k value from backcalculation (psi/in.);
CESAL = accumulated 18-kip ESALs from date of opening to traffic to date of Y measurement; and
YFIRST = first available Y measurement.

Figure 5. Regression models capturing the effect of site-specific experimental factors (including subsurface drainage) on flexible (left) and rigid (right) pavement performance (Hall and Crovetti 2007)

State-Level Research Studies

Indiana

Hassan et al. (1996) covered the most recent applications of pavement subdrainage in Indiana. They focused primarily on summarizing two previous research studies (Zubair et al. 1993, Ezpinoza 1993) as well as ongoing long-term research efforts to address issues related to use of subdrainage in Indiana, especially the question of the optimum location and combination of base layers. The long-term instrumentation of alternative pavement drainage sections involved the use of a time domain reflectometry (TDR) system to determine moisture content, a neutron probe to measure total moisture content, watermark blocks fabricated from plastic tubes (to offset the influence of soil salinity on resistance), thermocouples to measure pavement temperatures, and resistivity probes to determine frost penetration.

Zubair et al. (1993) evaluated the performance of Indiana pavement subdrainage systems and studied the behavior of moisture conditions below pavements through external visual inspection as well as a probe for internal inspection combined with instrumentation. The goal of instrumentation was to monitor the effects of different parameters influencing flow. The instrumentation included pressure transducers, moisture blocks, a thermistor probe, a rain gauge, a tipping bucket flow meter, and a data recording and storage system. The study presented a methodology that can be used by highway agencies for monitoring the condition of subsurface drainage systems as well as provided recommendations for improved drainage criteria for Indiana.

Espinoza (1993) presented a numerical model, based on finite difference formulation of the equations of water flow in unsaturated porous media, to provide highway engineers with a methodology to analyze the water migration and drainage into pavement structures. The numerical mode was implemented in the form of a computer program, PURDRAIN, which can analyze pavement drainage systems for varying geometries, material, and boundary characteristics.

Based on these research efforts, several modifications to INDOT subsurface drainage policy were implemented:

- The use of geocomposite drains were abandoned after September1995 and were replaced with edge drains using Group K pipes.
- A proposal to replace pre-cast concrete outlet protectors with larger cast, or in-place concrete pads, or pillows was made to help locate the outlet pipes more easily and to prevent vegetation from growing up around the outlets.
- A routine inspection and maintenance program was implemented.
- All construction projects will require inspection of all edge drains and repair of the deficiencies will be the contractor’s responsibility under the new policy.

Minnesota

Canelon and Neiber (2009) evaluated both edge drains and centerline drains at various depths (2 ft and 4 ft) to determine if centerline drainage systems are an effective alternative to edge drains. The purpose of their research was also to identify effective configurations of centerline drains. Tipping buckets were installed inside locked barrels fixed with instruments at drainage system outlets (see Figure 6). A hand-held electromagnetic instrument (Geonics EM38) was used to collect on-site moisture content data for pavement, base, and subgrade (see Figure 6). Select draining sections were also inspected for calcification deposits in an effort to determine the extent to which the material leaching through recycled concrete aggregate calcifies and obstructs the flow into the drain. The potential impact of the quantity of recycled concrete used in base course materials on drain tile condition was also assessed by collecting field samples of edged rain tiles and analyzing them for the presence of precipitated carbonates.

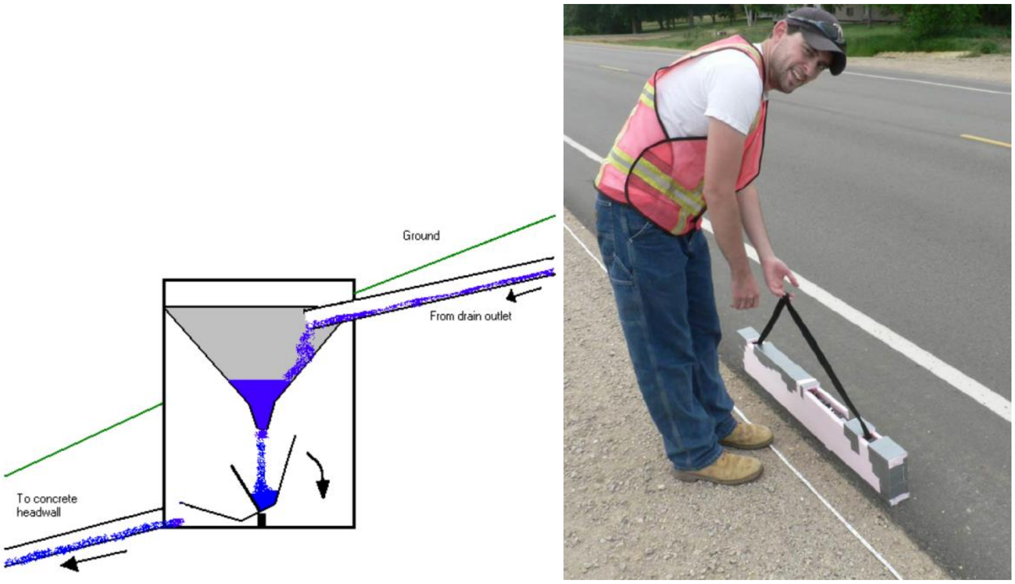


Figure 6. Tipping bucket system (left) and electromagnetic instrument (right) used in Minnesota drainage study field data collection (Canelon and Nieber 2009)

Based on data collected over a two-year period, statistical analysis, and finite element analysis of the drainage configurations, the following observations were made (Canelon and Nieber 2009):

- There was no significant difference in drainage volume of centerline drains between 2 ft and 4 ft centerline depths. The 4 ft depths redirected somewhat higher volumes over impermeable subgrades.
- The electromagnetic gauge readings revealed that more moisture was observed within edge drain lines than with centerline drains.
- Contrary to expectations, drainage lines that showed high levels of carbonate deposits were not in sections with recycled concrete aggregates. Carbonate sands in those locations may have led to this observation.
- There was no strong evidence between moisture readings and pavement distress.
- The recommended drainage system from highways and urban roadways is edge drain. However, centerline drainage (deeper configuration) may be useful in cases of permeable subgrades.

In conjunction with the study carried out by Canelon and Neiber (2009), a subsurface drainage manual for Minnesota pavements was also developed taking into account the variability of the soils, hydrology, and climate of the state (Arika et al. 2009). The manual includes methods for evaluating the need for subsurface drainage in Minnesota pavements, the selection of the type and design of the drainage system, guidelines on the construction and installation of subsurface drainage, proper maintenance of a drainage system, and methods for conducting an economic analysis of subsurface drainage.

California

Bhattacarya et al. (2009) discuss a recently completed study by the California Department of Transportation (Caltrans) to evaluate the performance of edge drain systems placed along PCC pavements in California and make recommendations to improve their performance. Over the years, a wide range of subsurface drainage designs have been constructed in California from retrofit drains to full subdrainage systems. However, it was later found that many of these drainage systems became ineffective due to design deficiencies, materials used, construction errors, and especially lack of maintenance.

A total of 24 projects in 15 different counties were surveyed and 9 were selected for further evaluation by excavating the shoulder. Field investigations revealed that fewer than 30 percent of the evaluated edge drains, which were generally in the areas of higher rainfall, were operating in an acceptable manner. The majority of the remaining sites revealed little or no maintenance and the drain pipes were clogged with soil from both roadbed drainage and the shoulder area (see Figure 7).

Figure 7. Clogging of edge drain outlet pipes in California PCC pavements (Bhattacarya et al. 2009)

The lack of end wall protection further exacerbated the clogging of outlet pipes. However, in many of the pavement sections, no significant correlation was found between observed pavement distresses and clogged edge drains, probably due to recent pavement rehabilitation activities.

Based on the study, several important conclusions and recommendations were presented by Bhattacarya et al. (2009):

- The larger diameter drain pipes, deep trenches, and treated permeable bases used in original construction edge drains contributed to relatively better performance than retrofit edge drains with slotted pipes.
- The lack of good performance observed in the retrofit projects were attributed to the shallow placement of edge drain trenches due to which they could not effectively collect all infiltrated water from PCC and base layers.
- Improper construction procedures led to installation of several edge drains in the higher side

of the cross slope, preventing the water flowing to the drainpipe.

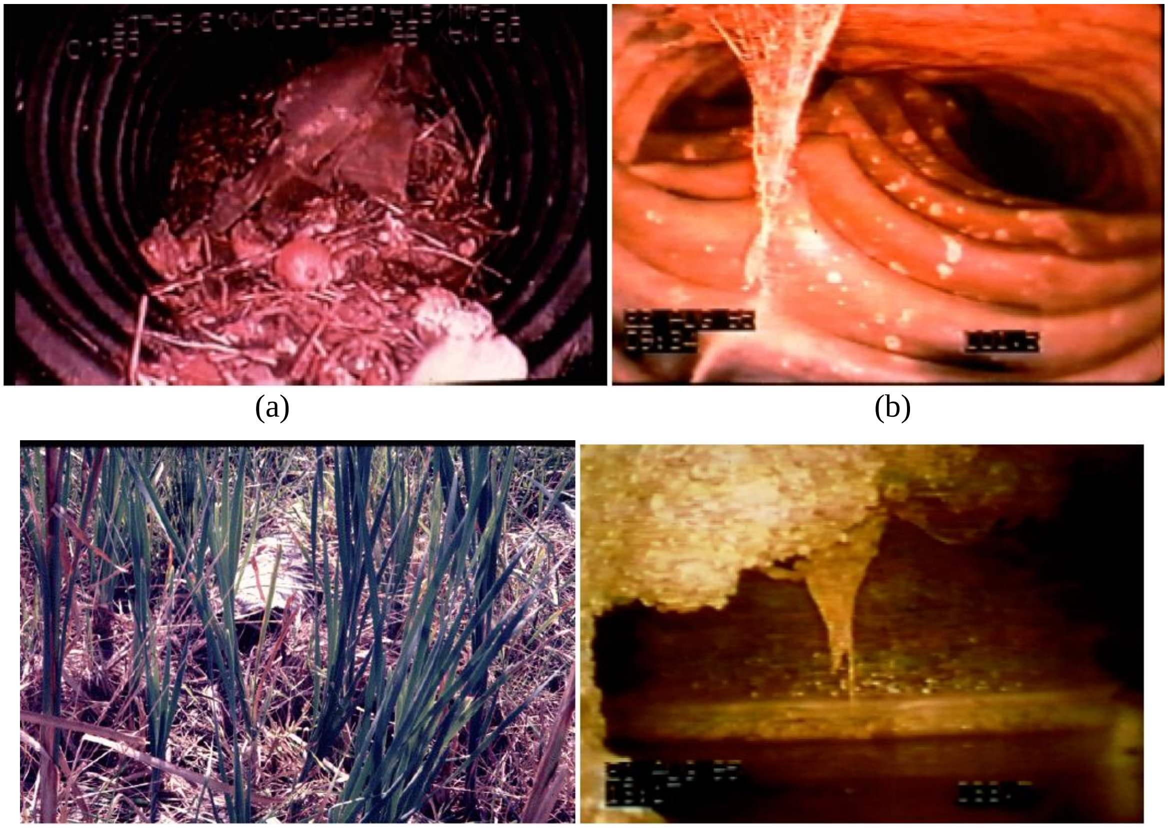
- Edge drains should be selected and designed for a given project only after prior investigation of rainfall occurrence in the project area, permeability of the natural soil in that area, and only if there is a long-term commitment for maintenance of the edge drain system. In addition, they are required only in critical drainage areas and not throughout the project.
- Geo-textile filter fabric materials used in edge drain design should be soil-specific and should be placed along the side of the shoulder and trench bottom to prevent migration of aggregate base fines.
- Larger diameter slotted pipes (4 in.) are preferred to allow for video inspections and dual outlet features are recommended for easier maintenance.
- The overall conclusion from the study seemed to indicate that the use of edge drain systems may not improve the PCC pavement performance significantly in the long term beyond those already offered by load transfer devices (dowel bars and tie bars), day lighted permeable bases, and asphalt concrete interlayers.

Other

Baumgardner (2002) presented several visual examples and case histories to document FHWA attempts at stressing the importance of maintenance of pavement subsurface drainage maintenance to SHAs. Some common maintenance problems encountered by SHAs are shown in Figure 8.

According to Baumgardner (2002), the use of headwalls, reference markers, signs on fences, reflector disks in the shoulder, or painted arrows on the shoulder help SHAs greatly in providing maintenance. Even a simple arrow painted on the edge of the shoulder serves as a good reference marker for maintenance personnel. The FHWA also recommends the use of larger headwalls given that it has the following advantages: easier for maintenance personnel to locate the drainage outlet pipe, roadside vegetation is located away from the outlet, reduces erosion at the pipe outlet, and prevents crushing of the outlet pipe during construction and mowing operations (Baumgardner 2002). In summary, Baumgardner’s synthesis study concluded that an SHA should not use permeable bases if it is unwilling to make a maintenance commitment because it will increase the rate of pavement damage.

An Annotated Bibliography is included in Appendix A to provide a detailed overview of all available research information and guides related to subsurface drainage practices.



(a) (b)

(c) (d)

Figure 8. Common subsurface drainage system maintenance problems encountered by SHAs: (a) rodent nest, (b) crushed pipes during construction, (c) hidden outlet pipe, and (d) ninety-degree tee (Baumgardner 2002)

Effects of Recycled Concrete Aggregate Base on Concrete Pavement Drainage

The use of recycled concrete aggregate (RCA) or crushed concrete as replacements for virgin aggregates in the unbound base/subbase layers of concrete pavements has been a common practice in the US for many years. However, field investigations carried out by different SHAs have raised concerns on the deposit of RCA-associated fines and precipitate and their role in reducing the capacity of subsurface drainage systems. Snyder and Bruinsma (1996) reviewed several published as well as unpublished field studies concerning the effects of RCA bases on PCC pavement drainage.

In Iowa, RCA has been used in concrete pavement subbase for about 30 years. Field investigations have revealed that this has led to the formation of tufa blocking subdrains, reducing the subbase permeability, damaging the vegetation nearby the drain outlets, and sometimes causing pavement shoulders to erode (Steffes 1999, White et al. 2008, Phan 2010). A survey conducted by Gupta and Kneller (1993) on the Ohio DOT (ODOT) use of slag and/or RCA as subbase aggregates, and related tufa problems revealed that not all RCA subbase aggregates produced tufa and it was not clear why tufa precipitation did not occur on all sites using an RCA subbase. In addition, previous studies indicate that calcite precipitates do not form with the use of natural aggregates such as gravel and crushed limestone, but with the use of RCA in the base/subbase (Phan 2010, Steffes 1999).

Several studies in the past have focused on investigating the conditions favorable for tufa formation when using RCA and/or slags in concrete pavement subbases, especially considering free lime (CaO) as a chemical component to produce tufa. A study by Narita et al. (1978) suggested that slags containing more than 1 percent CaO were likely to produce tufa. Another study by Gupta and Dollimore (2002) led to the recommendation that the use of RCA should be limited to coarse sizes to prevent the formation of tufa and that the RCA used in base/subbase layers should have a magnesium to calcium (Mg:Ca) ratio lower than 0.6. Bruinsma et al. (1997) reported the residence time of pore water in RCA subbase layers to be critical in controlling the tufa precipitate formation. Previous study findings suggest that tufa deposits are produced primarily from reactions between calcium hydroxide (CH), and other calcium-based compounds in portland cement paste of RCA, and carbon dioxide dissolved in water (Phan 2010).

Based on an extensive review of several field studies conducted in Minnesota, Michigan, and Ohio concerning the effects of RCA on PCC pavement drainage systems, Snyder and Bruinsma (1996) reported the following findings and recommendations:

- The use of RCA in PCC base/subbase, irrespective of gradation, produces precipitate. The amount of precipitate appears to be related directly to the quantity of RCA fines (# 4-minus).
- Although selective grading (to eliminate fines) or blending with virgin aggregates will reduce the precipitation potential significantly, they will not eliminate it completely.
- The potential for accumulation of fine material deposits in and around pavement drainage systems can be reduced by washing the RCA before using it in pavement foundation layers.
- The permittivity of typical drainage filter fabrics is reduced significantly by precipitate and insoluble residue accumulations resulting from the use of RCA.
- To prevent corrosion of rodent guard screens from the use of RCA, they should be fabricated from plastic or other corrosion-resistant materials.
- The use of the calcium ion concentration test (recommended by the Michigan DOT/MDOT) may be a good test to determine the precipitate potential of RCA products.
- The use of larger diameter drainpipes that are either unwrapped or wrapped in filter fabrics with high initial permittivities is recommended.

FORENSIC TESTING AND EVALUATION PROGRAM

A detailed forensic test plan was developed in consultation with the project technical advisory committee (TAC) for inspecting and evaluating the Iowa pavement subdrains. The forensic test plan included site selection for inspection, identification of drainage components among the entire drainage system for evaluation, and the detailed inspection and evaluation methods.

Site Selection for Evaluation

Representative pavement sites across Iowa for forensic testing and evaluation were identified in consultation with the TAC and Iowa district engineers based on the following considerations:

- Newer JPCPs and HMA pavements designed and constructed after 1990
- Variability of geographic locations
- Range of age and traffic
- Different pavement thickness
- Variability of pavement distress severities
- Type of base materials for JPCP (RPCC and virgin aggregate)

A total of 56 sites for new JPCP and 8 sites for new HMA pavements were selected to meet these considerations. Detailed information on the selected sites is included in Appendix B. The selected sites represent a variety of geographic locations across Iowa as seen in Figure 9.

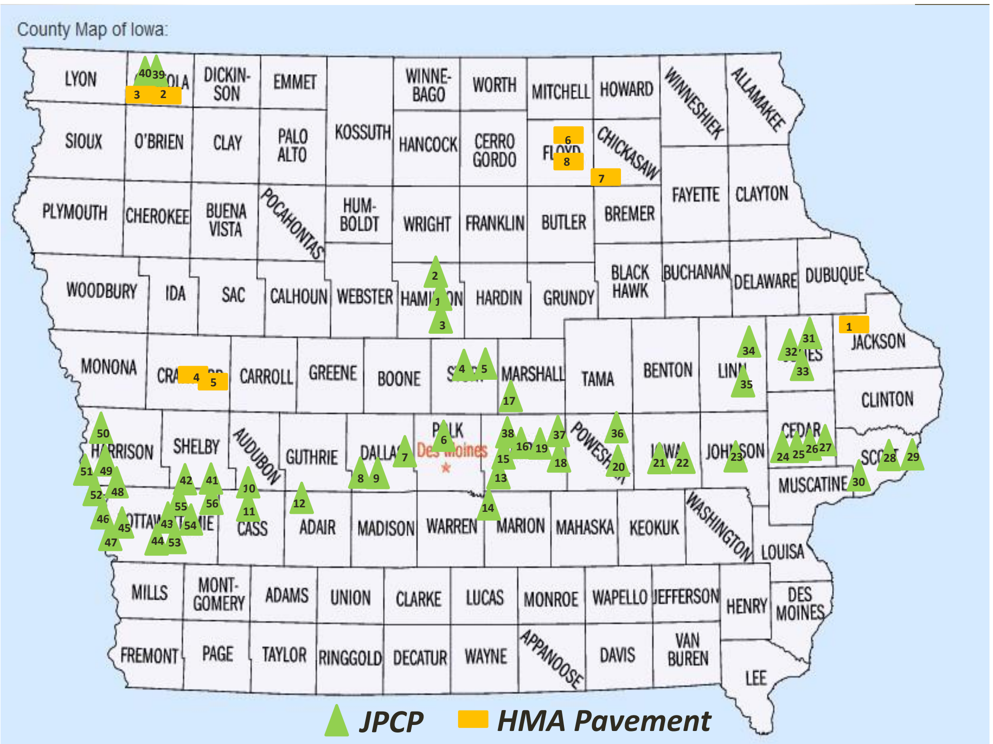
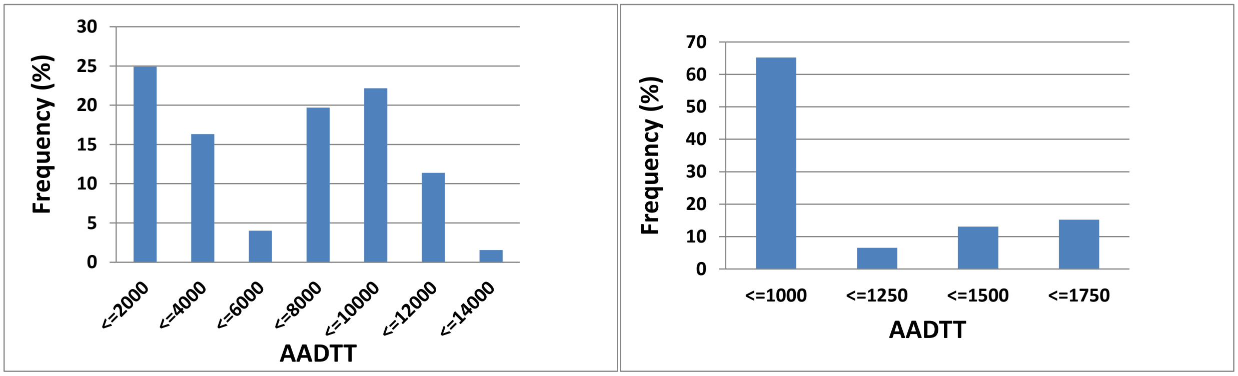


Figure 9. Geographical locations of selected Iowa pavement sites

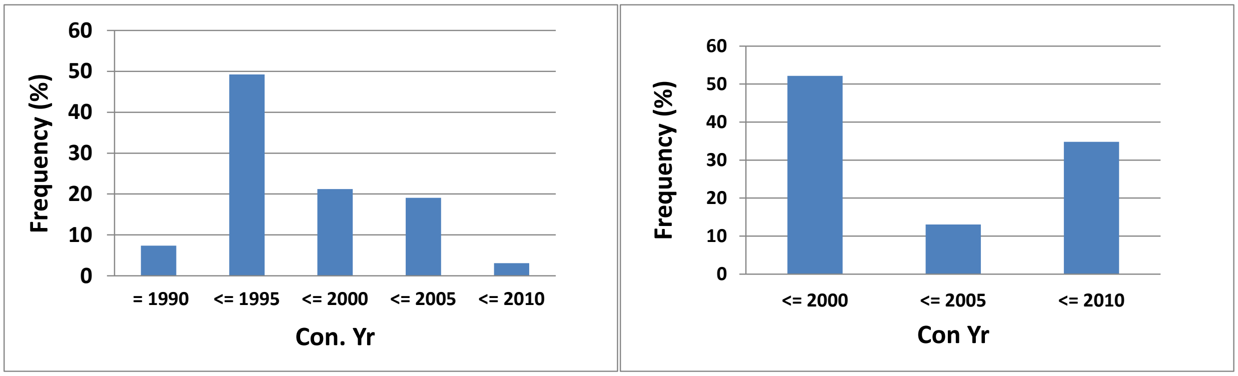
Figure 10 presents the average annual daily truck traffic (AADTT) distributions based on year 2011 for selected Iowa pavement sites. As seen in this figure, JPCPs are used with higher AADTT while the majority of HMA-surfaced pavements carry lower AADTT.



(a) (b)

Figure 10. Traffic distribution of selected Iowa pavement sites: (a) JPCP and (b) HMA

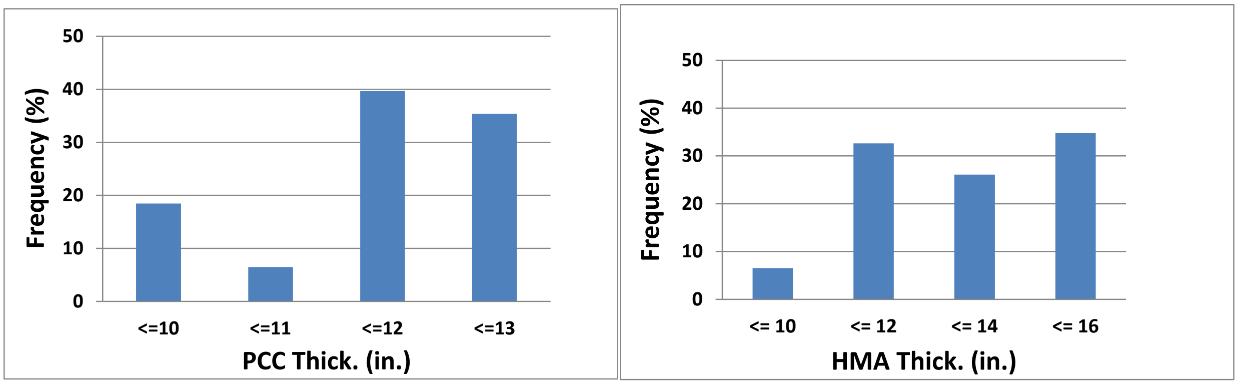
Figure 11 presents the construction year distribution for selected Iowa pavement sites. All selected pavement sites were constructed after 1990. More than half the JPCPs sites were constructed before 2000 (about 10 to 20 years of pavement age) and more than half the HMA pavement sites were constructed before 2005 (about 5 to 10 years of pavement age).



(a) (b)

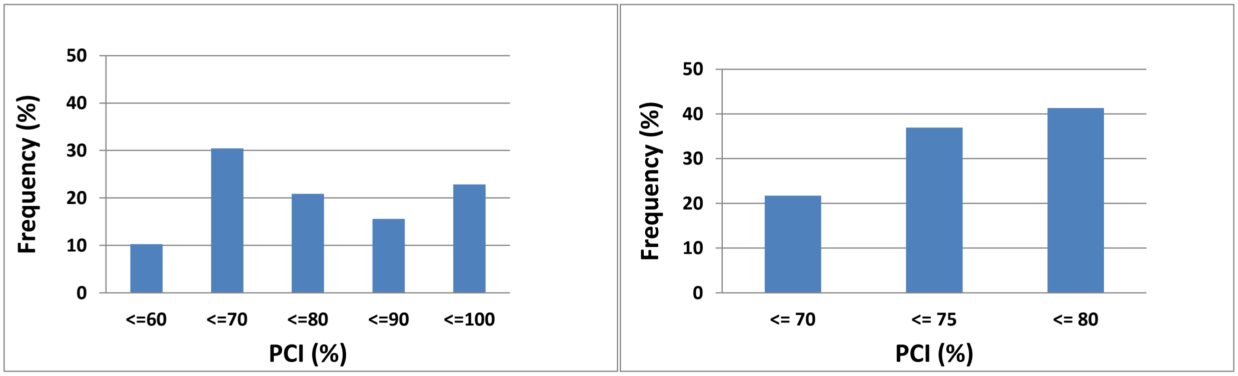
Figure 11. Construction year distribution of selected Iowa pavement sites: (a) JPCP and (b) HMA

Figure 12 illustrates pavement surface thickness distributions for selected Iowa pavement sites and Figure 13 presents pavement condition index (PCI) distributions as pavement performance indicators. These figures indicate that the selected pavement sites covered different pavement structural conditions and different pavement distress severities.



(a) (b)

Figure 12. Surface thickness distribution of selected Iowa pavement sites: (a) JPCP and (b) HMA



(a) (b)

Figure 13. Pavement condition index (PCI) distribution of selected Iowa pavement sites: (a) JPCP and (b) HMA

As shown in Figure 14, about 80 percent of the selected JPCP sites utilized RPCC as base materials. As discussed previously, field investigations have revealed concerns regarding the use of RPCC base materials in Iowa concrete pavements leading to poor drainage performance. The forensic test plan was designed to investigate this issue by intentionally selecting many JPCP sites using RPCC base materials. Note that the RPCC/ blended virgin aggregate base material sites in Figure 14 are the two JPCP sections of US 151: S/MP 62.57 to MP 67.57 and N/MP 62.57 to MP 67.48.

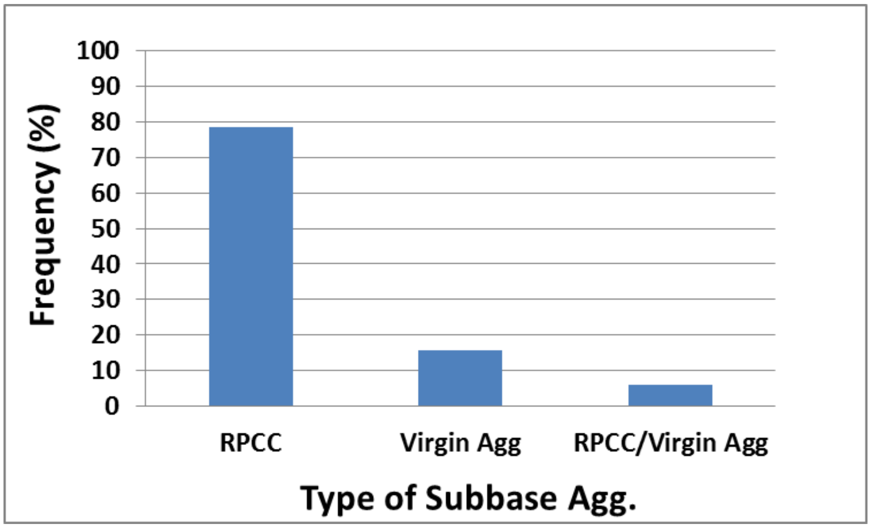


Figure 14. Base material distribution of selected Iowa JPCP sites

Description of Field Investigation

Field investigations were conducted on 64 selected (JPCP and HMA) pavement sites during the fall season (October to November) of 2012. Given that the drainage outlet visibly manifests the functionality of the entire drainage system and is related to most subdrainage problems, field investigations were focused on assessment of outlet condition with agreement from the project TAC. At least three drainage outlet spots per selected site representing start, middle, and end were investigated. The consideration for selection of each spot was based on vegetation condition nearby drainage outlet, pavement distress condition, and ease of access at the outlet spot (without traffic control). Note that poor vegetation condition surrounding the drain outlet was considered as evidence of poor drainage performance. Based on the recommendations from the project TAC and district maintenance engineers on problematic drainage sites, investigations were carried out every mile on some sites, such as I-80 in Cedar County and US 151 in Jones County. A total of 371 spots were investigated with respect to the selected JPCP and HMA pavement sites.

Most of the inspection took place on the right of the roadway. The survey crew traveled in a car or a mini-truck with a beacon light and stopped on the shoulder when needed for drainage inspection and the corresponding visual distress survey of pavements. At some spots, as shown in Figure 15, the outlets were covered by dirt, debris, soil, and other vegetation that was necessary to be cleaned out by using hand tools for inspection.

Figure 15. Clearing debris surrounding subsurface drainage outlet in I-35/N/MP140.35

A template drainage inspection report, incorporating the following items, was prepared and used during field inspections:

- Location of outlet spot inspected
- Types and size of outlet pipe
- Condition of outlet opening
- Screen present and type
- Outlet maker present
- Water present and condition (staying/moving) inside drain
- Tufa/Dead zone present (Y/N)
- Embankment slope condition
- Additional observation

Among these items, the condition of the outlet opening was rated in terms of percentage of blockage caused by coarse/fine materials accumulation. For instance, Figure 16 illustrates a 50 percent outlet blockage rating. Any pavement distresses observed near inspected drainage spots were also recorded (pictures and videos). Pavement distress records for selected sites were also extracted from the Iowa DOT Pavement Management Information System (PMIS) and organized with field inspection results.

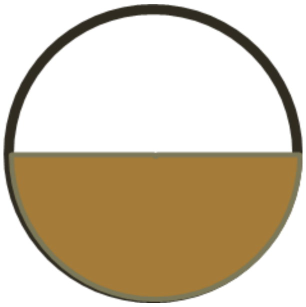


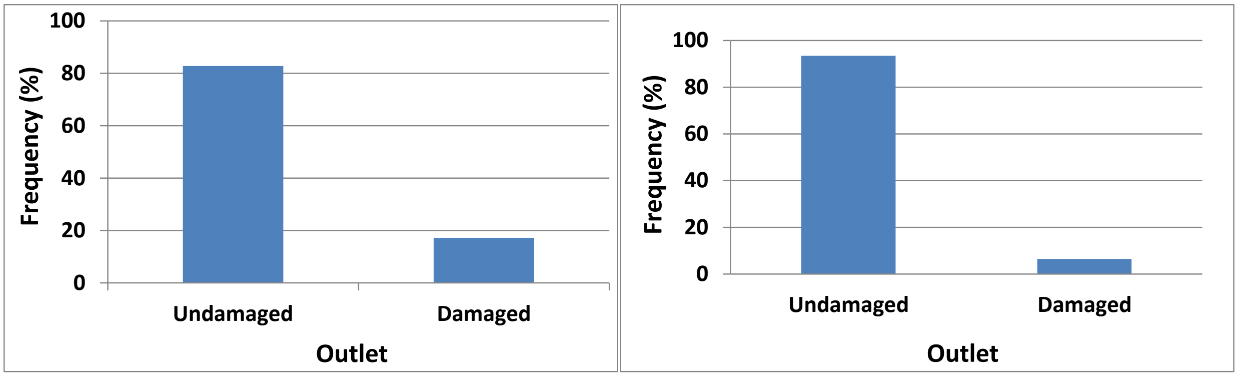
Figure 16. 50 percent blockage of subsurface drainage outlet condition

RESULTS AND DISCUSSION OF FIELD INVESTIGATIONS

Field investigation results with PMIS pavement distress records were compiled and are included in Appendix B. The findings and results from field investigations are discussed here with primary focus on subdrainage outlet conditions and pavement distress assessment near subdrainage outlet locations.

Subsurface Drainage Outlet Conditions

Figure 17 compares undamaged and damaged (broken outlet pipeline) subsurface drainage outlets among the ones that were investigated. Less than 20 percent of the investigated JPCP drainage outlets were damaged while less than 10 percent of HMA pavement drainage outlets were broken.



(a) (b)

Figure 17. Undamaged and damaged subsurface drainage outlet in Iowa pavements investigated: (a) JPCP and (b) HMA

Typical drainage outlet conditions observed during field investigation include the following (see Figure 18):

- No blockage (open)
- Tufa blockage
- Sediment blockage
- Soil/aggregate blockage

No blockage was reported when the inside outlet pipe was in very clean condition. Tufa blockage was reported when there was build-up of calcium carbonate observed either inside the outlet pipe or near rodent guard screens. Tufa blockage was only observed in JPCP containing RPCC base materials. Sediment blockage was reported when dirty or debris materials were deposited inside the outlet pipe or nearby rodent guard screens. Soil blockage was reported when an end of the outlet was not exposed outside but covered by soil or aggregate.

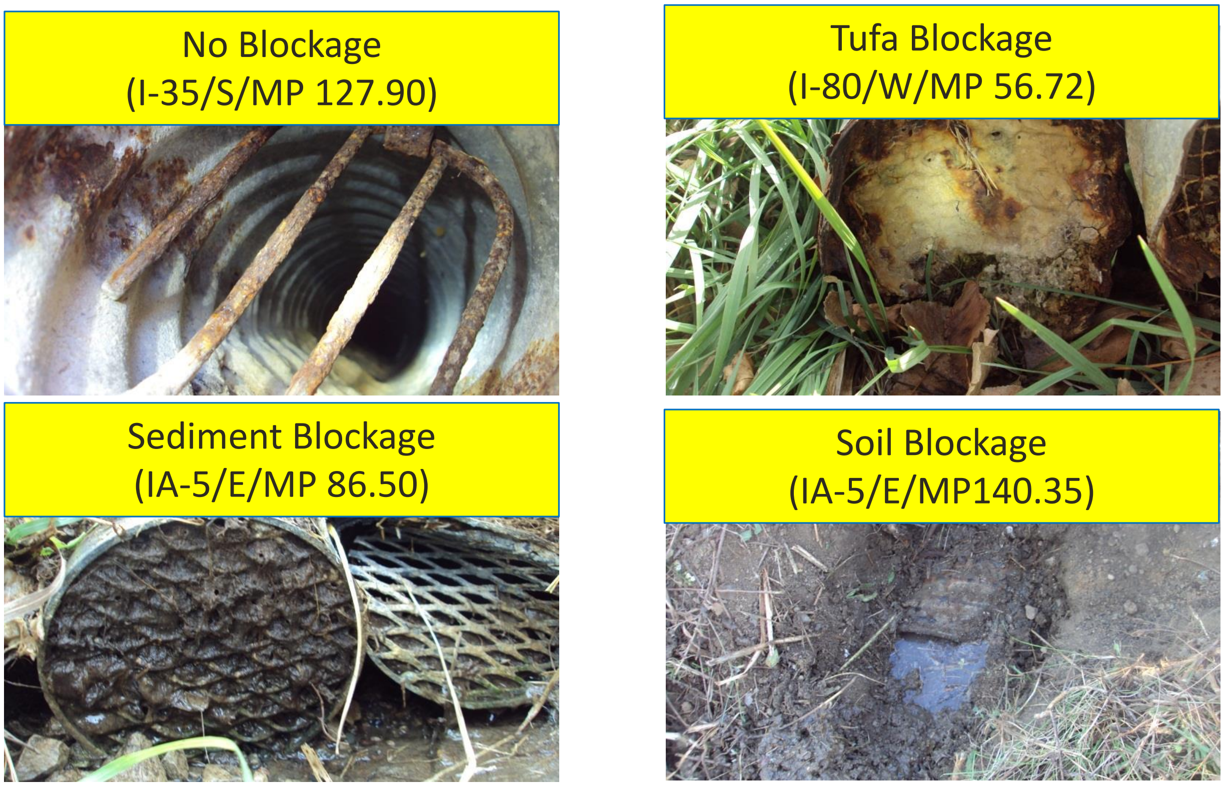
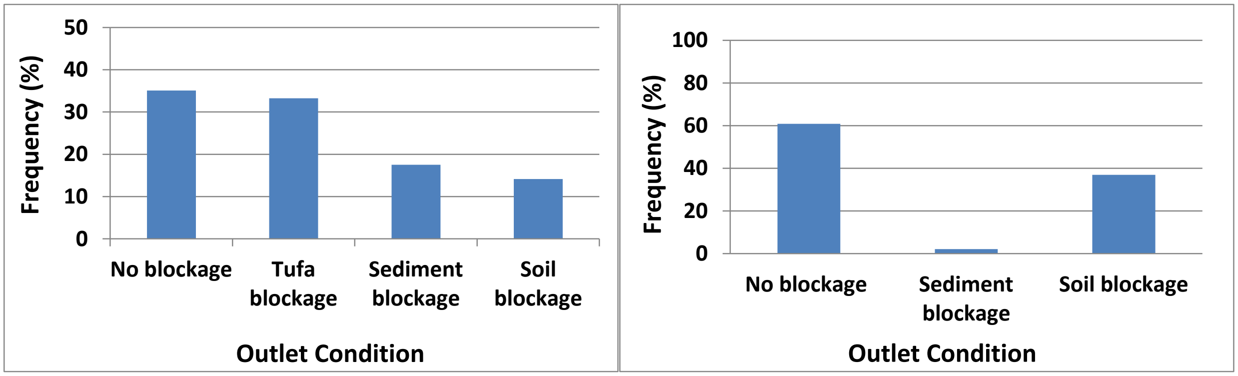


Figure 18. Typical roadway subsurface drainage outlet conditions in Iowa

Figure 19 presents the distributions of these four drainage outlet conditions observed in JPCPs and HMA pavements. About 35 percent of the outlets in JPCPs and 60 percent of outlets in HMA pavements were not blocked by any materials. About 35 percent of outlets in JPCPs were blocked by tufa, about 17 percent were blocked by sediment, and about 14 percent were blocked by soil deposits. However, most of the blocked outlets in HMA pavements were blocked by soil deposits (see Figure 19b). Only 2 percent of outlets in HMA pavements were blocked by sediment.



(a) (b)

Figure 19. Distribution of Iowa roadway subsurface drainage outlet condition categories: (a) JPCP and (b) HMA

Figure 20 presents distributions of drainage outlet conditions with respect to JPCP subbase aggregate material types. As seen in this figure, tufa formation and drain outlet blockage were observed mainly in JPCP with RPCC subbase materials. Few drain outlets with tufa blockage were observed in JPCP with blended RPCC and virgin aggregate subbase materials (10 spots on US 151/S/MP 67.57 to MP 67.57 and 9 spots on US 151/N/MP 62.55 to MP 67.48).

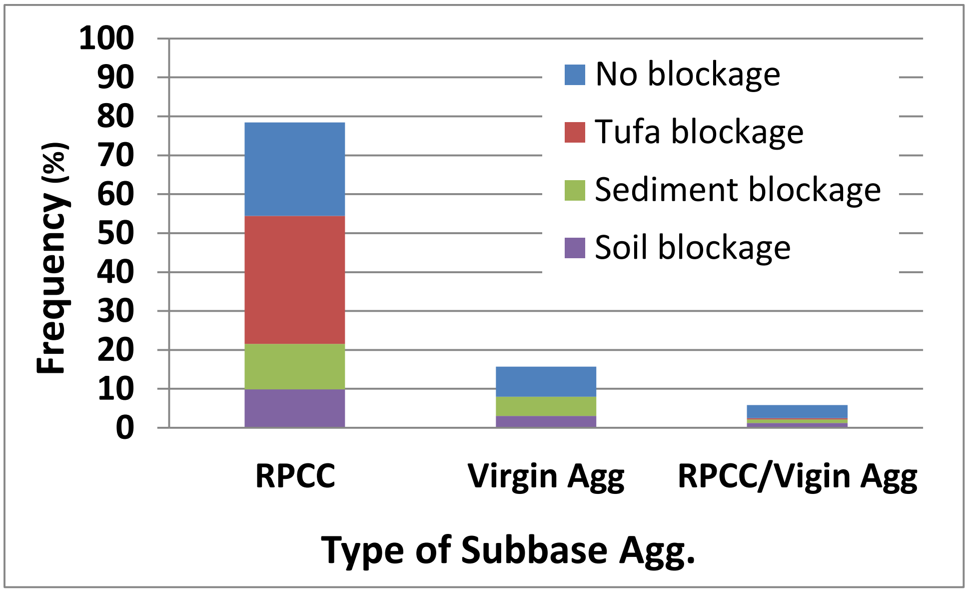


Figure 20. Subsurface drainage outlet conditions distribution with respect to Iowa JPCP subbase aggregate type

Figure 21 and Figure 22 present blockage rates of drainage outlet conditions in JPCPs and HMA pavements, respectively. As seen in Figure 21, at higher blockage rates, JPCP drain outlets are blocked primarily by tufa rather than soil and sediment. However, irrespective of the blockage rate, the HMA pavement subdrainage outlets are blocked primarily by soil.

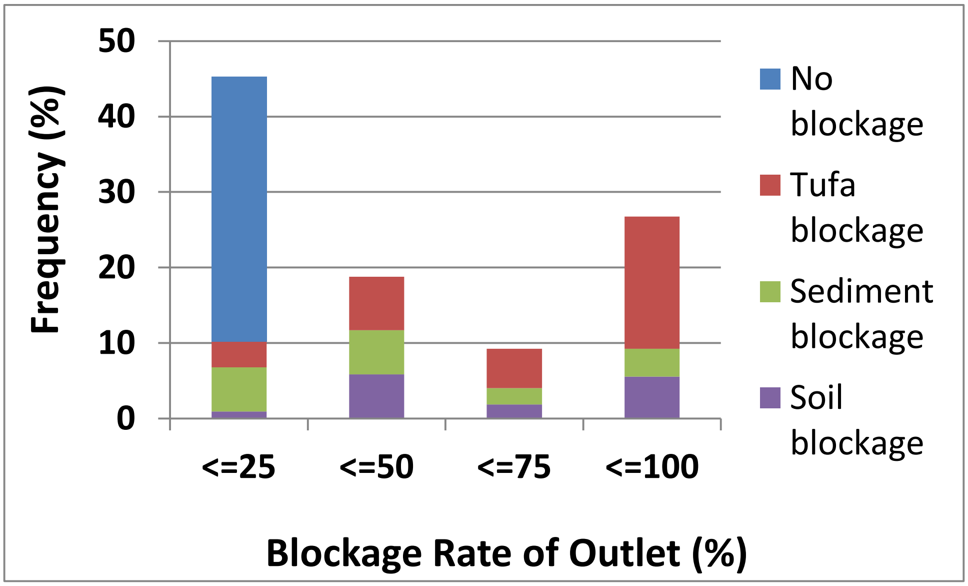


Figure 21. Blockage rate and type of Iowa JPCP subsurface drainage outlets

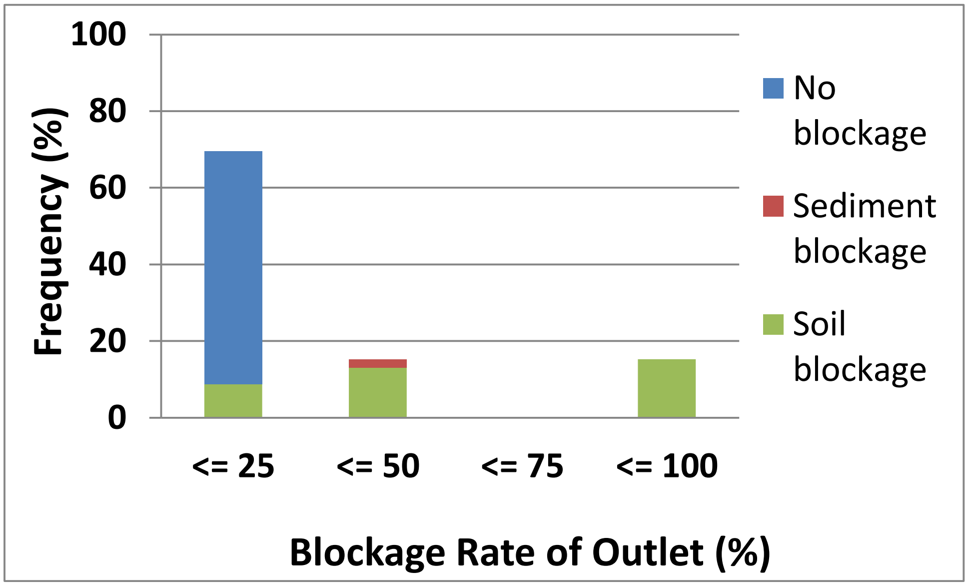


Figure 22. Blockage rate and type of Iowa HMA subsurface drainage outlets

Higher outlet blockage rates lead to slower discharge of water. However, higher blockage rates do not always stop the water from flowing from inside of the outlet pipe to outside of it, as shown in Figure 23, unless the outlet is completely blocked, i.e., 100 percent blockage rate. Note the free flowing drain outlet condition in Figure 23 was not evident at first sight, but was quite clear when viewing the recorded video.

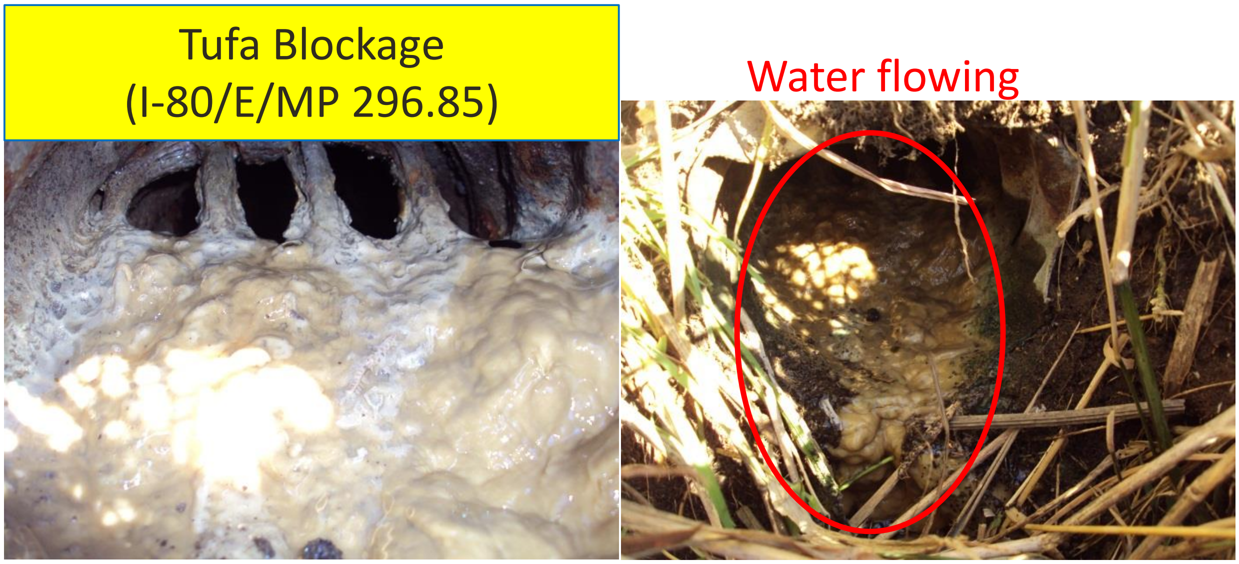


Figure 23. Free water flowing under 75 percent blocked subsurface drainage outlet

Rodent guards have been used in Iowa pavements to keep mice, rats, and other small rodents from entering subdrains. The two types of rodent guards used in Iowa are mesh screen and fork-shaped ones. Only one drainage spot, as seen in Figure 24, was observed as having rodent evidence.

Figure 24. Rodent evidence inside a subsurface drainage outlet during field investigations

In light of the significant blockage caused by tufa or sediment in many of the investigated drain outlets further complicated by the presence of rodent guards, the question of whether or not we should be using rodent guards has become a moot point. The mesh screen-type rodent guards in some drainage outlets, as shown in Figure 25, is causing clogging with tufa or sediment by filtering the flow of water. Removal of the rodent guards, as shown in Figure 25, often prevents this clogging problem.

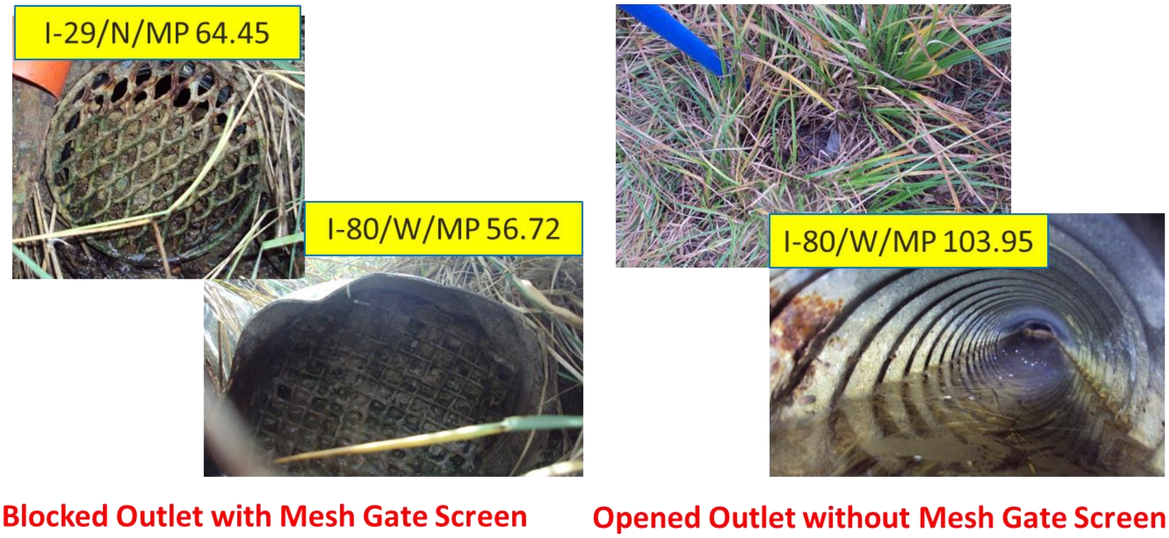
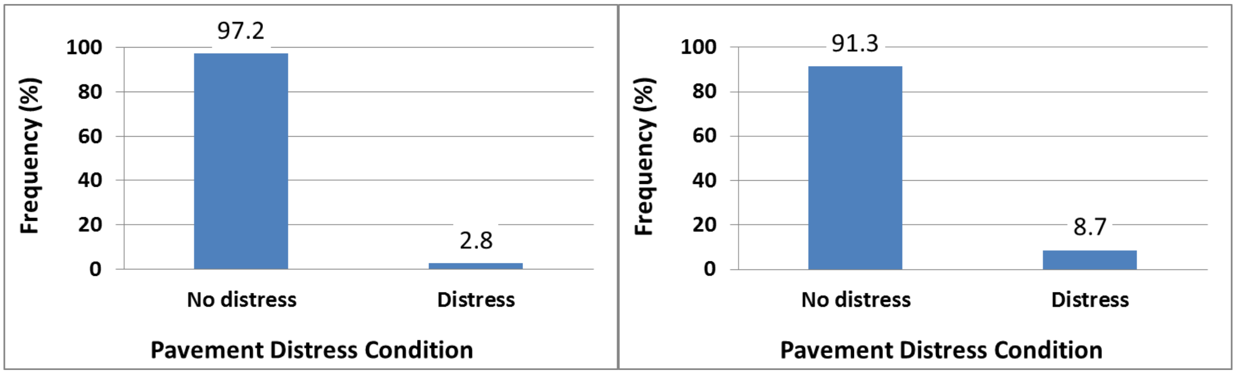


Figure 25. Subsurface drainage outlet conditions with/without mesh screen rodent guards

Pavement Distress Assessments near Subsurface Drainage Outlet

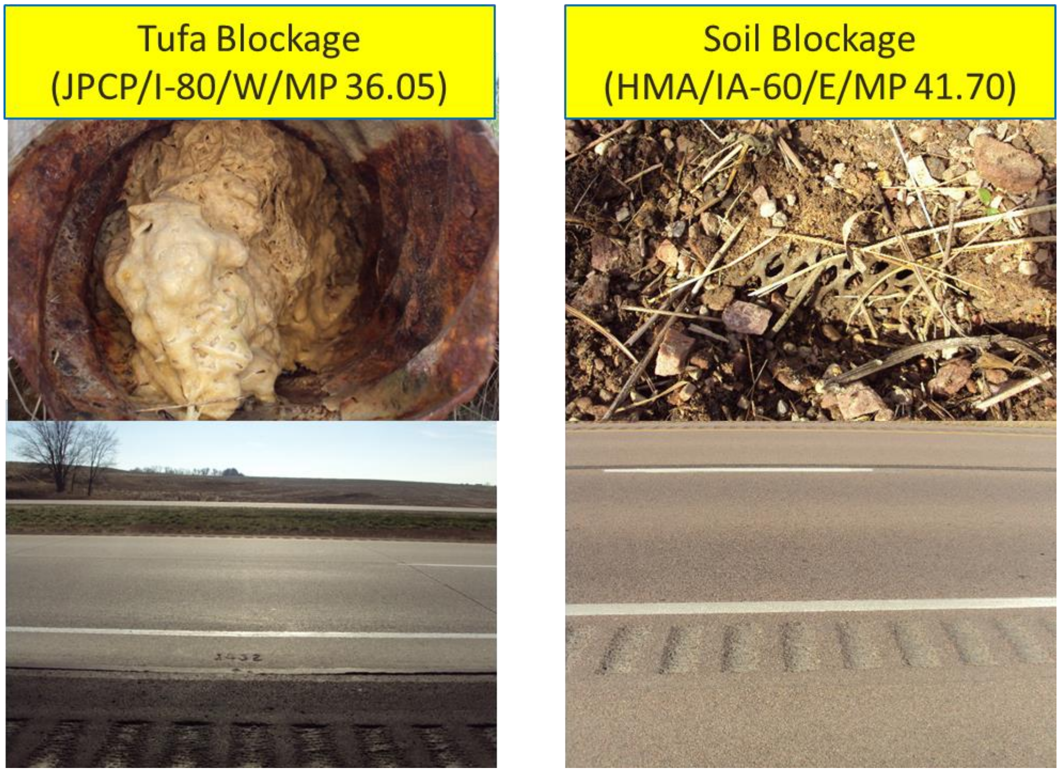
Figure 26 presents distributions of pavement surface distress observed on Iowa JPCPs and HMA pavements. More than 90 percent of investigated spots do not have any surface distress on both pavement types. The distress types observed in JPCP are transverse cracking, longitudinal cracking, and corner cracking. The only relevant distress observed for HMA pavement is transverse cracking.



(a) (b)

Figure 26. Distress condition in investigated Iowa pavements: (a) JPCP and (b) HMA

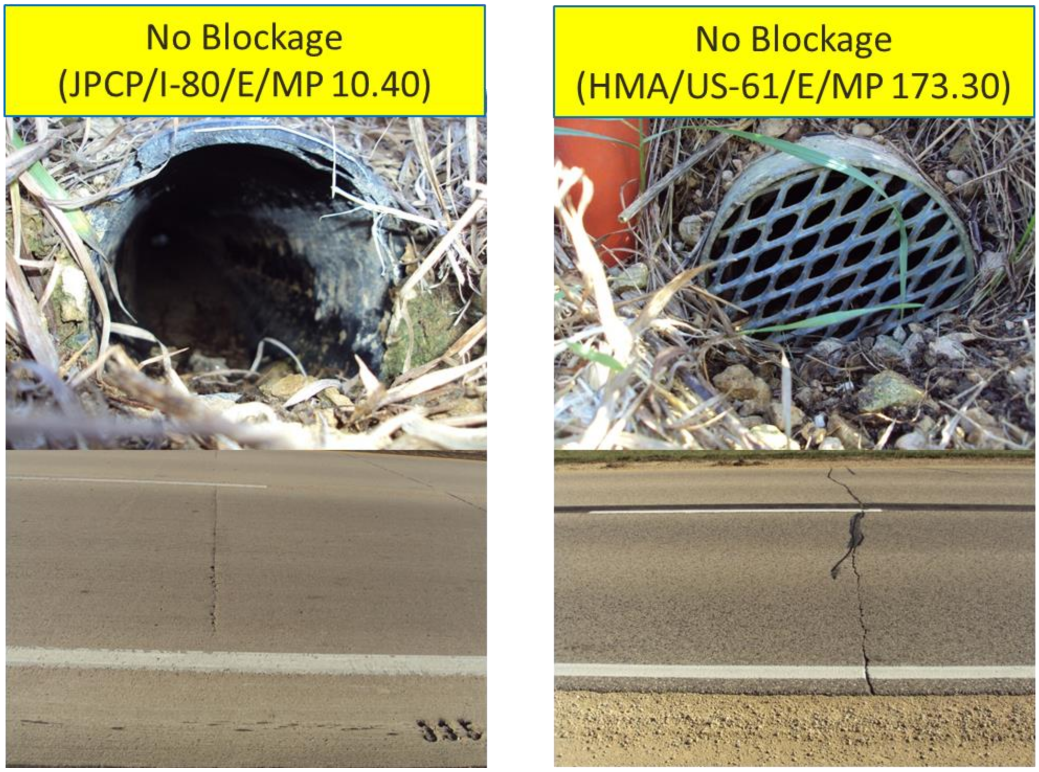
Most surface distresses were observed near open subsurface drainage outlet spots rather than blocked ones. The investigated JPCP sites with blocked outlet spots were constructed from 1990 to 2007 with PCC thicknesses ranging from 9 to 13 in. and AADTT ranging from 579 to 13,264. The JPCP sites with open outlet spots have similar ranges of pavement age, PCC thickness, and AADTT. The investigated HMA sites with both blocked and opened outlet spots were constructed from 1998 to 2006 with HMA thicknesses ranging from 9 to 15 in. and AADTT ranging from 738 to 1,730. As shown in Figure 27, no surface distresses were observed on blocked outlets in JPCP and little surface distress was observed on blocked outlets in HMA. Only one blocked outlet spot in HMA (US 61/E/MP173.00) had transverse cracking.



JPCP I-80/W/MP 36.05: construction year 2005, AADTT 8,093, PCC thickness 11.5 in.; HMA IA 60/E/MP 41.70: construction year 2006, AADTT 831, HMA thickness 14 in.

Figure 27. No surface distress near blocked subsurface drainage outlet

However, open subsurface drainage outlet spots in both pavement types had transverse cracking as shown in Figure 28. Especially note, the opened outlet spot in HMA (US 61/E/MP173.30) in Figure 28 is at a location near to the blocked outlet spot in HMA (US 61/E/MP173.00) that has transverse cracking. Transverse cracking was observed near several culverts (see Figure 29) rather than drainage outlet spots. These results indicate that blocked drainage outlet conditions do not have significant effect on pavement surface distress development.



JPCP I-80/E/MP 10.40: construction year 2003, AADTT 6,825, PCC thickness 12 in.; HMA US 61/E/MP 173.30: construction year 1999, AADTT 1,211, HMA thickness 12 in.

Figure 28. Transverse cracking observed near opened subsurface drainage outlet

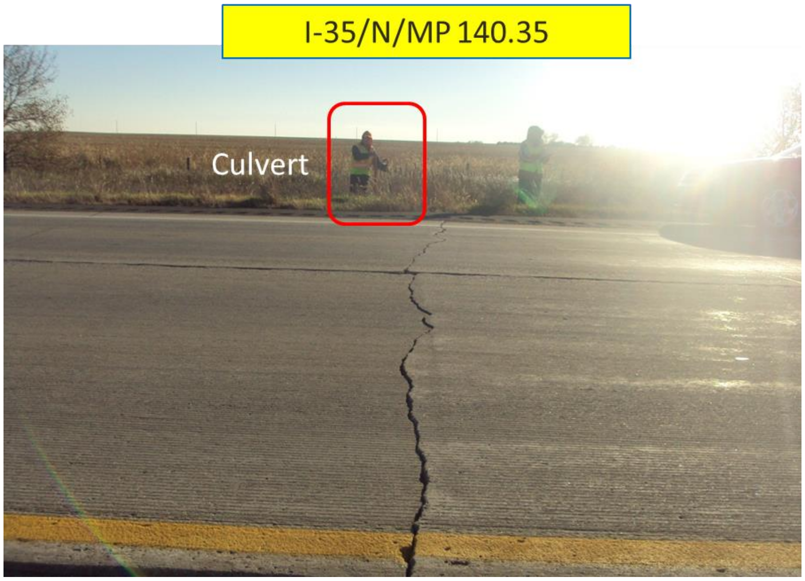


Figure 29. Transverse cracking observed near culvert

Rather than surface distresses, more shoulder distresses (shoulder drop or cracking) as shown in Figure 30 were observed near blocked drainage outlet spots. Note that the opened outlet captured in Figure 30 was newly installed to replace the 100 percent blocked outlet. Figure 31 compares frequency of outlet spots with observed shoulder distress under opened and blocked outlet conditions. More than 10 percent of the blocked drainage outlet spots have shoulder distresses while only 2 percent among opened drainage outlets have shoulder distresses.

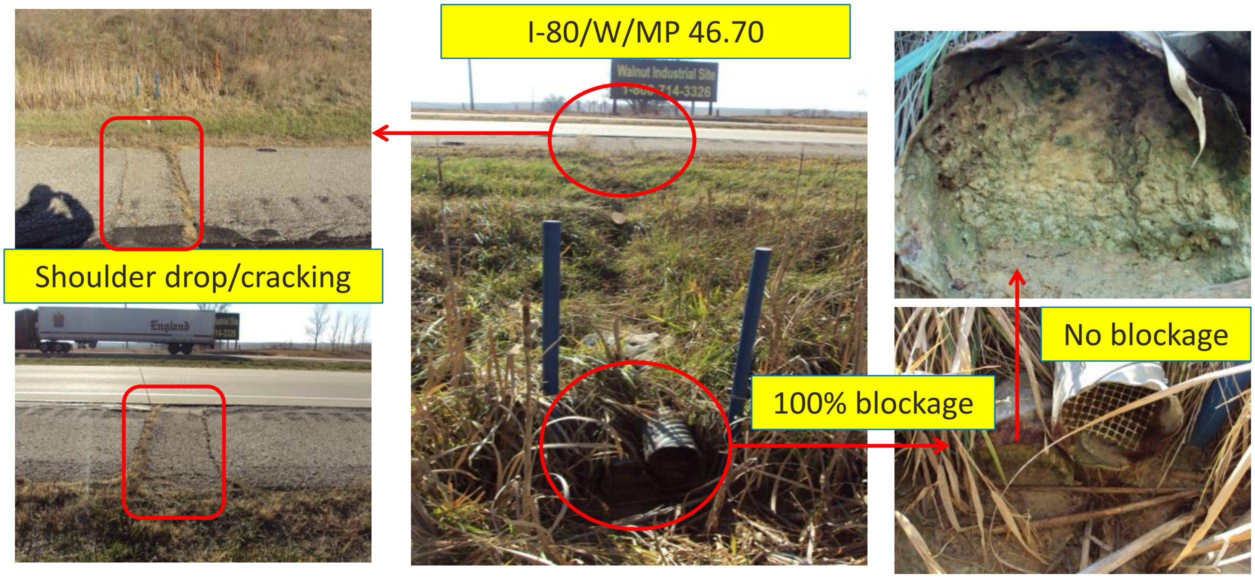


Figure 30. Shoulder drop/cracking observed on blocked outlet in Iowa JPCP

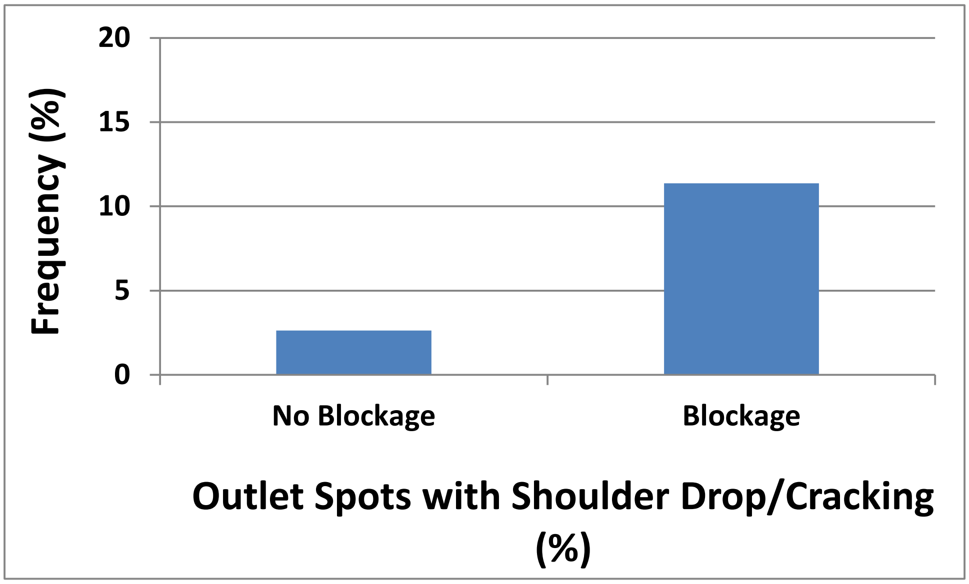


Figure 31. Outlet spots with shoulder drop/cracking in Iowa JPCP

PERFORMANCE ANALYSIS

The PCI from the Iowa DOT PMIS was utilized as a performance indicator of the pavement's structural integrity and pavement surface condition. The PCI is a numerical index ranging from 0 for a failed pavement to 100 for a pavement in perfect condition. Figure 32 compares PCI of pavements at the opened drainage outlet spots and at the blocked drainage outlet spots for both JPCP and HMA pavement types.

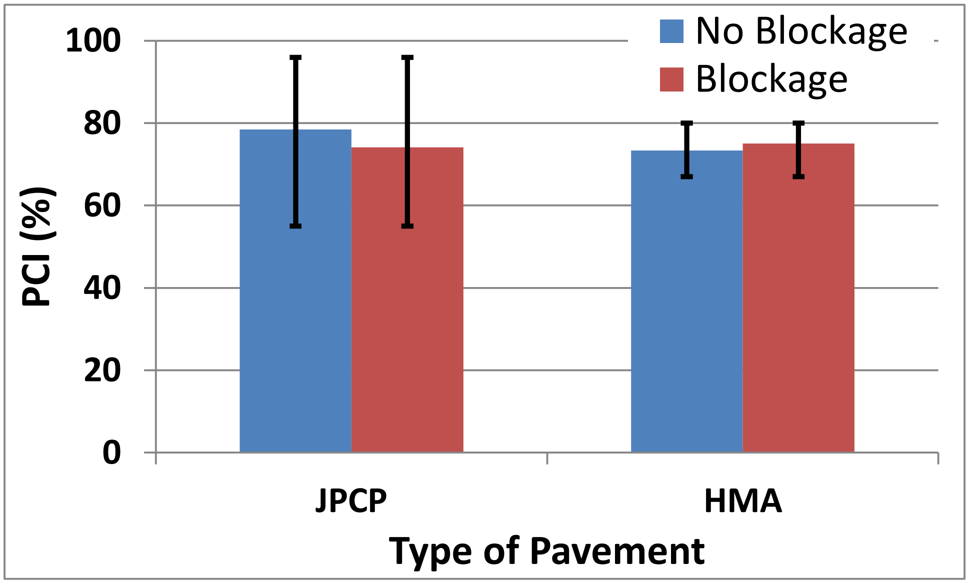


Figure 32. PCI distribution for investigated Iowa pavements with respect to drainage outlet condition

Opened drainage outlet spots in JPCP show a little better performance than blocked drainage outlet spots while both outlet conditions have almost similar influences on HMA performance. However, these comparisons could not explain whether drainage outlet condition can affect pavement performance given that both opened and blocked drainage outlet spots have different traffic, pavement age, and pavement structure, which can all contribute to pavement performance.

Statistical analysis was conducted on the field data to investigate the effect of drainage on pavement performance further. Linear regression analysis was utilized for this purpose. In analytical prediction model development, the first step is a triage procedure to identify significant factors that should be included in any kind of prediction model subsequently developed (Hall and Crovetti 2007). Although the prediction accuracy of linear regression-based prediction models may be poorer compared to other types of models (such as nonlinear regression) depending on the nature of factors and responses, utilization of linear regression analysis in the triage procedure is a more practical approach than direct use of any other type of model arbitrarily. This is especially so given that the question of interest is not the development of a prediction model with higher accuracy but detection of significant factors on pavement performance.

The PCI values of both JPCP and HMA pavements were used as a response or output (y) for regression analysis. The factors or inputs (x) for regression analysis are construction year representing pavement age, AADTT representing traffic level, JPCP/HMA thickness representing pavement structural property, and blockage rate of outlets representing drainage factor.

The following regression model was used to assess the significance of drainage factors and other factors on the pavement performance.

$$y = a_0 + a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 x_4 \tag{1}$$

Where, y = current PCI measurements, %
x_1 = construction year
x_2 = AADTT
x_3 = JPCP/HMA thickness, in.
x_4 = Blockage rate of outlets, %
a_0 = Intercept of regression model
a_1, a_2, a_3, a_4 = Coefficients

Table 1 presents the identified coefficients of the developed regression model along with the accuracy of model predictions (last row). A coefficient of determination (R^2) of 0.65 for PCI predictions for both pavement types indicates that accuracy of the regression model developed is reasonable.

Table 1. Regression analysis results for PCI

Statistic Term	**PCI for JPCP**	**PCI for HMA pavement**
a_0	-2816.83	-1608.33
a_1	1.4594	0.8409
a_2	-0.000958	-0.003211
a_3	-1.300052	0.1774428
a_4	0.003233	0.0057112
R^2	0.67	0.66

Table 2 presents test results expressed in terms of a p-value, which represents the weight of evidence for statistical significance. If the p-value of any factor is less than the selected significance level (α), the effect of that factor (input) on response or output is statistically significant. A 0.05 level of significance (α) was selected in this analysis.

Table 2. Effect test results for PCI to test statistical significance

Factors	***p*-value for JPCP**	***p*-value for HMA pavement**
Construction year	<0.001	0.0099
AADTT	<0.001	0.0053
JPCP/HMA thickness	0.1136	0.7864
Blockage rate of outlets	0.7694	0.6092

In both pavement types, the *p*-values of construction year and AADTT in Table 2 are less than 0.05 while the p-values of JPCP/HMA thickness and blockage rate of outlets are higher than 0.05. Although p-values of JPCP/HMA thickness are higher, it does not mean that JPCP/HMA thickness is not related to pavement performance. Higher p-values for JPCP/HMA thickness in this analysis might be related to limited JPCP/HMA thickness ranges of the investigated sites. Note that the JPCP thicknesses of investigated sites ranged from 9.5 to 12.5 in. and HMA thicknesses ranged from 9 to 14.5 in. depending on traffic levels. In addition to this, the JPCP/HMA thickness was designed to provide good performance if actual traffic condition and material properties were close to the estimated ones used in design. Unlike JPCP/HMA thickness, the blockage rate of outlets ranged from 0 to 100 percent. Thus, the higher p-values of blockage rate indicate that the drainage outlet conditions do not have much effect on pavement performance, which was also indicated by field distress observations.

CONCLUSIONS AND RECOMMENDATIONS

It is important to note that this research project was not intended to investigate whether or not Iowa pavements need subdrains, but to evaluate the subsurface drainage practices in Iowa.

Based on extensive literature review as well as field investigations, the conclusions and recommendations from this study are presented in terms of answers to the main questions raised by the research objectives:

Q.1. How are subdrains performing on Iowa pavements?

- Most Iowa subsurface drainage system outlet blockage is due to tufa, sediment, and soil.
- More than 80 percent of drainage outlets in JPCP were not damaged while less than 20 percent were damaged. For HMA pavements, less than 10 percent of drainage outlets were broken.
- About 35 percent of outlets in JPCP and 60 percent of outlets in HMA pavements were not blocked by any materials. About 35 percent of outlets in JPCP were blocked by tufa, about 17 percent were blocked by sediment, and about 14 percent were blocked by soil deposits. However, most of the blocked outlets in HMA pavements were blocked by soil deposits. Only 2 percent of outlets in HMA pavements were blocked by sediment.
- Higher blockage rates reduce the flow rate of water inside outlet pipes. However, higher blockage rates do not always stop water flowing from inside the outlet pipe to outside the outlet pipe unless the outlet is completely blocked (100 percent blockage).

Q.2. Are pavements in Iowa exhibiting moisture-related distress or failure that can be attributed to poor subdrain performance?

- Little pavement surface distress was observed near subsurface drainage system showing poor performance.
- Both field observations and performance analysis indicate that drainage outlet conditions do not have a significant effect on pavement performance.
- Rather than surface distresses, more shoulder distresses (shoulder drop or cracking) were observed near blocked drainage outlet spots. Among blocked drainage outlet spots, more than 10 percent have shoulder distresses while, among opened drainage outlet spots, only 2 percent have shoulder distresses.

Q.3. Is poor subdrain performance due to improper design, construction, or maintenance? Are there alternatives that will improve the performance, such as more maintenance-free outlet designs, contract maintenance, etc.?

Is the poor subdrain performance due to improper design, construction, or maintenance of pavements/subdrains?

- Use of RPCC as a subbase material results in tufa formation, which is the primary cause of

drainage outlet blockage in JPCP. However, those JPCP spots that utilized blended RPCC and virgin aggregate materials (10 spots on US 151/S/MP 67.57 to MP 67.57 and 9 spots on US 151/N/MP 62.55 to MP 67.48) as subbase materials experienced fewer outlet blockages due to tufa formation.
- The use of gate/mesh screen-type rodent guards has the potential to cause outlet blockage. Considering that very little rodent evidence was observed in Iowa subdrainage outlets during field investigations, it is highly recommended that these rodent guards not be used to cover the drainage outlets in Iowa.

Are there alternatives that will improve the performance, such as more maintenance-free outlet designs, contract maintenance, etc.?

- It is expected that the use of a drain outlet protection mechanism, such as a headwall mechanism used in nearby states, will be highly helpful in protecting and improving the performance of Iowa subdrains.
- Although selective grading (to eliminate fines) or blending with virgin aggregates will reduce the precipitation potential significantly, they will not eliminate it completely.
- The potential for accumulation of fine material deposits in and around pavement drainage systems can be reduced by washing the RPCC before using it in pavement foundation layers.

Based on current research findings, the project TAC recommended an expanded research study to address the following additional research needs:

- Evaluate the seasonal variation effects (dry Fall 2012 versus wet Spring/Summer 2013, etc.) on subdrain outlet condition and performance
- Investigate the condition of composite pavement subdrain outlets
- Examine the effect of resurfacing/widening/rehabilitation on subdrain outlets (e.g., the effects of patching on subdrain outlet performance)
- Investigate the characteristics of tufa formation in Iowa subdrain outlets (i.e., identify the factors influencing the tufa formation and prevention, at what stage does tufa formation start influencing subdrain outlet performance, etc.)
- Identify a suitable drain outlet protection mechanism (like a headwall) and design for Iowa subdrain outlets based on a survey of nearby states

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APPENDIX A. ANNOTATED BIBLIOGRAPHY

This annotated bibliography includes key references related to subsurface drainage (including almost verbatim abstracts/conclusions from each reference) which have been summarized in the body of the report. The bibliography is organized by: (1) study levels (national or state) and (2) publication year.

NCHRP Studies

TRB.1997. *Pavement Subsurface Drainage Systems*. NCHRP Synthesis 229, TRB, National Research Council, Washington DC.

TRB. 2000. *Maintenance of Highway Edge drains*. NCHRP Synthesis 285, TRB, National Research Council, Washington DC.

Two NCHRP Syntheses discussed the need for the maintenance of highway edge drain systems and the associated practices and procedures. The significant conclusions identified are reproduced as follows:

- Pavement subsurface drainage is a major factor in extending the life of a pavement.
- Although performance indicators to qualify the benefits of pavement subsurface drainage systems have not been established, use of a permeable base with a free-draining outlet system generally has demonstrated the best performance of all subsurface drainage strategies.
- The cost of pavement drainage system is high in terms of materials, construction, and maintenance, but the extended pavement life anticipated appears to make these systems cost-effective.
- There is a significant cost in terms of poor performing pavements to agencies that use edge drains and do not have an effective preventive maintenance program.
- A plugged subsurface drainage system may be worse than having no drainage system at all because the pavement system becomes permanently saturated.
- Edge drain failures have occurred where the water could not get out of the base fast enough (e.g., no pipe outlets, plugged outlets, crushed outlets, clogged filters, or clogged drains). Many drainage system failures are traced to poor construction and inspection.
- There is an apparent disconnect between maintenance, design and construction in many state agencies.

Harrigan, E. T. 2002. *Pavement of Pavement Subsurface Drainage*. NCHRP Synthesis 268, TRB, National Research Council, Washington DC.

This synthesis discussed key finding of NCHRP Project 1-34, “Performance of Subsurface Pavement Drainage.” The main objectives of this report were investigating the contribution of various subsurface drainage design features when improving performance of flexible (AC) and rigid (PCC) pavements and finding the condition that can make the features cost-effective. The significant findings are shown as follows:

- The subsurface drainage features are properly designed and constructed may decrease the occurrence of key distress types, such as rutting and fatigue cracking of flexible pavements and non-doweled joint faulting of jointed concrete pavements.

- Good subsurface drainage may decrease the loss of durability and the deterioration of cracks. The exits design features that reduce the effects of excess free moisture in the pavement structure
- Permeable bases (and, in some cases, edge drains by themselves) have the potential to increase pavement life, may be cost-effective, depending on the design situation and site conditions.
- For lower-trafficked JPCP where dowels are not used, a widened lane with a dense-graded base was very cost-effective. For doweled JPCP, both widened lanes and permeable bases were cost effective
- For flexible pavements, thicker layers of asphalt-bound aggregates and full-width paving should be used to prevent moisture from infiltrating from lane or shoulder cracks.

Hall, K. T., and J. A. Crovetti. 2003. *Effects of Subsurface Drainage on Performance of Asphalt and Concrete Pavements*. NCHRP report 499, TRB, National Research Council, Washington, DC.

Hall, K. T., and J. A. Crovetti. 2007. *Effects of Subsurface Drainage on Pavement Performance: Analysis of the SPS-1 andSPS-2 Field Sections*. NCHRP report 583, TRB, National Research Council, Washington, DC.

Under two of NCHRP Projects, Hall and Crovetti (2003, 2007) evaluate how the presence of subsurface drainage affected long-term pavement performance in the LTPP SPS-1 of HMA and SPS-2 of PCC pavement sections. The tests and analyses in these studies did not identify any aspect of the behavior or performance of the HMA and PCC pavement structures in the SPS-1 and SPS-2 experiments that could be shown to have been improved by the presence of subsurface pavement drainage. Instead, the measures of pavement behavior and performance analyzed for these pavements—namely, deflection response, roughness, rutting, faulting, and cracking—were found to be influenced by the stiffness, rather than the drainability of the base layers.

NCHRP. 2012. *Evaluation of Best Management Practices for Highway Runoff Control*. LID Design Manual. National Cooperative Highway Research Program Transportation Research Board, National Research Council.

LID Design Manual is part of NCHRP project, which provided selection guidance toward implementation of best management practice (BMP) and low impact development (LID) facilities for control of storm water quality in the highway environment for the highway engineer. Includes elements of drainage system, design cost, maintenance and pollution prevention.

FHWA Projects

FHWA. 1992. *Drainage Pavement System*. Participant Notebook: Demonstration Project 87, FHWA, Office of Technology Applications and Office of Engineering, Washington DC.

The objective of this project was to provide State highway engineers with current state-of-the-art drainage guidance on the design and construction of permeable bases and edge drains for Portland cement concrete pavements. In this notebook, design drainage, material design, construction, and maintenance were discussed. In the summary part, the manual provided the guidance for aggregate material, hydraulic design for permeable base, and the edged rain system.

Daleiden, J. F., and L. L. Peirce. 1997. "Subsurface drainage systems in roadway construction." *Transportation Research Record: Journal of the Transportation Research Board*, No. 1596, pp. 59-61, TRB, National Research Council, Washington, DC.
The objective of this research was using high-tech, closed-circuit video monitoring system to inspect subsurface drainage systems in roadway construction. The use of this system demonstrated the technology available for this purpose and provided a narrated video record of inspections. The technician can identify on screen the highway, direction of travel, the edge drain type and size, date, and other
Information through the integrated keyboard attached to the camera control unit. The inspection results for each site were listed in the paper, but several limitations were found by researchers, such as the type and size of pipe to be traversed. The analysis of recorded data showed that video inspection was beneficial for maintenance and rehabilitation of existing systems.

Daleiden, J. F. 1998. *Video Inspection of Highway Edgedrain Systems*. FHWA-SA-98-044. Virginia: Federal Highway Administration Office of Highway Infrastructure.
This study demonstrated the capabilities of advanced video technology inspect highway edged rain system and some problems associated with the performance of edged rain system. 287 video inspections of highway edged rain system were conducted in 29 states in US. The results showed that only one third of inspected systems performance as expected, and the rest two third systems had problem such as non-functional outlets and non-functional mainline. This study system showed that video inspection systems were very beneficial for both maintenance and rehabilitation on existing systems as well as a quality control measure for new systems.

Mallela, J., L. Titus-Glover, and M. I. Darter. 2000. "Considerations for providing subsurface drainage in jointed concrete pavements." *Transportation Research Record: Journal of the Transportation Research Board*, No. 1709, pp. 1-9, TRB, National Research Council, Washington DC.
The primary objective of this research is to provide a consistent framework for the design of subsurface drainage systems—specifically permeable base systems—for new or reconstructed jointed concrete pavements (JCP). In this paper, some topics about drainage system were discussed, such as determining drainage needs, permeable base system components, and hydraulic design of permeable base systems, structural design of permeable bases and separator layers, and economic considerations for providing drainage. At the end of paper, it is recommended that any future development of mechanistic based pavement design procedures should account directly for the drainage conditions in the pavement by taking into account performance data available from the LTPP database.

FHWA. 2002. *Construction of Pavement Subsurface Drainage Systems.* Reference Manual. Office of Pavement Technology, Federal Highway Administration, Department of Transportation.

This manual provided guidance for the construction of subsurface systems, especially for the permeability base, aggregate separator layer, longitudinal edge drains, and video inspection. In Chapter 4, pipe edge drains, trench design, geocomposite fin drains, and outlet pipes were described in details.

Baumgardner, R. H. 2002. *Maintenance of Highway Edgedrains.* U.S. Department of Transportation, Federal Highway Administration. https://www.fhwa.dot.gov/Pavement/concrete/edge.cfm (Accessed February 2012).
The objective of this study was identifying maintenance problems for edged rain system. The investigated results are shown as follow:

- Often outlets cannot be found because they are hidden by vegetative growth.
- Use concrete headwalls, reference markers, signs on fences, reflector disks in the shoulder, or painted arrows on the shoulders have better success in providing maintenance.
- Video inspection of edge drains is good for maintenance.
- If flexible corrugated plastic pipe has been used as an edged rain, the pipe will not be perfectly straight since the pipe has a tendency to coil during the laying process. Flushing or jet rodding the system is important in the maintenance scheme.

Mallela, J., G. Larson, T. Wyatt, J. Hall, and W. Barker. 2002. *User's Guide for Drainage Requirements in Pavements in Pavements- DRIP 2.0 Microcomputer Program.* User's Guide. Washington DC: Office of Pavement Technology Federal Highway Administration.
The objective of this user's Guide is providing instructions for operating the updated version of DRIP 2.0, a Windows-based microcomputer program for drainage analysis, which included software overview, program installation and uninstallation, program operations, and technical basis.

California

Bhattacharya, B. B., M. P. Zola, S. Rao, K. Smith, and C. Hannenian. 2009. Performance of edge drains in concrete pavements in California. Proceedings of National Conference on Preservation, Repair, and Rehabilitation of Concrete Pavements. St. Louis, Missouri, April 21-24, 2009, pp. 145-158.
The objective of this study was to evaluate the performance of edge drain system and find any factors that could improve their effectiveness for the Portland cement concrete (PCC) pavements in California. For the site selection, 24 sites were chosen from 30 counties, which include both retrofit and original construction edge drain projects. In addition, another 9 sites were selected for further evaluation by excavating the shoulder. A visual pavement survey was conducted for each site. During the survey, the condition of different types of edge drain systems and various distress types for the pavement were recorded to evaluate the performance of edge drain system. After analyzing the records form the survey, researchers from the California Department of Transportation (Caltrans) found that the majority of the edge drain had little or no maintenance, and a number of outlets were totally clogged by dirty or covered by the overgrown vegetables. Nevertheless, there was no significant correlation between observed pavement distresses

and clogged edge drains. Comparing with retrofit edge drain project, original projects have better performance because of larger diameter drainpipes, deep trenches, and treated permeable bases. In high rainfall areas, edge drain systems had better performance than that in low rainfall areas. Moreover, the majority of the edge drain trenches in retrofit projects were not deep enough to collect all infiltrated water from PCC and base layers. The study also showed that the geo-textile filter fabric materials for edge drain system were not soil-specific, which would cause outlet clog. In addition, improper construction procedures or practices could reduce the function of the edge drain system, as could improper placement of geo-fabric.

Corps of Engineers Studies

Allen, W. L. 1991. *Subsurface Drainage of Pavement Structures.* CRREL Report 91-22. U.S. Army Cold Regions Research and Engineering Laboratory, U.S. Department of Transportation.

The objective of this report was to summarize drainage criteria for pavements found in Corps of Engineers documents. These documents included relative paper or material published by Corps of Engineers, the FHWA, AASHTO and several states and universities. The criteria mainly composed by estimation of precipitation, infiltration and the flow capacity of drained pavements and design of pavement drainage. The criteria produced by Corps of Engineers for drainage of pavement system still needed to be improved, such as design drainage systems for cold regions.

Illinois

Stein, J. S., and B. J. Dempsey. 2004**.** *Performance Evaluation of Longitudinal Pipe Underdrains.* Project Report, IL: Department of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign.

The objective of this research was to evaluate the Illinois DOT (IDOT) longitudinal pipe under drain design procedure and develop guidelines for improved performance and cost savings. This study was divided into four phase.

- This first phase was a full lab study for three longitudinal drain designs in Illinois.
- The second phase was finding the relationship between drainage pipe holes and aggregate envelope and the amount of fines that migrate into the pipe. In this phase, researchers develop an index test for different combinations of envelope materials and pipe slot sizes. Then using this test to compare the relative performance of four envelope aggregate gradations with three slot sizes.
- The second phase was investigating hydraulic properties of IDOT FA4 gradation and its suitability as an envelope material. The objective of this procedure was testing the hydraulic conductivity for the selected soil sample.
- The last phase was using geotextiles for soil filtration to prevent clogging of the drain system. In this phase, researchers obtained four different geotextiles and attempted to identify clogging potential with two different tests, includes Gradient ratio Test and Hydraulic Conductivity Ratio Test.

The conclusions from this study are shown as follows:

- The use of an open-graded FA4 sand back-fill as an envelope material without a geotextile wrap in highway edge drains is a viable design.
- The standard pipe slot size of less than 2 mm in width is small enough to keep most of the FA4 envelope from infiltrating into the pipe.
- Neither one of the standard tests for geotextile clogging, the Gradient Ratio Test nor the Hydraulic Conductivity Ratio Test identified soil-geotextile combinations that would clog in the field.

Indiana

Espinoza, R. D., P. L. Bourdeau, and T. D. White. 1993. *Pavement Drainage and Pavement-Shoulder Joint Evaluation and Rehabilitatio*n. Final Report, FHUA/TN/.THRP 93/2. IN: Indiana Department of Transportation, Purdue University.

Researchers at Purdue University conducted this study to provide highway engineers with a methodology to analyze the water migration and drainage into pavement systems. A numerical model was introduced in this report, and this model was a finite difference formulation of the equations of water flow in unsaturated porous media. In addition, a computer program named PURDRAIN was tested using available experimental data. The conclusion of this study is shown as follows:

- Using numerical examples that the rate of drainage is not only dependent upon the soil hydraulic conductivity but also on the soil water retention characteristics.
- Using numerical examples that depending on the unsaturated hydraulic characteristics, large degrees of saturation may be expected below the pavement slab even after several hours of drainage.
- Modeling coupled saturated-unsaturated flow problems is in general more difficult than modeling separately saturated or unsaturated conditions.

Ahmed, Z., White, T. D., and P. L. Bourdeau. 1993. *Pavement Drainage and Pavement-Shoulder Joint Evaluation and Rehabilitation.* Publication FHWA/IN/JHRP-93/02-2. Joint Highway Research Project, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana.

Hassan, H. F., T. D. White, R. McDaniel, and D. Andrewski 1996. “Indiana Subdrainage Experience and Application.” *Transportation Research Record: Journal of the Transportation Research Board,* No. 1519, pp. 41-50, TRB, National Research Council, Washington DC.

Ahmed et al. (1993) and Hassan et al. (1996) present the applications of pavement subdrainage in the state of Indiana. They evaluated pavement subdrainage systems by using internal inspection of drain and measuring hydraulic properties of different types of subgrade, base, and subbase. Based on research and observations, several modifications in the subsurface drainage policy in Indiana have been implemented as follow.

- Use of geocomposite drains stopped after September 1995. They were replaced with edge drains using Group K pipes
- Cast, or in-place, concrete pads, or pillows, are being proposed to replace the pre-cast concrete outlet protectors currently used.
- An inspection and maintenance program has been implemented

- Inspection of all edge drains would be required on all new construction projects

Hassan, H. F., and T. D. White. 1996. *Locating the Drainage layer for Flexible Pavements.* Publication FHWA/IN/JHRP-96/14.Joint Highway Research Project, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana.
This study focused on the drainage performance of the three candidate sections. The study could be divided into four basic parts: field instrumentation, laboratory testing, analysis of field data, and finite element modeling of pavement drainage. Different instrumentations were installed in the selected sites to measure the properties of materials. In the laboratory part, hydraulic characteristics of materials were obtained and analyzed. Finally, a Numerical modeling was built to simulate and analysis different pavement conditions. Based on the study, 12 conclusions were listed in the reports. For the outlet pipe, researchers found that the outflow pipe has limited capacity, even without the contamination.

Ahmed, Z., T. D. White, and T. Kuczek. 1997. "Comparative field performance of subdrainage system." *ASCE: Journal of Irrigation and Drainage Engineering* 123:3
Ahmed et al. (1997) conducted a study to evaluate and compare drainage layer and collector system effectiveness for various types of in-place pavements in Indiana. Data were recorded by researchers from seven selected sites, includes precipitation and edge drain outflow. Data collected from instrumented sites show varying response rates and time of outflow with respect to precipitation for pavement and collector types. The results showed that Pavement-shoulder joints were found to be the major source of surface infiltration. Statistical analysis has shown significant influence of base permeability in addition to pavement and drain types on outflow volumes.

Hassan, H. F., and T. D. White. 2001. "Modeling pavements subdrainage system." *Transportation Research Record: Journal of the Transportation Research Board*, No. 1772, pp. 137-141, TRB, National Research Council, Washington DC.
In this project, Hassan et al. (2001) conducted an extensive study of pavement subdrainage systems. Three test sections were located at I-469, Indiana, which were constructed as part of a new bypass. Different Instrumentation was installed in the test sections during construction, includes sensors to measure temperature, frost, and moisture, Tipping bucket flow meters, and rain gauge. Besides that, several laboratory tests were also conducted during the study, as hydraulic conductivity tests and conventional saturated permeability, moisture-suction tests. Data were recorded for the three sections for 3 years. The conclusion of this project was the infinite element method is effective for analysis of complex pavement subdrainage systems.

Iowa

Steffes, R. 1999. Laboratory Study of the Leachate From Crushed Portland Cement Concrete Base Material. Final Report, MLR-96-4. IA: Iowa Department of Transportation.
This study focused on the high PH value of water flowing out of the longitudinal drains on projects having recycled PCC drainable bases. High PH water made crystalline deposits grow on the drain outlet wire mesh rodent guard and sometimes block the pipe.

The objective of this research was to simulate drainage of water through recycled crushed PCC base material and record the resultant change of pH in the water.

Three types of material were located at three narrow and long boxes, and distilled water was poured with aggregate in the boxes. The pH of water left from the boxes was recorded. The conclusions of the tests are showed as follow:

- High pH levels of drainage water will continue high for many years following construction.
- The high pH drainage water will leave precipitates at the edge drain outlets, which will made crystalline deposits grow on the drain outlet wire mesh rodent guard.
- The high pH of the drainage water can kill or impede grass growth at the drain outlet.
- Soil erosion may occur from a loss of vegetation growth at drain outlets, which have high pH.

Graziano, F., S. Stein, E. Umbrell, and B. Martin. 2001. *Hydraulics of Slope-Tapered Pipe Culverts*. Final Report, FHWA-RD-02-0077. VA: Office of Infrastructure Research and Development, Federal Highway Administration.

This report was about the design procedure for circular, slope-tapered concrete culverts in Iowa State. In this study, new inlet control design constants and entrance loss coefficients were calculated, which were used to compare with the HDS-5 coefficient. The research results showed that the taper ratio and the number of reducers do not seem to affect the energy loss through the slope-tapered inlets or the transition between inlet control and outlet control for smaller culvert slopes.

Muste, M., R. Ettema, H. C. Ho, and S. Miyawaki. 2009. *Development of Self-Cleaning Box Culvert Design*. Final Report for IHRB TR-545. IA: The Iowa Department of Transportation, the University of Iowa.

Muste, M., H. C. Ho, and D. Mehl. 2009. *Insight into the Origin and Characteristics of the Sedimentation Process at Multi-Barrel Culverts in Iowa*. Final Report for IHRB TR-596. IA: The Iowa Department of Transportation, the University of Iowa.

These studies were focused on the design and implementation of self-cleaning culverts, and tried to configure culverts to prevent the formation of sediment deposits after culvert construction or cleaning. For the design procedure of self-cleaning culverts, the study was divided into three parts. Part 1: Conducting field observations to investigate typical sedimentation pattern, Part 2: Conducing laboratory experiments to test alternative self-cleaning concepts applied to culverts, this step was also used for modeling sedimentation process. This last part was building numerical simulations to enhance the understanding of the sedimentation processes.

In the second publication, researchers had deeply investigation about the culvert sedimentation process and culvert sedimentation mechanics. The study procedure was same as they used in the first paper, which include literature researches, field and laboratory experiments, and Numerical simulation.

These two studies showed that the research team has available a set of experimental tools and procedures to tackle new research geometries and flow conditions for the Iowa culverts. The experiences and knowledge will used to formulate guidelines to retrofit existing culverts and to improve the design specifications in order to provide sediment deposition mitigation.

Kentucky

Fleckenstein, L. J., and D. L. Allen. 1996. “Evaluation of pavement edge drains and their effect on pavement performance.” *Transportation Research Record: Journal of the Transportation Research Board*, No. 1519, pp. 29-33, TRB, National Research Council, Washington DC.

Researchers from Kentucky Transportation Center evaluated the performance of edge drain system. Four factors were considered for the evaluation: construction, maintenance, performance of the edge drain backfill and geotextile, and the lateral effectiveness of pavement edge drains across the pavement structure. The significant conclusions identified are as follows:

- Improper construction and less or no maintenance reduce the service life of edge drainage system. Sufficient maintenance could prevent premature pavement failures.
- The san-slurry backfill used for panel drains can reduce construction damage. During construction, proper backfill density could reduce trench settlement and structural damage to the panels.
- Double-wall, smooth-lined, corrugated polyethylene pipe can decrease pipe failures in the edge drain outlet pipe, but the single should not use for outlet pipe or inside the headwall.
- The gradation analysis showed that sand prevent the fines enter the geotextile from broken concrete immediately after construction, which act as a filter.
- Test subgrade moisture indicated that edge drain can help drain off water laterally across the pavement structure, and FWD data showed that edge drains could drain off water to increase the subgrade strength and pavement life. In addition, RI data also showed that edge drain could increase pavement life.
- Edge drain system was cost effective in most cases.

Mahboub, K. C., Y. Liu, and D. L. Allen. 2003. *Evaluation and Analysis of Highway Pavement Drainage*. Research Report KTC-03-32/SPR207-00-1F. Kentucky: Kentucky Transportation Center, University of Kentucky.

Researchers at Kentucky Transportation Center evaluated the drainage characteristics of some key pavement in Kentucky. The SEEP/W option in the GEOSLOPE computer tool was used as computational tool. Analysis method used in the study was finite element models, which can determine the flow paths and water flux quantities through the cross-sectional area of the pavement. The conclusion was shown as follows:

- Broken and seated PCCP works as an effective drainage layer
- A superpave surface has higher permeability, and it reduce the water quantity that goes through the sides of the pavement
- A centrally-located, longitudinal drain can change the flux distribution in the pavement and therefore improve the drainage efficiency of the pavement
- The increase of the cross slope of the drainage blanket can increase the drainage ability of the pavement

Louisiana

Tao, M., and M. Y. Abu-Farsakh. 2008. *Effect of Drainage in Unbound Aggregate Bases on Flexible Pavement Performance.* Final Report: FHWA/LA.07/429. Louisiana, Louisiana Transportation Research Center.

The study was conducted to determine a proper/optimum gradation through laboratory testing for unbound aggregates of Mexican limestone that are commonly used in Louisiana highways. The properties of the Mexican limestone with various gradations were determined by a series of laboratory tests. The results showed that

- The coarse branches of Louisiana class II gradation outperform the fine counterpart in terms of permanent deformation and hydraulic conductivity.
- CBR and DCP values may not be good properties to differentiate performance of unbound aggregate with different gradations.
- An optimum gradation is identified, which outperforms current Louisiana class II base gradation in terms of both structural stability and permeability.

Minnesota

Hagen, M. G., and G. R. Cochran. 1996. "Comparison of pavement drainage systems." *Transportation Research Record: Journal of the Transportation Research Board*, No. 1519, pp. 1-7, TRB, National Research Council, Washington DC.

This study conducted a sensitivity analysis of input parameters such as drainage flows, percent of rainfall drained, time to drain, base and subgrade moisture content, and pavement and joint durability to evaluate the performance of various drains and their effect on pavement performance. Four drainage systems under joint PCC pavements were selected by researchers from the Minnesota Department of Transportation (MnDOT), including the MnDOT standard dense-graded base, two dense-graded base sections incorporating transverse drains placed under the transverse joints, and permeable asphalt-stabilized base. The results showed that the permeable asphalt-stabilized base can remove water the most efficiently within two hours after rainfall ended. About 40 percent of rainfall gets into the concrete pavement, and spring thaw flows are roughly equal to a major rain event. Moreover, sealing the longitudinal and transverse joints can reduce rain inflow. Reducing panel lengths was a good method to prevent mid-panel cracking.

Snyder, B, and J. E. Bruinsma. 1996. "Review of studies concerning effects of unbound crushed concrete bases on PCC pavement drainage." *Transportation Research Record: Journal of the Transportation Research Board*, No. 1519, pp. 51-57, TRB, National Research Council, Washington DC.

This paper was concerned with the deposit of Recycled concrete aggregate (RCA) associated fines and precipitate suspected of reducing the drainage capacity of RCA base layers and associated drainage systems. Four sites were selected for field studies in Minnesota. Five laboratory studies by DOTs or universities of different states were also described in the paper. The field tests and studies showed that calcium based compounds are present in recycled concrete aggregates in quantities that are sufficient to be leached and precipitated in the presence of atmospheric carbon dioxide. Insoluble, non-carbonate-based residue makes up a major portion of the materials found in and around pavement drainage systems. Precipitate and insoluble residue accumulations can produce significant reductions in the permittivity of typical drainage filter fabrics.

Voller, V. 2003. *Designing pavement Drainage Systems: The MnDrain Software.* Final Report MN/RC - 2003-17 Minnesota, MN: Department of Civil Engineering, University of Minnesota.

In this report, Voller (2003) introduced the development of MnDrain, which was a suite of computer codes embedded in a Microsoft Excel spreadsheet. User can use this software to investigate the consequences of an edge drain design decision. In order to demonstrate the operation of the MnDrain code and the CVFE solution used in MnDrain, Voller outline some of the basic concepts used in modeling variably saturated flow, includes variables, moisture flux, and Richards Equation. Moreover, software elements, material data and boundary conditions were also discussed in the report. In the conclusion part, the attributes and some disadvantages of MnDrain were listed. This report has shown that MnDrain can compete, in terms of accuracy and flexibility, with existing commercial codes, which means MnDrain can be reconfigured to deal with a large array of pavement drainage issues.

Arika, C. N., Canelon, D. J., and J. L. Nieber. 2009. *Subsurface Drainage Manual for Pavements in Minnesota.* Final Report MN/RC 2009-17. MN: University of Minnesota, Minnesota Department of Transportation.

This manual provided guidance for the design and evaluation of subsurface drainage system in Minnesota. Besides introducing different types of subsurface system, selection, design, cost and maintenance of drainage system were also described in the manual.

Canelon, D. J., and J. L. Nieber. 2009. *Evaluating Roadway Subsurface Drainage Practices.* MN/RC 2009-08. Minnesota: Minnesota Department of Transportation Research Services Section.

The main objective of this study was to look at the efficiency of edge drains compared to centerline drains, and the selected sites were located between the towns Worthington and Rushmore in Minnesota.

Three drainage treatments were examined. Besides one edged rain, two centerline drains were located at depths of 2 ft and 4 ft respectively. An electromagnetic instrument was installed to Measure the electrical conductivity for different drain configurations, and Statistical analyses were used for the collected data. The conclusion identified is shown as follow:

- The edged rain treatment yielded by far the greatest volume of drainage water during the two-year period of monitoring
- Regarding road elevation, considering all drain treatments, drains at relatively low elevations had a higher drain volume during the March and April monitoring periods, but during the rest of the year the drainage volumes did not have a tendency to depend on elevation.
- Overall, the edged rain treatments had lower bulk electrical conductivity.
- The outcome of a given drain configuration depends heavily on the hydraulic properties of the native subgrade material, the depth and degree of compaction of the subgrade material, and the depth of the drain.

- The electromagnetic method for indexing the bulk moisture content beneath pavements has high potential for success.

Nieber, J. 2009. *Evaluating Roadway Subsurface Drainage Practices*. Technical Summary. University of Minnesota, Local Road Research Board (LRRB).
Centerline drain system was proposed by engineers as an alternative to edge drain system. Nieber (2009) conducted some tests to contrast the performance of two systems to find which system was better for highway design. The team installed various combinations of edge drains at the shoulders and another two centerline drains located at 2 ft depths and 4 ft depths beneath the pavement surface, respectively. Drainage volume, on-site moisture data, and pavement material data were recorded by researchers. Finally, researchers found that it’s better to retain edge drain systems for highway and urban roadway design. However, centerline drain systems will be a good selection when the subgrade of the highway is permeable.

Nieber, J. 2010. *Subsurface Drainage Manual for Minnesota Pavements*. Technical Summary. University of Minnesota, Local Road Research Board (LRRB).
The objective of this project was to create a manual that would be specific to Minnesota conditions, which taking into account the variability of the soils, hydrology and climate of the state. John Nieber with his team from University of Minnesota conducted a detailed literature review about pavement drainage system, and they complied and augmented this information to create this manual. This manual introduced key factors determining the need for subsurface drainage, selection and maintenance of pavement subsurface drainage systems.

New Jersey

Zaghloul, S., A. Ayed, Z. Ahmed, B. Henderson, J. Springer, and N. Vitillo. 2007. “Effect of positive drainage on flexible pavement life-cycle cost.” *Transportation Research Record: Journal of the Transportation Research Board*, No. 1868, pp. 135-141, TRB, National Research Council, Washington DC.
This study tried to use a structural adequacy index to assess the pavement structural service life, and then presented a methodology to quantify the effect of moisture infiltration in pavement on its service life. The 24 selected sites were in New Jersey. The test sections are instrumented to measure volumetric moisture content, pavement temperature, freeze–thaw depths, groundwater depth, and climatic measurements continuously. The results showed that poor subsurface drainage made base course moisture content increase, which decrease pavement service life. In addition, good subsurface drainage could increase the structural service life of the pavement significantly.

New Mexico

Stormont, J. C., and S. Zhou. 2001**.** *Improving Pavement Sub-surface Drainage Systems by Considering Unsaturated Water Flow.* Cooperative agreement DTFH61-00-X-00099. NM: Department of Civil Engineering, University of New Mexico.

The study focused on the understanding of pavement subsurface drainage systems, which include unsaturated water flow. The first task was conducted a literature review and identify attributable pavement quality problems for drainage system. Then the performance of existing drainage system was evaluated. After the first two steps, A simulation was conducted with a gravel-filled trench that extended the width of the trench from the trench bottom to the top of the pavement, and results of this simulation were be used to compare to the baseline simulation. The analysis data is necessary for researchers improving the existing drainage systems. According to the selected data, researchers summarized eleven conclusions about unsaturated water flow, moisture conditions, subgrade wetting, trench system, geocomposite capillary barrier drain, geotextile clogging, and properties of base course and subgrade.

Stormont, J. C., and S. Zhou. 2005. "Impact of unsaturated flow on pavement edge-drain performance." *Transportation Research Record: Journal of the Transportation Research Board*, No. 131, pp. 46-53, TRB, National Research Council, Washington DC.
The study focused on the impact of unsaturated flow on pavement edged rain performance. Simulations were conducted to investigate water movement in and around edged rain trenches, and two selected sites had different base course materials as well as different edged rain. Then simulations were conducted with the VS2DHI computer program developed by the USGS. This program was used in a wide range of applications involving unsaturated water flow in the near surface, employing various model configurations and conditions. Results of simulations are shown as follow:

- The performance of the edged rain trench depends on whether water directly enters the trench or has to first move through a finer grained soil.
- The conventional base course material produces more drainage than the permeable base for comparable trench configuration and backfill materials.
- Conventional design guidance for assessing the adequacy of base course materials for drainage (which are based on saturated hydraulic conductivity) may not always result in optimal drainage performance due to unsaturated flow.
- A reasonable backfill selection strategy may be to select a material that can accept the anticipated maximum flow from the base course using saturated flow assumption.

Ohio

Christopher, B. C., and A. Zhao. 2001. *Design Manual for Roadway Geocomposite Underdrain Systems.* Ohio: Contech Engineered Solutions.
This study provided design guidance for a new alternative drainage method, which includes a horizontal geocomposite drainage layer tied directly and continuously into an edged rain system. In this manual, solutions for both conventional and geocomposite layer were discussed. Moreover, requirements for edge drain and outlet, drainage geocomposites, Permeable layer and geotextile filter were also provided in the manual.

Long, A. R., and A. M. Ioannides. 2007. "Drainage evaluation at the U.S. 50 joint sealant experiment." *Journal of Transportation Engineering*, Vol. 133(8), pp.480 - 489, *ASCE*.
The objective of this paper is to demonstrate how a lack of maintenance can affect the subsurface drainage system and determine the adequacy of the subsurface drainage

design incorporated at the project site. Long and Ioannides conducted a study of the subsurface drainage features of the test pavement at the U.S. 50 joint sealant experiment near Athens, Ohio, and they found subsurface drainage system was lack of proper design and maintenance. Most of the outlets were clogged by dirty or covered by overgrown vegetable. The specified base thickness and permeability combination do not meet federal guidelines. The drainage capabilities were assessed by the software DRIP 2.0, distributed by the Federal Highway Administration, but there were no design calculations before the design construction. Researchers conducted a literature review to the performance of Permeable Bases and drainage system in different state in US, and they found drainage system lack proper design and maintenance were a common phenomenon. Based on the research, some recommendations were reproduced as follow:

- Implement a drainage outlet maintenance program that includes cleaning silt and debris from the outlets on an annual basis.
- Subsurface drainage parameters should not only depend on software or any current means approved by the FHWA, but also ensure design match with the local climatology and geology.
- Remove and replace all sealants having an average effectiveness below 75% to prevent water into the joint.
- Monitor joint sealant and performance should extend over both sealed and unsealed test section.

Tennessee

Rainwater, N. R., G. Zuo, E. C. Drumm, W. C. Wright, and R. E. Yoder. 2001. “In situ measurement and empirical modeling of base infiltration in highway pavement systems.” *Transportation Research Record: Journal of the Transportation Research Board*, No. 1772, pp. 143-149, TRB, National Research Council, Washington DC.

Rainwater et al. (2001) presented the application of monitoring method and modeling approach for base infiltration in highway pavement systems. The test was through installing Free-drainage lysimeters at three sites in Tennessee to monitor the movement of water in the pavement. Based on the recorded precipitation data, researchers developed a model to predict the measured infiltration, and the amount of water that would infiltrate into the stone base and eventually into the soil subgrade. This project showed that Free-drainage lysimeters are an effective method for monitoring the sources and movement of water in pavement systems, but the installation of lysimeters is labor intensive. In addition, the instrumentation and modeling techniques were demonstrated on a new pavement system with a permeability that was larger than the expected for most new pavement.

Virginia

Diefenderfer, B. K., K. Galal, and D. W. Mokarem. 2005. *Effect of Subsurface Drainage on the Structural Capacity of Flexible Pavement.* Final Report VTRC 05-R35. VA: Virginia Transportation Research Council.

The objective of this project is to determine the effectiveness of including subsurface drainage systems in pavements in Virginia. Besides conducting a literature review, researchers compared the strengths of pavement sections with and without a subsurface drainage layer in a limited field investigation involving two pavement structures. A falling-weight deflectometer (FWD) was used for field tests to measure the structural capacity of in-service pavements nondestructively. After the data analysis, the conclusions were as follows:

- The FWD appears to be an effective tool in evaluating the performance of a drainage layer as it contributes to the structure of the pavement system.
- The drainage layer appears to impact the in situ SN positively in the two projects investigated. The drainage layer does not influence the measured deflection negatively.
- The in-situ subgrade resilient modulus was influenced positively for only one of the two projects investigated.
- Maintaining drainage outlet pipes was very important for the drainage system.
- Subsurface drainage features do not appear to be benefiting the Route 19 location, possibly due to the pavement being located in primarily a rock-filled area.

Others

Raymond, G.P., R. J. Bathurst, and J. Hajek. 1999. "Evaluation and Suggested Improvements to Highway Edge Drains Incorporating Geotextiles." *Geotextiles and Geomembranes*. Canada: Ministry of Transportation.

The objective of this study is to evaluate the performance of various types of geosynthetic edge drains at selected locations on Ontario highways. Three types of geosynthetic drains systems were excavated in six selected sites include geocomposite edge drains, geotextile-wrapped pipe edge drains and geotextile-wrapped aggregate edge drains. The main observation results for three types of geosynthetic edge drains system are shown as follow:

- The installation of a drainage system does not prevent pumping.
- Lean concrete, cement treated base, and geotextile can prevent the migration of clay or silt sized subgrade fines.
- All recovered geotextile sock-warped pipe installed using the ploughed-in-place method were severely damaged with many holes of 10 mm size. Outlet pipe trenches must have slope and inverts low enough to discharge all edge drain trench water.
- Drains that were installed adjacent to and in contact with the pavement edge soon became separated from the pavement edge by eroded/pumped fine soil particles seriously compromising the performance of the pavement subdrain systems, particularly where an open-graded drainage layer (OGDL) was used.
- The granular backfill was considerably (up to 1000 times) less permeable than the geotextiles used for the edge drains.

Fwa, T. F., S. A. Tan, and Y. K. Guwe. 2001. Rational basis for evaluation and design of pavement drainage layer. *Transportation Research Record: Journal of the Transportation Research Board*, No. 1772, pp. 175-179, TRB, National Research Council, Washington DC.

Researchers from University of Singapore proposed two procedures for a rational evaluation or design of pavement drainage layers based on engineering principles by using new permeability measuring apparatus. The first one is using an expedient laboratory falling-head test to determine the permeability of drainage materials, and the second one is through laboratory clogging test to assess the clogging potential of the proposed material and thickness. These two procedures provide the basis for a rational framework of drainage capacity design for pavement drainage layers. This study demonstrated that the practical expedient laboratory procedures make rigorous drainage analysis and design of pavement drainage layers possible now.

Nijland, H. J., F. W. Croon, and H. P. Ritzema. 2005. *Subsurface Drainage Practices: Guidelines for the Implementation, Operation and Maintenance of Subsurface Pipe Drainage Systems*. Wageningen, Alterra, ILRI Publication.
The handbook focused on the construction process of subsurface pipe drainage systems. The planning, organization, and installation techniques and the information for improving the quality of pipe drainage installation were discussed. In the end of this handbook, some case studies about subsurface drainage system from other counties were also described. However, because of copyright issues, only part of this book can be seen.

Aho. S., and T. Saarenketo. 2006. *Managing Drainage on Low Volume Roads.* Executive Summary. Swedish: The Swedish Road Administration, Northern Region.
This executive summary focuses on the drainage problem classification, monitoring methods. The effect of the poor drainage to pavement performance, drainage improvement techniques and their life cycle costs were also described. Researchers found that the main reason for the short lifetime of low volume roads was inadequate maintenance.

Napper, C. 2008. *Soil and Water Road-Condition Index -Desk Reference.* U.S. Department of Transportation and USDA Forest Service.
The objective of this project was providing a road condition assessment tool that named Soil and Water Road-Condition Index -Desk Reference (SWRIC) for watershed- and project-scale analysis. SWRIC is used to identify effects of roads to soil quality and function, and impacts to water quality and downstream values. This reference contained two main parts. The first part was characterizing the Road, such as road surface shape and road gradient. The second part was identifying related indicators for road-surface system, included Road-Stream Connectivity and Stream-Crossing Structure Condition.

Lebeau, M., and J. Konrad. 2009. “Pavement subsurface drainage: importance of appropriate subbase materials.” *Canadian Geotechnical Journal.* 46(8): 987-999.
Lebeau and Konrad (2009) focused on the effect of subbase material characteristics under saturated and unsaturated conditions. The objective of this paper was to extend current drainage design by accounting for the presence of a pervious subbase layer. Multilayer time-to-drain method was used to access the impact of a pervious underlying subbase layer on hydraulic design. Then a numerical model for saturated-unsaturated was builds for the study. The conclusion for this study is shown as follow:

- Specific subbase materials were linked to different hydraulic behavior.
- Course or large-pored subbase materials were prone to the formation of a capillary barrier.

- Fine-pored subbase materials with a large air-entry value and high hydraulic conductivity were more likely to favor downward flow.
- The saturated hydraulic conductivity of the subbase material and the effective relative hydraulic conductivity of the subbase material at the interface of the base and subbase layer effected drainage time of a multilayer pavement.

APPENDIX B. FIELD INVESTIGATION RESULTS

Table B.1. JPCP site information

ID	Route	Dir	Bpst	Epst	County	Pave Type	Oshld Type	Subbase Agg Typ	Con Yr	Construction Project	AADTT	PCC	Base	Subbase Thick
I-35/N/MP140.22	I-35	1 (North)	140.19	142.07	Hamilton County	JPCP	HMA	RPCC	2003	IM-35-6(94)140--13-40	4,945	11.5	10.2	0.0
I-35/N/MP140.35	I-35	1 (North)	140.19	142.07	Hamilton County	JPCP	HMA	RPCC	2003	IM-35-6(94)140--13-40	4,945	11.5	10.2	0.0
I-35/N/MP140.60	I-35	1 (North)	140.19	142.07	Hamilton County	JPCP	HMA	RPCC	2003	IM-35-6(94)140--13-40	4,945	11.5	10.2	0.0
I-35/N/MP140.80	I-35	1 (North)	140.19	142.07	Hamilton County	JPCP	HMA	RPCC	2003	IM-35-6(94)140--13-40	4,945	11.5	10.2	0.0
I-35/N/MP141.30	I-35	1 (North)	140.19	142.07	Hamilton County	JPCP	HMA	RPCC	2003	IM-35-6(94)140--13-40	4,945	11.5	10.2	0.0
I-35/N/MP143.30	I-35	1 (North)	143.28	143.91	Hamilton County	JPCP	HMA	RPCC	2003	IM-35-6(94)140--13-40	3,984	11.5	10.2	0.0
I-35/N/MP143.45	I-35	1 (North)	143.28	143.91	Hamilton County	JPCP	HMA	RPCC	2003	IM-35-6(94)140--13-40	3,984	11.5	10.2	0.0
I-35/N/MP143.65	I-35	1 (North)	143.28	143.91	Hamilton County	JPCP	HMA	RPCC	2003	IM-35-6(94)140--13-40	3,984	11.5	10.2	0.0
I-35/S/MP 129.00	I-35	2 (South)	126.04	131.03	Hamilton County	JPCP	HMA	RPCC	1999	IM-35-5(71)111--13-85	5,033	11.8	10.2	0.0
I-35/S/MP 128.00	I-35	2 (South)	126.04	131.03	Hamilton County	JPCP	HMA	RPCC	1999	IM-35-5(71)111--13-85	5,033	11.8	10.2	0.0
I-35/S/MP 127.90	I-35	2 (South)	126.04	131.03	Hamilton County	JPCP	HMA	RPCC	1999	IM-35-5(71)111--13-85	5,033	11.8	10.2	0.0
I-35/S/MP 127.85	I-35	2 (South)	126.04	131.03	Hamilton County	JPCP	HMA	RPCC	1999	IM-35-5(71)111--13-85	5,033	11.8	10.2	0.0
I-35/S/MP 127.50	I-35	2 (South)	126.04	131.03	Hamilton County	JPCP	HMA	RPCC	1999	IM-35-5(71)111--13-85	5,033	11.8	10.2	0.0
I-35/S/MP 127.20	I-35	2 (South)	126.04	131.03	Hamilton County	JPCP	HMA	RPCC	1999	IM-35-5(71)111--13-85	5,033	11.8	10.2	0.0
I-35/S/MP 126.00	I-35	2 (South)	111.75	126.04	Story County	JPCP	HMA	RPCC	1999	IM-35-5(71)111-13-85	5,288	11.8	10.2	0.0
I-35/S/MP 123.70	I-35	2 (South)	111.75	126.04	Story County	JPCP	HMA	RPCC	1999	IM-35-5(71)111-13-85	5,288	11.8	10.2	0.0
US-30/W/MP 156.50_1	US-30	2 (West)	151.92	156.80	Story County	JPCP	HMA	Vigin Agg	1992	F-30-5(80)--20-85	1,084	10.0	10.0	0.0
US-30/W/MP 156.50_2	US-30	2 (West)	151.92	156.80	Story County	JPCP	HMA	Vigin Agg	1992	F-30-5(80)--20-85	1,084	10.0	10.0	0.0
US-30/W/MP 156.00	US-30	2 (West)	151.92	156.80	Story County	JPCP	HMA	Vigin Agg	1992	F-30-5(80)--20-85	1,084	10.0	10.0	0.0
US-30/W/MP 155.80	US-30	2 (West)	151.92	156.80	Story County	JPCP	HMA	Vigin Agg	1992	F-30-5(80)--20-85	1,084	10.0	10.0	0.0
US-30/W/MP 153.00	US-30	2 (West)	151.92	156.80	Story County	JPCP	HMA	Vigin Agg	1992	F-30-5(80)--20-85	1,084	10.0	10.0	0.0
I-80/W/MP 132.86	I-80	2 (West)	131.48	132.84	Polk County	JPCP	HMA	RPCC	1997	IM-35-3(69)82--13-77	13,264	12.5	12.0	0.0
I-80/W/MP 132.20_1	I-80	2 (West)	131.48	132.84	Polk County	JPCP	HMA	RPCC	1997	IM-35-3(69)82--13-77	13,264	12.5	12.0	0.0
I-80/W/MP 132.20_2	I-80	2 (West)	131.48	132.84	Polk County	JPCP	HMA	RPCC	1997	IM-35-3(69)82--13-77	13,264	12.5	12.0	0.0
I-80/W/MP 131.85	I-80	2 (West)	131.48	132.84	Polk County	JPCP	HMA	RPCC	1997	IM-35-3(69)82--13-77	13,264	12.5	12.0	0.0
I-80/W/MP 131.80	I-80	2 (West)	131.48	132.84	Polk County	JPCP	HMA	RPCC	1997	IM-35-3(69)82--13-77	13,264	12.5	12.0	0.0
US-6/E/MP 121.30	US-6	1 (East)	121.27	123.38	Dallas County	JPCP	PCC	Vigin Agg	1999	STP-6-3(48)--2C-25	538	10.6	9.8	0.0
I-80/W/MP 104.80	I-80	2 (West)	103.23	105.37	Dallas County	JPCP	HMA	RPCC	1991	IR-80-2(131)99	7,940	12.0	9.0	0.0
I-80/W/MP 103.95	I-80	2 (West)	103.23	105.37	Dallas County	JPCP	HMA	RPCC	1991	IR-80-2(131)99	7,940	12.0	9.0	0.0
I-80/W/MP 103.90_1	I-80	2 (West)	103.23	105.37	Dallas County	JPCP	HMA	RPCC	1991	IR-80-2(131)99	7,940	12.0	9.0	0.0
I-80/W/MP 103.90_2	I-80	2 (West)	103.23	105.37	Dallas County	JPCP	HMA	RPCC	1991	IR-80-2(131)99	7,940	12.0	9.0	0.0
I-80/W/MP 103.40	I-80	2 (West)	103.23	105.37	Dallas County	JPCP	HMA	RPCC	1991	IR-80-2(131)99	7,940	12.0	9.0	0.0
I-80/W/MP 102.35	I-80	2 (West)	101.64	102.41	Dallas County	JPCP	HMA	RPCC	1991	IR-80-2(131)99	7,940	12.0	9.0	0.0
I-80/W/MP 102.25	I-80	2 (West)	101.64	102.41	Dallas County	JPCP	HMA	RPCC	1991	IR-80-2(131)99	7,940	12.0	9.0	0.0
I-80/W/MP 102.07	I-80	2 (West)	101.64	102.41	Dallas County	JPCP	HMA	RPCC	1991	IR-80-2(131)99	7,940	12.0	9.0	0.0
I-80/W/MP 102.00_1	I-80	2 (West)	101.64	102.41	Dallas County	JPCP	HMA	RPCC	1991	IR-80-2(131)99	7,940	12.0	9.0	0.0
I-80/W/MP 102.00_2	I-80	2 (West)	101.64	102.41	Dallas County	JPCP	HMA	RPCC	1991	IR-80-2(131)99	7,940	12.0	9.0	0.0

Table B.1. JPCP site information (continued)

ID	Route	Dir	Bpst	Epst	County	Pave Type	Oshld Type	Subbase Agg Typ	Con Yr	Construction Project	AADTT	PCC	Base	Subbase Thick
I-80/W/MP 59.90	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/W/MP 59.60	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/W/MP 59.50	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/W/MP 58.75	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/W/MP 58.25_1	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/W/MP 58.25_2	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/W/MP 57.65_1	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/W/MP 57.65_2	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/W/MP 57.10_1	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/W/MP 57.10_2	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/W/MP 56.72_1	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/W/MP 56.72_2	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/W/MP 56.00	I-80	2 (West)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1992	IR-80-1(186)43	7,682	12.0	9.0	0.0
I-80/E/MP 55.93	I-80	1 (East)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,682	12.0	9.0	0.0
I-80/E/MP 56.53	I-80	1 (East)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,682	12.0	9.0	0.0
I-80/E/MP 57.00	I-80	1 (East)	55.33	59.90	Cass County	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,682	12.0	9.0	0.0
I-80/E/MP 73.45	I-80	1 (East)	73.32	85.75	Adair County	JPCP	HMA	RPCC	2000	IM-80-2(156)73--13-01	7,810	11.4	10.0	0.0
I-80/E/MP 74.00	I-80	1 (East)	73.32	85.75	Adair County	JPCP	HMA	RPCC	2000	IM-80-2(156)73--13-01	7,810	11.4	10.0	0.0
I-80/E/MP 79.04	I-80	1 (East)	73.32	85.75	Adair County	JPCP	HMA	RPCC	2000	IM-80-2(156)73--13-01	7,810	11.4	10.0	0.0
I-80/E/MP 79.27	I-80	1 (East)	73.32	85.75	Adair County	JPCP	HMA	RPCC	2000	IM-80-2(156)73--13-01	7,810	11.4	10.0	0.0
I-80/E/MP 82.27	I-80	1 (East)	73.32	85.75	Adair County	JPCP	HMA	RPCC	2000	IM-80-2(156)73--13-01	7,810	11.4	10.0	0.0
I-80/E/MP 84.45	I-80	1 (East)	73.32	85.75	Adair County	JPCP	HMA	RPCC	2000	IM-80-2(156)73--13-01	7,810	11.4	10.0	0.0
IA-163/W/MP 20.67	IA-163	2 (West)	16.93	21.44	Jasper County	JPCP	HMA	Vigin Agg	1998	NHSN-163-2(15)--2R-50	1,262	10.0	10.0	0.0
IA-163/W/MP 19.63_1	IA-163	2 (West)	16.93	21.44	Jasper County	JPCP	HMA	Vigin Agg	1998	NHSN-163-2(15)--2R-50	1,262	10.0	10.0	0.0
IA-163/W/MP 19.63_2	IA-163	2 (West)	16.93	21.44	Jasper County	JPCP	HMA	Vigin Agg	1998	NHSN-163-2(15)--2R-50	1,262	10.0	10.0	0.0
IA-163/W/MP 18.82_1	IA-163	2 (West)	16.93	21.44	Jasper County	JPCP	HMA	Vigin Agg	1998	NHSN-163-2(15)--2R-50	1,262	10.0	10.0	0.0
IA-163/W/MP 18.82_2	IA-163	2 (West)	16.93	21.44	Jasper County	JPCP	HMA	Vigin Agg	1998	NHSN-163-2(15)--2R-50	1,262	10.0	10.0	0.0
IA-163/W/MP 17.60	IA-163	2 (West)	16.93	21.44	Jasper County	JPCP	HMA	Vigin Agg	1998	NHSN-163-2(15)--2R-50	1,262	10.0	10.0	0.0
IA-5/E/MP 87.55_1	IA-5	1(East)	85.24	88.09	Warren County	JPCP	Gravel	Vigin Agg	1999	STPN-5-4(40)--2J-91	579	10.0	10.0	0.0
IA-5/E/MP 87.55_2	IA-5	1(East)	85.24	88.09	Warren County	JPCP	Gravel	Vigin Agg	1999	STPN-5-4(40)--2J-91	579	10.0	10.0	0.0
IA-5/E/MP 86.50_1	IA-5	1(East)	85.24	88.09	Warren County	JPCP	Gravel	Vigin Agg	1999	STPN-5-4(40)--2J-91	579	10.0	10.0	0.0
IA-5/E/MP 86.50_2	IA-5	1(East)	85.24	88.09	Warren County	JPCP	Gravel	Vigin Agg	1999	STPN-5-4(40)--2J-91	579	10.0	10.0	0.0
IA-5/E/MP 86.25	IA-5	1(East)	85.24	88.09	Warren County	JPCP	Gravel	Vigin Agg	1999	STPN-5-4(40)--2J-91	579	10.0	10.0	0.0
I-80/E/MP 151.60	I-80	1 (East)	151.48	156.28	Jasper County	JPCP	HMA	RPCC	1993	IM-80-5(164)154--13-50	8,582	12.0	9.0	0.0
I-80/E/MP 152.15_1	I-80	1 (East)	151.48	156.28	Jasper County	JPCP	HMA	RPCC	1993	IM-80-5(164)154--13-50	8,582	12.0	9.0	0.0
I-80/E/MP 152.15_2	I-80	1 (East)	151.48	156.28	Jasper County	JPCP	HMA	RPCC	1993	IM-80-5(164)154--13-50	8,582	12.0	9.0	0.0
I-80/E/MP 153.80	I-80	1 (East)	151.48	156.28	Jasper County	JPCP	HMA	RPCC	1993	IM-80-5(164)154--13-50	8,582	12.0	9.0	0.0
I-80/E/MP 154.55	I-80	1 (East)	151.48	156.28	Jasper County	JPCP	HMA	RPCC	1993	IM-80-5(164)154--13-50	8,582	12.0	9.0	0.0

Table B.1. JPCP site information (continued)

ID	Route	Dir	Bpst	Epst	County	Pave Type	Oshld Type	Subbase Agg Typ	Con Yr	Construction Project	AADTT	PCC	Base	Subbase Thick
I-80/E/MP 161.75_2	I-80	1 (East)	160.35	165.12	Jasper County	JPCP	HMA	RPCC	1996	IM-80-5(184)160--13-50	8,679	12.0	9.0	0.0
I-80/E/MP 164.10	I-80	1 (East)	160.35	165.12	Jasper County	JPCP	HMA	RPCC	1996	IM-80-5(184)160--13-50	8,679	12.0	9.0	0.0
I-80/E/MP 165.40	I-80	1 (East)	165.12	169.57	Jasper County	JPCP	HMA	RPCC	1994	IM-80-5(169)165--13-50	8,847	12.0	9.0	0.0
I-80/E/MP 167.10	I-80	1 (East)	165.12	169.57	Jasper County	JPCP	HMA	RPCC	1994	IM-80-5(169)165--13-50	8,847	12.0	9.0	0.0
I-80/E/MP 169.20_1	I-80	1 (East)	165.12	169.57	Jasper County	JPCP	HMA	RPCC	1994	IM-80-5(169)165--13-50	8,847	12.0	9.0	0.0
I-80/E/MP 169.20_2	I-80	1 (East)	165.12	169.57	Jasper County	JPCP	HMA	RPCC	1994	IM-80-5(169)165--13-50	8,847	12.0	9.0	0.0
I-80/E/MP 169.90	I-80	1 (East)	169.57	174.21	Jasper County	JPCP	HMA	RPCC	1995	IM-80-5(184)160--13-50	9,007	12.0	9.0	0.0
I-80/E/MP 171.90	I-80	1 (East)	169.57	174.21	Jasper County	JPCP	HMA	RPCC	1995	IM-80-5(184)160--13-50	9,007	12.0	9.0	0.0
I-80/E/MP 173.90	I-80	1 (East)	169.57	174.21	Jasper County	JPCP	HMA	RPCC	1995	IM-80-5(184)160--13-50	9,007	12.0	9.0	0.0
IA-330/W/MP 14.15	IA-330	2 (West)	13.25	14.29	Marshall County	JPCP	HMA	Vigin Agg	2002	NHSX-330-2(39)--3H-64	698	10.2	10.2	0.0
IA-330/W/MP 13.80_1	IA-330	2 (West)	13.25	14.29	Marshall County	JPCP	HMA	Vigin Agg	2002	NHSX-330-2(39)--3H-64	698	10.2	10.2	0.0
IA-330/W/MP 13.80_2	IA-330	2 (West)	13.25	14.29	Marshall County	JPCP	HMA	Vigin Agg	2002	NHSX-330-2(39)--3H-64	698	10.2	10.2	0.0
IA-330/W/MP 13.65	IA-330	2 (West)	13.25	14.29	Marshall County	JPCP	HMA	Vigin Agg	2002	NHSX-330-2(39)--3H-64	698	10.2	10.2	0.0
IA-330/W/MP 13.55_1	IA-330	2 (West)	13.25	14.29	Marshall County	JPCP	HMA	Vigin Agg	2002	NHSX-330-2(39)--3H-64	698	10.2	10.2	0.0
IA-330/W/MP 13.55_2	IA-330	2 (West)	13.25	14.29	Marshall County	JPCP	HMA	Vigin Agg	2002	NHSX-330-2(39)--3H-64	698	10.2	10.2	0.0
I-80/E/MP 193.07	I-80	1 (East)	192.82	204.80	Poweshiek County	JPCP	HMA	RPCC	1990	IR-80-6(136)193	8,994	11.5	9.0	0.0
I-80/E/MP 193.20_1	I-80	1 (East)	192.82	204.80	Poweshiek County	JPCP	HMA	RPCC	1990	IR-80-6(136)193	8,994	11.5	9.0	0.0
I-80/E/MP 193.20_2	I-80	1 (East)	192.82	204.80	Poweshiek County	JPCP	HMA	RPCC	1990	IR-80-6(136)193	8,994	11.5	9.0	0.0
I-80/E/MP 195.10	I-80	1 (East)	192.82	204.80	Poweshiek County	JPCP	HMA	RPCC	1990	IR-80-6(136)193	8,994	11.5	9.0	0.0
I-80/E/MP 198.05	I-80	1 (East)	192.82	204.80	Poweshiek County	JPCP	HMA	RPCC	1990	IR-80-6(136)193	8,994	11.5	9.0	0.0
I-80/E/MP 202.35	I-80	1 (East)	192.82	204.80	Poweshiek County	JPCP	HMA	RPCC	1990	IR-80-6(136)193	8,994	11.5	9.0	0.0
I-80/E/MP 206.26	I-80	1 (East)	204.80	209.65	Iowa County	JPCP	HMA	RPCC	1990	IR-80-6(136)193	9,022	11.5	9.0	0.0
I-80/E/MP 207.10	I-80	1 (East)	204.80	209.65	Iowa County	JPCP	HMA	RPCC	1990	IR-80-6(136)193	9,022	11.5	9.0	0.0
I-80/E/MP 207.43	I-80	1 (East)	204.80	209.65	Iowa County	JPCP	HMA	RPCC	1990	IR-80-6(136)193	9,022	11.5	9.0	0.0
I-80/E/MP 208.45	I-80	1 (East)	204.80	209.65	Iowa County	JPCP	HMA	RPCC	1990	IR-80-6(136)193	9,022	11.5	9.0	0.0
I-80/E/MP 221.60	I-80	1 (East)	221.35	225.93	Iowa County	JPCP	HMA	RPCC	1996	IM-80-6(187)221--13-48	9,431	12.0	10.0	0.0
I-80/E/MP 222.23	I-80	1 (East)	221.35	225.93	Iowa County	JPCP	HMA	RPCC	1996	IM-80-6(187)221--13-48	9,431	12.0	10.0	0.0
I-80/E/MP 223.65	I-80	1 (East)	221.35	225.93	Iowa County	JPCP	HMA	RPCC	1996	IM-80-6(187)221--13-48	9,431	12.0	10.0	0.0
I-80/E/MP 224.18	I-80	1 (East)	221.35	225.93	Iowa County	JPCP	HMA	RPCC	1996	IM-80-6(187)221--13-48	9,431	12.0	10.0	0.0
I-80/E/MP 248.35	I-80	1 (East)	247.90	253.58	Johnson County	JPCP	HMA	RPCC	1993	IM-80-7(59)247--13-52	11,755	12.0	9.0	0.0
I-80/E/MP 250.00	I-80	1 (East)	247.90	253.58	Johnson County	JPCP	HMA	RPCC	1993	IM-80-7(59)247--13-52	11,755	12.0	9.0	0.0
I-80/E/MP 250.50	I-80	1 (East)	247.90	253.58	Johnson County	JPCP	HMA	RPCC	1993	IM-80-7(59)247--13-52	11,755	12.0	9.0	0.0
I-80/E/MP 252.15	I-80	1 (East)	247.90	253.58	Johnson County	JPCP	HMA	RPCC	1993	IM-80-7(59)247--13-52	11,755	12.0	9.0	0.0
I-80/E/MP 253.80	I-80	1 (East)	253.58	257.66	Cedar County	JPCP	HMA	RPCC	1993	IM-80-7(59)247--13-52	11,780	12.0	9.0	0.0
I-80/E/MP 254.85	I-80	1 (East)	253.58	257.66	Cedar County	JPCP	HMA	RPCC	1993	IM-80-7(59)247--13-52	11,780	12.0	9.0	0.0
I-80/E/MP 256.53	I-80	1 (East)	253.58	257.66	Cedar County	JPCP	HMA	RPCC	1993	IM-80-7(59)247--13-52	11,780	12.0	9.0	0.0

Table B.1. JPCP site information (continued)

ID	Route	Dir	Bpst	Epst	County	Pave Type	Oshld Type	Subbase Agg Typ	Con Yr	Construction Project	AADTT	PCC	Base	Subbase Thick
I-80/E/MP 266.37	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 266.50	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 266.60	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 266.85	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 267.40	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 267.65	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 268.03	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 268.13	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 268.85	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 269.63	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 270.60	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 270.90	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 271.03	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 271.30	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 272.07	I-80	1 (East)	265.76	272.08	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,632	12.0	9.0	0.0
I-80/E/MP 273.00	I-80	1 (East)	272.08	275.34	Cedar County	JPCP	HMA	RPCC	1992	IR-80-7(57)265	11,457	12.0	9.0	0.0
I-80/E/MP 273.17	I-80	1 (East)	272.08	275.34	Cedar County	JPCP	HMA	RPCC	1992	IR-80-7(57)265	11,457	12.0	9.0	0.0
I-80/E/MP 273.70	I-80	1 (East)	272.08	275.34	Cedar County	JPCP	HMA	RPCC	1992	IR-80-7(57)265	11,457	12.0	9.0	0.0
I-80/E/MP 274.13	I-80	1 (East)	272.08	275.34	Cedar County	JPCP	HMA	RPCC	1992	IR-80-7(57)265	11,457	12.0	9.0	0.0
I-80/E/MP 274.50	I-80	1 (East)	272.08	275.34	Cedar County	JPCP	HMA	RPCC	1992	IR-80-7(57)265	11,457	12.0	9.0	0.0
I-80/E/MP 275.25	I-80	1 (East)	272.08	275.34	Cedar County	JPCP	HMA	RPCC	1992	IR-80-7(57)265	11,457	12.0	9.0	0.0
I-80/E/MP 276.10	I-80	1 (East)	272.08	275.34	Cedar County	JPCP	HMA	RPCC	1992	IR-80-7(57)265	11,457	12.0	9.0	0.0
I-80/E/MP 276.43_1	I-80	1 (East)	275.34	278.10	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,473	12.0	9.0	0.0
I-80/E/MP 276.43_2	I-80	1 (East)	275.34	278.10	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,473	12.0	9.0	0.0
I-80/E/MP 277.65	I-80	1 (East)	275.34	278.10	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,473	12.0	9.0	0.0
I-80/E/MP 278.20	I-80	1 (East)	275.34	278.10	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,473	12.0	9.0	0.0
I-80/E/MP 278.30	I-80	1 (East)	275.34	278.10	Cedar County	JPCP	HMA	RPCC	1991	IR-80-7(57)265	11,473	12.0	9.0	0.0
I-80/E/MP 278.60	I-80	1 (East)	278.10	280.78	Scott County	JPCP	HMA	RPCC	1997	IM-80-8(165)279--13-82	11,552	11.8	10.2	0.0
I-80/E/MP 278.97	I-80	1 (East)	278.10	280.78	Scott County	JPCP	HMA	RPCC	1997	IM-80-8(165)279--13-82	11,552	11.8	10.2	0.0
I-80/E/MP 278.60	I-80	1 (East)	278.10	280.78	Scott County	JPCP	HMA	RPCC	1997	IM-80-8(165)279--13-82	11,552	11.8	10.2	0.0
US-61/E/MP 107.50	US-61	1 (East)	107.16	109.58	Scott County	JPCP	HMA	Vigin Agg	2001	NHSX-61-5(92)--3H-82	1,757	10.5	10.3	0.0
US-61/E/MP 108.40_1	US-61	1 (East)	107.16	109.58	Scott County	JPCP	HMA	Vigin Agg	2001	NHSX-61-5(92)--3H-82	1,757	10.5	10.3	0.0
US-61/E/MP 108.40_2	US-61	1 (East)	107.16	109.58	Scott County	JPCP	HMA	Vigin Agg	2001	NHSX-61-5(92)--3H-82	1,757	10.5	10.3	0.0
US-61/E/MP 109.00	US-61	1 (East)	107.16	109.58	Scott County	JPCP	HMA	Vigin Agg	2001	NHSX-61-5(92)--3H-82	1,757	10.5	10.3	0.0
I-80/E/MP 296.85	I-80	1 (East)	294.66	298.66	Scott County	JPCP	HMA	RPCC	1997	IM-80-8(171)295--13-82	9,609	11.8	10.2	0.0
I-80/E/MP 297.60	I-80	1 (East)	294.66	298.66	Scott County	JPCP	HMA	RPCC	1997	IM-80-8(171)295--13-82	9,609	11.8	10.2	0.0
I-80/E/MP 298.40	I-80	1 (East)	294.66	298.66	Scott County	JPCP	HMA	RPCC	1997	IM-80-8(171)295--13-82	9,609	11.8	10.2	0.0

Table B.1. JPCP site information (continued)

ID	Route	Dir	Bpst	Epst	County	Pave Type	Oshld Type	Subbase Agg Typ	Con Yr	Construction Project	AADTT	PCC	Base	Subbase Thick
US-151/S/MP 73.60_1	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 73.60_1	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 72.95_1	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 72.95_2	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 72.00_1	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 72.00_2	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 70.85_1	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 70.85_2	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 70.00_1	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 70.00_2	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 68.55	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 68.00_1	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 68.00_2	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 67.70	US-151	2 (South)	67.57	73.78	Jones County	JPCP	Gravel	RPCC	2003	NHSX-151-4(85)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 67.10_1	US-151	2 (South)	62.57	67.57	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 67.10_2	US-151	2 (South)	62.57	67.57	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 66.70	US-151	2 (South)	62.57	67.57	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 65.80_1	US-151	2 (South)	62.57	67.57	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 65.80_2	US-151	2 (South)	62.57	67.57	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 64.50	US-151	2 (South)	62.57	67.57	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 63.60_1	US-151	2 (South)	62.57	67.57	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 63.60_2	US-151	2 (South)	62.57	67.57	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 62.90_1	US-151	2 (South)	62.57	67.57	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--3H-53	1,101	9.5	10.0	0.0
US-151/S/MP 62.90_2	US-151	2 (South)	62.57	67.57	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--3H-53	1,101	9.5	10.0	0.0
US-151/N/MP 64.05	US-151	1 (North)	62.55	67.48	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--2R-53	1,101	9.5	10.0	0.0
US-151/N/MP 65.05_1	US-151	1 (North)	62.55	67.48	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--2R-53	1,101	9.5	10.0	0.0
US-151/N/MP 65.05_2	US-151	1 (North)	62.55	67.48	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--2R-53	1,101	9.5	10.0	0.0
US-151/N/MP 65.95_1	US-151	1 (North)	62.55	67.48	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--2R-53	1,101	9.5	10.0	0.0
US-151/N/MP 65.95_2	US-151	1 (North)	62.55	67.48	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--2R-53	1,101	9.5	10.0	0.0
US-151/N/MP 66.90_1	US-151	1 (North)	62.55	67.48	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--2R-53	1,101	9.5	10.0	0.0
US-151/N/MP 66.90_2	US-151	1 (North)	62.55	67.48	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--2R-53	1,101	9.5	10.0	0.0
US-151/N/MP 67.25_1	US-151	1 (North)	62.55	67.48	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--2R-53	1,101	9.5	10.0	0.0
US-151/N/MP 67.25_2	US-151	1 (North)	62.55	67.48	Jones County	JPCP	Gravel	RPCC/Vigin Agg	2003	NHSX-151-4(90)--2R-53	1,101	9.5	10.0	0.0
US-151/N/MP 44.80_1	US-151	1 (North)	40.04	45.14	Linn County	JPCP	Gravel	RPCC	1992	F-RP-151-3(79)	997	9.5	10.0	0.0
US-151/N/MP 44.80_2	US-151	1 (North)	40.04	45.14	Linn County	JPCP	Gravel	RPCC	1992	F-RP-151-3(79)	997	9.5	10.0	0.0
US-151/N/MP 43.20_1	US-151	1 (North)	40.04	45.14	Linn County	JPCP	HMA	RPCC	1992	F-RP-151-3(79)	997	9.5	10.0	0.0
US-151/N/MP 43.20_2	US-151	1 (North)	40.04	45.14	Linn County	JPCP	HMA	RPCC	1992	F-RP-151-3(79)	997	9.5	10.0	0.0
US-151/N/MP41.00_1	US-151	1 (North)	40.04	45.14	Linn County	JPCP	HMA	RPCC	1992	F-RP-151-3(79)	997	9.5	10.0	0.0
US-151/N/MP41.00_2	US-151	1 (North)	40.04	45.14	Linn County	JPCP	HMA	RPCC	1992	F-RP-151-3(79)	997	9.5	10.0	0.0

Table B.1. JPCP site information (continued)

ID	Route	Dir	Bpst	Epst	County	Pave Type	Oshld Type	Subbase Agg Typ	Con Yr	Construction Project	AADTT	PCC	Base	Subbase Thick
US-30/W/MP 262.90_1	US-30	2 (West)	259.82	263.30	Linn County	JPCP	Gravel	Vigin Agg	2000	NHSX-30-7(94)--3H-57	918	10.0	10.3	0.0
US-30/W/MP 262.90_2	US-30	2 (West)	259.82	263.30	Linn County	JPCP	Gravel	Vigin Agg	2000	NHSX-30-7(94)--3H-57	918	10.0	10.3	0.0
US-30/W/MP 261.35	US-30	2 (West)	259.82	263.30	Linn County	JPCP	Gravel	Vigin Agg	2000	NHSX-30-7(94)--3H-57	918	10.0	10.3	0.0
US-30/W/MP 260.80	US-30	2 (West)	259.82	263.30	Linn County	JPCP	Gravel	Vigin Agg	2000	NHSX-30-7(94)--3H-57	918	10.0	10.3	0.0
US-30/W/MP 260.20	US-30	2 (West)	259.82	263.30	Linn County	JPCP	Gravel	Vigin Agg	2000	NHSX-30-7(94)--3H-57	918	10.0	10.3	0.0
I-80/W/MP 203.50	I-80	2 (West)	192.82	204.80	Poweshiek County	JPCP	HMA	RPCC	1991	IR-80-6(145)191	8,994	11.5	9.0	0.0
I-80/W/MP 202.65	I-80	2 (west)	192.82	204.80	Poweshiek County	JCCP	HMA	RPCC	1991	IR-80-6(145)191	8,994	11.5	9.0	0.0
I-80/W/MP 201.55	I-80	2 (west)	192.82	204.80	Poweshiek County	JCCP	HMA	RPCC	1991	IR-80-6(145)191	8,994	11.5	9.0	0.0
I-80/W/MP 197.70	I-80	2 (west)	192.82	204.80	Poweshiek County	JCCP	HMA	RPCC	1991	IR-80-6(145)191	8,994	11.5	9.0	0.0
I-80/W/MP 197.15_1	I-80	2 (west)	192.82	204.80	Poweshiek County	JCCP	HMA	RPCC	1991	IR-80-6(145)191	8,994	11.5	9.0	0.0
I-80/W/MP 197.15_2	I-80	2 (west)	192.82	204.80	Poweshiek County	JCCP	HMA	RPCC	1991	IR-80-6(145)191	8,994	11.5	9.0	0.0
I-80/W/MP 194.45_1	I-80	2 (west)	192.82	204.80	Poweshiek County	JCCP	HMA	RPCC	1991	IR-80-6(145)191	8,994	11.5	9.0	0.0
I-80/W/MP 194.45_2	I-80	2 (west)	192.82	204.80	Poweshiek County	JCCP	HMA	RPCC	1991	IR-80-6(145)191	8,994	11.5	9.0	0.0
I-80/W/MP 193.60_1	I-80	2 (west)	192.82	204.80	Poweshiek County	JCCP	HMA	RPCC	1991	IR-80-6(145)191	8,994	11.5	9.0	0.0
I-80/W/MP 193.60_2	I-80	2 (west)	192.82	204.80	Poweshiek County	JCCP	HMA	RPCC	1991	IR-80-6(145)191	8,994	11.5	9.0	0.0
I-80/W/MP 193.00_1	I-80	2 (west)	192.82	204.80	Poweshiek County	JCCP	HMA	RPCC	1991	IR-80-6(145)191	8,994	11.5	9.0	0.0
I-80/W/MP 193.00_2	I-80	2 (west)	192.82	204.80	Poweshiek County	JCCP	HMA	RPCC	1991	IR-80-6(145)191	8,994	11.5	9.0	0.0
I-80/W/MP 173.75	I-80	2 (west)	156.28	174.21	Jasper County	JPCP	HMA	RPCC	1995	IM-80-5(184)160--13-50	8,815	12.0	9.0	0.0
I-80/W/MP 171.95	I-80	2 (west)	156.28	174.21	Jasper County	JPCP	HMA	RPCC	1995	IM-80-5(184)160--13-50	8,815	12.0	9.0	0.0
I-80/W/MP 170.35	I-80	2 (west)	156.28	174.21	Jasper County	JPCP	HMA	RPCC	1995	IM-80-5(184)160--13-50	8,815	12.0	9.0	0.0
I-80/W/MP 167.30	I-80	2 (west)	156.28	174.21	Jasper County	JPCP	HMA	RPCC	1995	IM-80-5(184)160--13-50	8,815	12.0	9.0	0.0
I-80/W/MP 163.55	I-80	2 (west)	156.28	174.21	Jasper County	JPCP	HMA	RPCC	1995	IM-80-5(184)160--13-50	8,815	12.0	9.0	0.0
I-80/W/MP 159.59	I-80	2 (west)	156.28	174.21	Jasper County	JPCP	HMA	RPCC	1995	IM-80-5(184)160--13-50	8,815	12.0	9.0	0.0
I-80/W/MP 157.70-1	I-80	2 (west)	156.28	174.21	Jasper County	JPCP	HMA	RPCC	1995	IM-80-5(184)160--13-50	8,815	12.0	9.0	0.0
I-80/W/MP 157.70-2	I-80	2 (west)	156.28	174.21	Jasper County	JPCP	HMA	RPCC	1995	IM-80-5(184)160--13-50	8,815	12.0	9.0	0.0
I-80/W/MP 151.35	I-80	2 (west)	149.89	151.48	Jasper County	JPCP	HMA	RPCC	1990	IR-80-5(130)143	8,580	11.5	9.0	0.0
I-80/W/MP 150.85	I-80	2 (west)	149.89	151.48	Jasper County	JPCP	HMA	RPCC	1990	IR-80-5(130)144	8,580	11.5	9.0	0.0
I-80/W/MP 150.10	I-80	2 (west)	149.89	151.48	Jasper County	JPCP	HMA	RPCC	1990	IR-80-5(130)145	8,580	11.5	9.0	0.0
IA-60/E/MP 47.75	IA-60	1(East)	47.69	51.27	Osceola County	JPCP	HWA	Vigin Agg	2007	NHSX-060-4(35)--3H-72	956	10.2	10.2	0.0
IA-60/E/MP 48.35_1	IA-60	1(East)	47.69	51.27	Osceola County	JPCP	HWA	Vigin Agg	2007	NHSX-060-4(35)--3H-72	956	10.2	10.2	0.0
IA-60/E/MP 48.35_2	IA-60	1(East)	47.69	51.27	Osceola County	JPCP	HWA	Vigin Agg	2007	NHSX-060-4(35)--3H-72	956	10.2	10.2	0.0
IA-60/E/MP 49.06_1	IA-60	1(East)	47.69	51.27	Osceola County	JPCP	HWA	Vigin Agg	2007	NHSX-060-4(35)--3H-72	956	10.2	10.2	0.0
IA-60/E/MP 49.06_2	IA-60	1(East)	47.69	51.27	Osceola County	JPCP	HWA	Vigin Agg	2007	NHSX-060-4(35)--3H-72	956	10.2	10.2	0.0
IA-60/E/MP 51.10	IA-60	1(East)	47.69	51.27	Osceola County	JPCP	HWA	Vigin Agg	2007	NHSX-060-4(35)--3H-72	956	10.2	10.2	0.0
IA-60/W/MP 51.15	IA-60	2(West)	47.69	51.27	Osceola County	JPCP	HWA	Vigin Agg	2007	NHSX-060-4(35)--3H-72	956	10.2	10.2	0.0
IA-60/W/MP 50.20_1	IA-60	2(West)	47.69	51.27	Osceola County	JPCP	HWA	Vigin Agg	2007	NHSX-060-4(35)--3H-72	956	10.2	10.2	0.0
IA-60/W/MP 50.20_2	IA-60	2(West)	47.69	51.27	Osceola County	JPCP	HWA	Vigin Agg	2007	NHSX-060-4(35)--3H-72	956	10.2	10.2	0.0
IA-60/W/MP 47.75	IA-60	2(West)	47.69	51.27	Osceola County	JPCP	HWA	Vigin Agg	2007	NHSX-060-4(35)--3H-72	956	10.2	10.2	0.0

Table B.1. JPCP site information (continued)

ID	Route	Dir	Bpst	Epst	County	Pave Type	Oshld Type	Subbase Agg Typ	Con Yr	Construction Project	AADTT	PCC	Base	Subbase Thick
I-80/W/MP 49.30_1	I-80	2 (west)	45.14	49.71	ttawattamie Cour	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/W/MP 49.30_2	I-80	2 (west)	45.14	49.71	ttawattamie Cour	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/W/MP 49.03	I-80	2 (west)	45.14	49.71	ttawattamie Cour	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/W/MP 48.50_1	I-80	2 (west)	45.14	49.71	ttawattamie Cour	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/W/MP 48.50_2	I-80	2 (west)	45.14	49.71	ttawattamie Cour	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/W/MP 48.30_1	I-80	2 (west)	45.14	49.71	ttawattamie Cour	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/W/MP 48.30_2	I-80	2 (west)	45.14	49.71	ttawattamie Cour	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/W/MP 47.70_1	I-80	2 (west)	45.14	49.71	ttawattamie Cour	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/W/MP 47.70_2	I-80	2 (west)	45.14	49.71	ttawattamie Cour	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/W/MP 46.70_1	I-80	2 (west)	45.14	49.71	ttawattamie Cour	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/W/MP 46.70_2	I-80	2 (west)	45.14	49.71	ttawattamie Cour	JPCP	HMA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/W/MP 38.20	I-80	2(west)	35.09	39.50	ttawattamie Cour	JPCP	HMA	RPCC	2005	IM-80-1(286)35--13-78	8,093	11.5	12.3	0.0
I-80/W/MP 37.90	I-80	2(west)	35.09	39.50	ttawattamie Cour	JPCP	HMA	RPCC	2005	IM-80-1(286)35--13-78	8,093	11.5	12.3	0.0
I-80/W/MP 37.35	I-80	2(west)	35.09	39.50	ttawattamie Cour	JPCP	HMA	RPCC	2005	IM-80-1(286)35--13-78	8,093	11.5	12.3	0.0
I-80/W/MP 36.05	I-80	2(west)	35.09	39.50	ttawattamie Cour	JPCP	HMA	RPCC	2005	IM-80-1(286)35--13-78	8,093	11.5	12.3	0.0
I-80/W/MP 34.70	I-80	2(west)	35.09	39.50	ttawattamie Cour	JPCP	HMA	RPCC	2005	IM-80-1(286)35--13-78	8,093	11.5	12.3	0.0
I-80/W/MP 26.75	I-80	2(west)	21.70	28.04	ttawattamie Cour	JPCP	HMA	RPCC	1998	IM-80-1(235)23--13-78	6,404	11.8	10.2	0.0
I-80/W/MP 24.90	I-80	2(west)	21.70	28.04	ttawattamie Cour	JPCP	HMA	RPCC	1998	IM-80-1(235)23--13-78	6,404	11.8	10.2	0.0
I-80/W/MP 23.75	I-80	2(west)	21.70	28.04	ttawattamie Cour	JPCP	HMA	RPCC	1998	IM-80-1(235)23--13-78	6,404	11.8	10.2	0.0
I-80/W/MP 21.75	I-80	2(west)	21.70	28.04	ttawattamie Cour	JPCP	HMA	RPCC	1998	IM-80-1(235)23--13-78	6,404	11.8	10.2	0.0
I-80/W/MP 10.50	I-80	2(west)	5.21	10.80	ttawattamie Cour	JPCP	HMA	RPCC	1999	IM-80-1(249)6--13-78	6,825	11.8	10.2	0.0
I-80/W/MP 9.50	I-80	2(west)	5.21	10.80	ttawattamie Cour	JPCP	HMA	RPCC	1999	IM-80-1(249)6--13-78	6,825	11.8	10.2	0.0
I-29/N/MP 58.80	I-29	1(north)	57.70	66.63	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	2,575	11.5	9.0	4.0
I-29/N/MP 59.85	I-29	1(north)	57.70	66.63	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	2,575	11.5	9.0	4.0
I-29/N/MP 60.35	I-29	1(north)	57.70	66.63	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	2,575	11.5	9.0	4.0
I-29/N/MP 63.05	I-29	1(north)	57.70	66.63	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	2,575	11.5	9.0	4.0
I-29/N/MP 64.45	I-29	1(north)	57.70	66.63	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	2,575	11.5	9.0	4.0
I-29/N/MP 65.13_1	I-29	1(north)	57.70	66.63	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	2,575	11.5	9.0	4.0
I-29/N/MP 65.13_2	I-29	1(north)	57.70	66.63	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	2,575	11.5	9.0	4.0
I-29/S/MP 65.20_1	I-29	2(south)	60.80	65.50	ttawattamie Cour	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,241	11.5	9.0	0.0
I-29/S/MP 65.20_2	I-29	2(south)	60.80	65.50	ttawattamie Cour	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,241	11.5	9.0	0.0
I-29/S/MP 63.35	I-29	2(south)	60.80	65.50	ttawattamie Cour	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,241	11.5	9.0	0.0
I-29/S/MP 60.98	I-29	2(south)	60.80	65.50	ttawattamie Cour	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,241	11.5	9.0	0.0
I-29/S/MP 60.35_1	I-29	2(south)	59.58	60.80	ttawattamie Cour	JPCP	HMA	RPCC	1994	IM-29-3(38)58--13-78	2,721	11.5	9.0	0.0
I-29/S/MP 60.35_2	I-29	2(south)	59.58	60.80	ttawattamie Cour	JPCP	HMA	RPCC	1994	IM-29-3(38)58--13-78	2,721	11.5	9.0	0.0
I-29/S/MP 60.20_1	I-29	2(south)	59.58	60.80	ttawattamie Cour	JPCP	HMA	RPCC	1994	IM-29-3(38)58--13-78	2,721	11.5	9.0	0.0
I-29/S/MP 60.20_2	I-29	2(south)	59.58	60.80	ttawattamie Cour	JPCP	HMA	RPCC	1994	IM-29-3(38)58--13-78	2,721	11.5	9.0	0.0

Table B.1. JPCP site information (continued)

ID	Route	Dir	Bpst	Epst	County	Pave Type	Oshld Type	Subbase Agg Typ	Con Yr	Construction Project	AADTT	PCC	Base	Subbase Thick
I-29/N/MP 70.90_1	I-29	1(North)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,242	11.5	9.0	4.0
I-29/N/MP 70.90_2	I-29	1(North)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,242	11.5	9.0	4.0
I-29/N/MP 71.08_1	I-29	1(North)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,242	11.5	9.0	4.0
I-29/N/MP 71.08_2	I-29	1(North)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,242	11.5	9.0	4.0
I-29/N/MP 71.65_1	I-29	1(North)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,242	11.5	9.0	4.0
I-29/N/MP 71.65_2	I-29	1(North)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,242	11.5	9.0	4.0
I-29/N/MP 72.15_1	I-29	1(North)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,242	11.5	9.0	4.0
I-29/N/MP 72.15_2	I-29	1(North)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,242	11.5	9.0	4.0
I-29/N/MP 72.90_1	I-29	1(North)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,609	11.5	9.0	4.0
I-29/N/MP 72.90_2	I-29	1(North)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,609	11.5	9.0	4.0
I-29/N/MP 74.25_1	I-29	1(North)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,609	11.5	9.0	4.0
I-29/N/MP 74.25_2	I-29	1(North)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,609	11.5	9.0	4.0
I-29/N/MP 74.60_1	I-29	1(North)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,609	11.5	9.0	4.0
I-29/N/MP 74.60_2	I-29	1(North)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,609	11.5	9.0	4.0
I-29/N/MP 76.25_1	I-29	1(North)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,609	11.5	9.0	4.0
I-29/N/MP 76.25_2	I-29	1(North)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1992	IM-29-4(39)56	3,609	11.5	9.0	4.0
I-29/N/MP 77.30_1	I-29	1(North)	76.54	90.72	Harrison County	JPCP	HMA	Vigin Agg	1999	IM-29-4(52)72--13-43	3,185	11.8	3.9	0.0
I-29/N/MP 77.30_2	I-29	1(North)	76.54	90.72	Harrison County	JPCP	HMA	Vigin Agg	1999	IM-29-4(52)72--13-43	3,185	11.8	3.9	0.0
I-29/N/MP 79.05	I-29	1(North)	76.54	90.72	Harrison County	JPCP	HMA	Vigin Agg	1999	IM-29-4(52)72--13-43	3,185	11.8	3.9	0.0
I-29/N/MP 82.90_1	I-29	1(North)	76.54	90.72	Harrison County	JPCP	HMA	Vigin Agg	1999	IM-29-4(52)72--13-43	3,185	11.8	3.9	0.0
I-29/N/MP 82.90_2	I-29	1(North)	76.54	90.72	Harrison County	JPCP	HMA	Vigin Agg	1999	IM-29-4(52)72--13-43	3,185	11.8	3.9	0.0
I-29/N/MP 85.35_1	I-29	1(North)	76.54	90.72	Harrison County	JPCP	HMA	Vigin Agg	1999	IM-29-4(52)72--13-43	3,185	11.8	3.9	0.0
I-29/N/MP 85.35_2	I-29	1(North)	76.54	90.72	Harrison County	JPCP	HMA	Vigin Agg	1999	IM-29-4(52)72--13-43	3,185	11.8	3.9	0.0
I-29/N/MP 87.15	I-29	1(North)	76.54	90.72	Harrison County	JPCP	HMA	Vigin Agg	1999	IM-29-4(52)72--13-43	3,185	11.8	3.9	0.0
I-29/N/MP 90.15	I-29	1(North)	76.54	90.72	Harrison County	JPCP	HMA	Vigin Agg	1999	IM-29-4(52)72--13-43	3,185	11.8	3.9	0.0
I-29/S/MP 76.40_1	I-29	2(South)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,609	11.5	9.0	0.0
I-29/S/MP 76.40_2	I-29	2(South)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,609	11.5	9.0	0.0
I-29/S/MP 75.00_1	I-29	2(South)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,609	11.5	9.0	0.0
I-29/S/MP 75.00_2	I-29	2(South)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,609	11.5	9.0	0.0
I-29/S/MP 73.90	I-29	2(South)	72.45	76.54	Harrison County	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,609	11.5	9.0	0.0
I-29/S/MP 71.90	I-29	2(South)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,605	11.5	9.0	0.0
I-29/S/MP 71.15_1	I-29	2(South)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,605	11.5	9.0	0.0
I-29/S/MP 71.15_2	I-29	2(South)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,605	11.5	9.0	0.0
I-29/S/MP 70.80_1	I-29	2(South)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,605	11.5	9.0	0.0
I-29/S/MP 70.80_2	I-29	2(South)	70.84	72.45	ttawattamie Cour	JPCP	HMA	RPCC	1995	IM-29-3(52)61--13-78	3,605	11.5	9.0	0.0
I-80/E/MP 5.90	I-80	1(East)	5.10	10.80	ttawattamie Cour	JPCP	HMA	RPCC	2003	IM-80-1(251)6--13-78	6,825	12.0	10.3	0.0
I-80/E/MP 6.10	I-80	1(East)	5.10	10.80	ttawattamie Cour	JPCP	HMA	RPCC	2003	IM-80-1(251)6--13-78	6,825	12.0	10.3	0.0
I-80/E/MP 7.40	I-80	1(East)	5.10	10.80	ttawattamie Cour	JPCP	HMA	RPCC	2003	IM-80-1(251)6--13-78	6,825	12.0	10.3	0.0
I-80/E/MP 9.65	I-80	1(East)	5.10	10.80	ttawattamie Cour	JPCP	HMA	RPCC	2003	IM-80-1(251)6--13-78	6,825	12.0	10.3	0.0
I-80/E/MP 10.40	I-80	1(East)	5.10	10.80	ttawattamie Cour	JPCP	HMA	RPCC	2003	IM-80-1(251)6--13-78	6,825	12.0	10.3	0.0
I-80/E/MP 10.50	I-80	1(East)	5.10	10.80	ttawattamie Cour	JPCP	HMA	RPCC	2003	IM-80-1(251)6--13-78	6,825	12.0	10.3	0.0

Table B.1. JPCP site information (continued)

ID	Route	Dir	Bpst	Epst	County	Pave Type	Oshld Type	Subbase Agg Typ	Con Yr	Construction Project	AADTT	PCC	Base	Subbase Thick
I-80/E/MP 22.40	I-80	1(East)	20.70	28.04	ttawattamie Cour	JPCP	HMA	RPCC	1998	IM-80-1(235)23--13-78	6,404	11.8	10.2	0.0
I-80/E/MP 24.10	I-80	1(East)	20.70	28.04	ttawattamie Cour	JPCP	HMA	RPCC	1998	IM-80-1(235)23--13-78	6,404	11.8	10.2	0.0
I-80/E/MP 25.85	I-80	1(East)	20.70	28.04	ttawattamie Cour	JPCP	HMA	RPCC	1998	IM-80-1(235)23--13-78	6,404	11.8	10.2	0.0
I-80/E/MP 28.00	I-80	1(East)	20.70	28.04	ttawattamie Cour	JPCP	HMA	RPCC	1998	IM-80-1(235)23--13-78	6,404	11.8	10.2	0.0
I-80/E/MP 35.10_1	I-80	1(East)	35.09	39.29	ttawattamie Cour	JPCP	HMA	RPCC	1990	IR-80-1(183)34	8,093	11.5	9.0	0.0
I-80/E/MP 35.10_2	I-80	1(East)	35.09	39.29	ttawattamie Cour	JPCP	HMA	RPCC	1990	IR-80-1(183)34	8,093	11.5	9.0	0.0
I-80/E/MP 35.25_1	I-80	1(East)	35.09	39.29	ttawattamie Cour	JPCP	HMA	RPCC	1990	IR-80-1(183)34	8,093	11.5	9.0	0.0
I-80/E/MP 35.25_2	I-80	1(East)	35.09	39.29	ttawattamie Cour	JPCP	HMA	RPCC	1990	IR-80-1(183)34	8,093	11.5	9.0	0.0
I-80/E/MP 36.20_1	I-80	1(East)	35.09	39.29	ttawattamie Cour	JPCP	HMA	RPCC	1990	IR-80-1(183)34	8,093	11.5	9.0	0.0
I-80/E/MP 36.20_2	I-80	1(East)	35.09	39.29	ttawattamie Cour	JPCP	HMA	RPCC	1990	IR-80-1(183)34	8,093	11.5	9.0	0.0
I-80/E/MP 37.23	I-80	1(East)	35.09	39.29	ttawattamie Cour	JPCP	HMA	RPCC	1990	IR-80-1(183)34	8,093	11.5	9.0	0.0
I-80/E/MP 38.05_1	I-80	1(East)	35.09	39.29	ttawattamie Cour	JPCP	HMA	RPCC	1990	IR-80-1(183)34	8,093	11.5	9.0	0.0
I-80/E/MP 38.05_2	I-80	1(East)	35.09	39.29	ttawattamie Cour	JPCP	HMA	RPCC	1990	IR-80-1(183)34	8,093	11.5	9.0	0.0
I-80/E/MP 38.37_1	I-80	1(East)	35.09	39.29	ttawattamie Cour	JPCP	HMA	RPCC	1990	IR-80-1(183)34	8,093	11.5	9.0	0.0
I-80/E/MP 38.37_2	I-80	1(East)	35.09	39.29	ttawattamie Cour	JPCP	HMA	RPCC	1990	IR-80-1(183)34	8,093	11.5	9.0	0.0
I-80/E/MP 45.70	I-80	1(East)	45.14	49.71	ttawattamie Cour	JPCP	HWA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/E/MP 46.35	I-80	1(East)	45.14	49.71	ttawattamie Cour	JPCP	HWA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/E/MP 47.65	I-80	1(East)	45.14	49.71	ttawattamie Cour	JPCP	HWA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/E/MP 48.40	I-80	1(East)	45.14	49.71	ttawattamie Cour	JPCP	HWA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0
I-80/E/MP 49.55	I-80	1(East)	45.14	49.71	ttawattamie Cour	JPCP	HWA	RPCC	1991	IR-80-1(178)40	7,793	12.0	9.0	0.0

Table B.2. JPCP drainage outlet inspection location information

ID	Inspection Location No	Date of Inspection	MP	GPS
I-35/N/MP140.22	1	Oct/10/2012	140.22	N42(D)24(M)53(S) and W93(D)34(M)12(S)
I-35/N/MP140.35	2	Oct/10/2012	140.35	N42(D)24(M)00(S) and W93(D)24(M)06(S)
I-35/N/MP140.60	3	Oct/10/2012	140.60	N42(D)25(M)13(S) and W93(D)34(M)12(S)
I-35/N/MP140.80	4	Oct/10/2012	140.80	N42(D)25(M)25(S) and W93(D)34(M)12(S)
I-35/N/MP141.30	5	Oct/10/2012	141.30	N42(D)25(M)50(S) and W93(D)34(M)12(S)
I-35/N/MP143.30	1	Oct/10/2012	143.30	N42(D)27(M)34(S) and W93(D)34(M)7(S)
I-35/N/MP143.45	2	Oct/10/2012	143.45	N42(D)27(M)39(S) and W93(D)34(M)7(S)
I-35/N/MP143.65	3	Oct/10/2012	143.65	N42(D)27(M)54(S) and W93(D)34(M)7(S)
I-35/S/MP 129.00	1	Oct/10/2012	129.00	N42(D)15(M)9(S) and W93(D)34(M) 14(S)
I-35/S/MP 128.00	2	Oct/10/2012	128.00	N42(D)14(M)24(S) and W93(D)34(M)14(S)
I-35/S/MP 127.90	3	Oct/10/2012	127.90	N42(D)14(M)12(S) and W93(D)34(M)16(S)
I-35/S/MP 127.85	4	Oct/10/2012	127.85	N42(D)14(M)9(S) and W93(D)34(M)16(S)
I-35/S/MP 127.50	5	Oct/10/2012	127.50	N42(D)13(M)11(S) and W93(D)34(M)17(S)
I-35/S/MP 127.20	6	Oct/10/2012	127.20	N42(D)13(M)35(S) and W93(D)34(M)18(S)
I-35/S/MP 126.00	1	Oct/10/2012	126.00	N42(D)12(M)3(S) and W93(D)34(M)14(S)
I-35/S/MP 123.70	2	Oct/10/2012	123.70	N42(D)10(M)33(S) and W93(D)34(M)15(S)
US-30/W/MP 156.50_1	1	Oct/10/2012	156.50	N42(D)0(M)31(S) and W93(D)29(M)3(S)
US-30/W/MP 156.50_2	1	Oct/10/2012	156.50	N42(D)0(M)31(S) and W93(D)29(M)3(S)
US-30/W/MP 156.00	2	Oct/10/2012	156.00	N42(D)0(M)32(S) and W93(D)29(M)17(S)
US-30/W/MP 155.80	3	Oct/10/2012	155.80	N42(D)0(M)32(S) and W93(D)29(M)50(S)
US-30/W/MP 153.00	4	Oct/10/2012	153.00	N42(D)0(M)32(S) and W93(D)32(M)22(S)
I-80/W/MP 132.86	1	Oct/17/2012	132.86	N41(D)39(M)5(S) and W93(D)41(M)0(S)
I-80/W/MP 132.20_1	2	Oct/17/2012	132.20	N41(D)39(M)6(S) and W93(D)41(M)5(S)
I-80/W/MP 132.20_2	2	Oct/17/2012	132.20	N41(D)39(M)6(S) and W93(D)41(M)5(S)
I-80/W/MP 131.85	3	Oct/17/2012	131.85	N41(D)39(M)6(S) and W93(D)41(M)17(S)
I-80/W/MP 131.80	4	Oct/17/2012	131.80	N41(D)39(M)6(S) and W93(D)41(M)18(S)
US-6/E/MP 121.30	1	Oct/17/2012	121.30	N41(D)36(M)53(S) and W93(D)53(M)36(S)
I-80/W/MP 104.80	1	Oct/17/2012	104.80	N41(D)31(M)4(S) and W94(D)6(M)30(S)
I-80/W/MP 103.95	2	Oct/17/2012	103.95	N41(D)31(M)4(S) and W94(D)7(M)30(S)
I-80/W/MP 103.90_1	3	Oct/17/2012	103.90	N41(D)31(M)4(S) and W94(D)7(M)32(S)
I-80/W/MP 103.90_2	3	Oct/17/2012	103.90	N41(D)31(M)4(S) and W94(D)7(M)32(S)
I-80/W/MP 103.40	4	Oct/17/2012	103.40	N41(D)31(M)4(S) and W94(D)8(M)8(S)
I-80/W/MP 102.35	1	Oct/17/2012	102.35	N41(D)31(M)4(S) and W94(D)9(M)21(S)
I-80/W/MP 102.25	2	Oct/17/2012	102.25	N41(D)31(M)4(S) and W94(D)9(M)21(S)
I-80/W/MP 102.07	3	Oct/17/2012	102.07	N41(D)37(M)4(S) and W94(D)9(M)40(S)
I-80/W/MP 102.00_1	4	Oct/17/2012	102.07	N41(D)31(M)4(S) and W94(D)9(M)47(S)
I-80/W/MP 102.00_2	4	Oct/17/2012	102.07	N41(D)31(M)4(S) and W94(D)9(M)47(S)

Table B.2. JPCP drainage outlet inspection location information (continued)

ID	Inspection Location No	Date of Inspection	MP	GPS
I-80/W/MP 59.90	1	Oct/17/2012	59.90	N41(D)29(M)50(S) and W94(D)57(M)31(S)
I-80/W/MP 59.60	2	Oct/17/2012	59.60	N41(D)29(M)50(S) and W94(D)57(M)52(S)
I-80/W/MP 59.50	3	Oct/17/2012	59.50	N41(D)29(M)50(S) and W94(D)57(M)58(S)
I-80/W/MP 58.75	4	Oct/17/2012	58.75	N41(D)29(M)50(S) and W94(D)57(M)51(S)
I-80/W/MP 58.25_1	5	Oct/17/2012	58.25	N41(D)29(M)51(S) and W94(D)59(M)25(S)
I-80/W/MP 58.25_2	5	Oct/17/2012	58.25	N41(D)29(M)51(S) and W94(D)59(M)25(S)
I-80/W/MP 57.65_1	6	Oct/17/2012	57.65	N41(D)29(M)51(S) and W96(D)0(M)7(S)
I-80/W/MP 57.65_2	6	Oct/17/2012	57.65	N41(D)29(M)51(S) and W96(D)0(M)7(S)
I-80/W/MP 57.10_1	7	Oct/17/2012	57.10	N41(D)29(M)50(S) and W96(D)0(M)46(S)
I-80/W/MP 57.10_2	7	Oct/17/2012	57.10	N41(D)29(M)50(S) and W96(D)0(M)46(S)
I-80/W/MP 56.72_1	8	Oct/17/2012	56.72	N41(D)29(M)50(S) and W95(D)1(M)14(S)
I-80/W/MP 56.72_2	8	Oct/17/2012	56.72	N41(D)29(M)50(S) and W95(D)1(M)14(S)
I-80/W/MP 56.00	9	Oct/17/2012	56.00	N41(D)29(M)50(S) and W95(D)2(M)1(S)
I-80/E/MP 55.93	1	Oct/17/2012	55.93	N41(D)29(M)49(S) and W95(D)2(M)6(S)
I-80/E/MP 56.53	2	Oct/17/2012	56.53	N41(D)29(M)49(S) and W95(D)1(M)25(S)
I-80/E/MP 57.00	3	Oct/17/2012	57.00	N41(D)29(M)49(S) and W95(D)0(M)52(S)
I-80/E/MP 73.45	1	Oct/17/2012	73.45	N41(D)29(M)48(S) and W94(D)41(M)50(S)
I-80/E/MP 74.00	2	Oct/17/2012	74.00	N41(D)29(M)48(S) and W94(D)41(M)22(S)
I-80/E/MP 79.04	3	Oct/17/2012	79.04	N41(D)29(M)40(S) and W94(D)35(M)29(S)
I-80/E/MP 79.27	4	Oct/17/2012	79.27	N41(D)29(M)48(S) and W94(D)35(M)40(S)
I-80/E/MP 82.27	5	Oct/17/2012	82.27	N41(D)29(M)45(S) and W94(D)31(M)43(S)
I-80/E/MP 84.45	6	Oct/17/2012	84.45	N41(D)29(M)48(S) and W94(D)29(M)15(S)
IA-163/W/MP 20.67	1	Oct/24/2012	20.67	N41(D)35(M)18(S) and W93(D)12(M)23(S)
IA-163/W/MP 19.63_1	2	Oct/24/2012	19.63	N41(D)35(M)17(S) and W93(D)13(M)36(S)
IA-163/W/MP 19.63_2	2	Oct/24/2012	19.63	N41(D)35(M)17(S) and W93(D)13(M)36(S)
IA-163/W/MP 18.82_1	3	Oct/24/2012	18.82	N41(D)35(M)24(S) and W93(D)14(M)30(S)
IA-163/W/MP 18.82_2	3	Oct/24/2012	18.82	N41(D)35(M)24(S) and W93(D)14(M)30(S)
IA-163/W/MP 17.60	4	Oct/24/2012	17.60	N41(D)36(M)54(S) and W93(D)15(M)40(S)
IA-5/E/MP 87.55_1	1	Oct/24/2012	87.55	N41(D)29(M)26(S) and W93(D)28(M)25(S)
IA-5/E/MP 87.55_2	1	Oct/24/2012	87.55	N41(D)29(M)26(S) and W93(D)28(M)25(S)
IA-5/E/MP 86.50_1	2	Oct/24/2012	86.50	N41(D)29(M)26(S) and W93(D)28(M)25(S)
IA-5/E/MP 86.50_2	2	Oct/24/2012	86.50	N41(D)29(M)26(S) and W93(D)28(M)25(S)
IA-5/E/MP 86.25	3	Oct/24/2012	86.25	N41(D)28(M)59(S) and W93(D)26(M)57(S)
I-80/E/MP 151.60	1	Oct/24/2012	151.60	N41(D)40(M)53(S) and W93(D)18(M)54(S)
I-80/E/MP 152.15_1	2	Oct/24/2012	152.15	N41(D)40(M)54(S) and W93(D)18(M)15(S)
I-80/E/MP 152.15_2	2	Oct/24/2012	152.15	N41(D)40(M)54(S) and W93(D)18(M)15(S)
I-80/E/MP 153.80	3	Oct/24/2012	153.80	N41(D)40(M)11(S) and W93(D)16(M)22(S)
I-80/E/MP 154.55	4	Oct/24/2012	154.55	N41(D)41(M)21(S) and W93(D)15(M)33(S)

Table B.2. JPCP drainage outlet inspection location information (continued)

ID	Inspection Location No	Date of Inspection	MP	GPS
I-80/E/MP 160.65	1	Oct/24/2012	160.65	N41(D)41(M)21(S) and W93(D)15(M)34(S)
I-80/E/MP 161.75_1	2	Oct/24/2012	161.75	N41(D)40(M)54(S) and W93(D)7(M)36(S)
I-80/E/MP 161.75_2	2	Oct/24/2012	161.75	N41(D)40(M)54(S) and W93(D)7(M)36(S)
I-80/E/MP 164.10	3	Oct/24/2012	164.10	N41(D)40(M)57(S) and W93(D)4(M)53(S)
I-80/E/MP 165.40	1	Oct/24/2012	165.40	N41(D)41(M)0(S) and W93(D)3(M)23(S)
I-80/E/MP 167.10	2	Oct/24/2012	167.10	N41(D)40(M)58(S) and W93(D)1(M)25(S)
I-80/E/MP 169.20_1	3	Oct/24/2012	169.20	N41(D)40(M)54(S) and W92(D)58(M)59(S)
I-80/E/MP 169.20_2	3	Oct/24/2012	169.20	N41(D)40(M)54(S) and W92(D)58(M)59(S)
I-80/E/MP 169.90	1	Oct/24/2012	169.90	N41(D)40(M)52(S) and W92(D)58(M)11(S)
I-80/E/MP 171.90	2	Oct/24/2012	171.90	N41(D)40(M)49(S) and W92(D)55(M)52(S)
I-80/E/MP 173.90	3	Oct/24/2012	173.90	N41(D)40(M)58(S) and W92(D)53(M)35(S)
IA-330/W/MP 14.15	1	Oct/24/2012	14.15	N41(D)56(M)52(S) and W93(D)6(M)29(S)
IA-330/W/MP 13.80_1	2	Oct/24/2012	13.80	N41(D)56(M)40(S) and W93(D)6(M)47(S)
IA-330/W/MP 13.80_2	2	Oct/24/2012	13.80	N41(D)56(M)40(S) and W93(D)6(M)47(S)
IA-330/W/MP 13.65	3	Oct/24/2012	13.65	N41(D)56(M)34(S) and W93(D)6(M)55(S)
IA-330/W/MP 13.55_1	4	Oct/24/2012	13.55	N41(D)58(M)30(S) and W93(D)7(M)0(S)
IA-330/W/MP 13.55_2	4	Oct/24/2012	13.55	N41(D)58(M)30(S) and W93(D)7(M)0(S)
I-80/E/MP 193.07	1	Oct/30/2012	193.07	N41(D)56(M)30(S) and W93(D)7(M)0(S)
I-80/E/MP 193.20_1	2	Oct/30/2012	193.20	N41(D)41(M)44(S) and W92(D)31(M)23(S)
I-80/E/MP 193.20_2	2	Oct/30/2012	193.20	N41(D)41(M)44(S) and W92(D)31(M)23(S)
I-80/E/MP 195.10	3	Oct/30/2012	195.10	N41(D)41(M)40(S) and W92(D)29(M)12(S)
I-80/E/MP 198.05	4	Oct/30/2012	198.05	N41(D)41(M)45(S) and W92(D)25(M)47(S)
I-80/E/MP 202.35	5	Oct/30/2012	202.35	N41(D)41(M)43(S) and W92(D)20(M)47(S)
I-80/E/MP 206.26	1	Oct/30/2012	206.26	N41(D)41(M)45(S) and W92(D)16(M)16(S)
I-80/E/MP 207.10	2	Oct/30/2012	207.10	N41(D)41(M)45(S) and W92(D)15(M)17(S)
I-80/E/MP 207.43	3	Oct/30/2012	207.43	N41(D)41(M)49(S) and W92(D)14(M)54(S)
I-80/E/MP 208.45	4	Oct/30/2012	208.45	N41(D)41(M)44(S) and W92(D)13(M)44(S)
I-80/E/MP 221.60	1	Oct/30/2012	221.60	N41(D)41(M)12(S) and W91(D)58(M)31(S)
I-80/E/MP 222.23	2	Oct/30/2012	222.23	N41(D)41(M)12(S) and W91(D)57(M)47(S)
I-80/E/MP 223.65	3	Oct/30/2012	223.65	N41(D)41(M)16(S) and W91(D)56(M)9(S)
I-80/E/MP 224.18	4	Oct/30/2012	224.18	N41(D)41(M)16(S) and W91(D)55(M)33(S)
I-80/E/MP 248.35	1	Oct/30/2012	248.35	N41(D)40(M)41(S) and W91(D)27(M)51(S)
I-80/E/MP 250.00	2	Oct/30/2012	250.00	N41(D)40(M)41(S) and W91(D)26(M)9(S)
I-80/E/MP 250.50	3	Oct/30/2012	250.50	N41(D)40(M)3(S) and W91(D)25(M)32(S)
I-80/E/MP 252.15	4	Oct/30/2012	252.15	N41(D)39(M)59(S) and W91(D)23(M)37(S)
I-80/E/MP 253.80	1	Oct/30/2012	253.80	N41(D)39(M)54(S) and W91(D)21(M)45(S)
I-80/E/MP 254.85	2	Oct/30/2012	254.85	N41(D)39(M)50(S) and W91(D)20(M)32(S)
I-80/E/MP 256.53	3	Oct/30/2012	256.53	N41(D)39(M)46(S) and W91(D)18(M)37(S)

Table B.2. JPCP drainage outlet inspection location information (continued)

ID	Inspection Location No	Date of Inspection	MP	GPS
US-151/S/MP 73.60_1	1	Oct/31/2012	73.60	N42(D)17(M)35(S) and W91(D)3(M)18(S)
US-151/S/MP 73.60_1	1	Oct/31/2012	73.60	N42(D)17(M)35(S) and W91(D)3(M)18(S)
US-151/S/MP 72.95_1	2	Oct/31/2012	72.95	N42(D)17(M)31(S) and W91(D)3(M)51(S)
US-151/S/MP 72.95_2	2	Oct/31/2012	72.95	N42(D)17(M)31(S) and W91(D)3(M)51(S)
US-151/S/MP 72.00_1	3	Oct/31/2012	72.00	N42(D)17(M)12(S) and W91(D)4(M)50(S)
US-151/S/MP 72.00_2	3	Oct/31/2012	72.00	N42(D)17(M)12(S) and W91(D)4(M)50(S)
US-151/S/MP 70.85_1	4	Oct/31/2012	70.85	N42(D)17(M)1(S) and W91(D)6(M)13(S)
US-151/S/MP 70.85_2	4	Oct/31/2012	70.85	N42(D)17(M)1(S) and W91(D)6(M)13(S)
US-151/S/MP 70.00_1	5	Oct/31/2012	70.00	N42(D)16(M)58(S) and W91(D)7(M)9(S)
US-151/S/MP 70.00_2	5	Oct/31/2012	70.00	N42(D)16(M)58(S) and W91(D)7(M)9(S)
US-151/S/MP 68.55	6	Oct/31/2012	68.55	N42(D)16(M)17(S) and W91(D)8(M)29(S)
US-151/S/MP 68.00_1	7	Oct/31/2012	68.00	N42(D)15(M)53(S) and W91(D)8(M)48(S)
US-151/S/MP 68.00_2	7	Oct/31/2012	68.00	N42(D)15(M)53(S) and W91(D)8(M)48(S)
US-151/S/MP 67.70	8	Oct/31/2012	67.70	N42(D)15(M)41(S) and W91(D)5(M)5(S)
US-151/S/MP 67.10_1	1	Oct/31/2012	67.10	N42(D)15(M)21(S) and W91(D)9(M)27(S)
US-151/S/MP 67.10_2	1	Oct/31/2012	67.10	N42(D)15(M)21(S) and W91(D)9(M)27(S)
US-151/S/MP 66.70	2	Oct/31/2012	66.70	N42(D)14(M)57(S) and W91(D)9(M)43(S)
US-151/S/MP 65.80_1	3	Oct/31/2012	65.80	N42(D)14(M)15(S) and W91(D)10(M)9(S)
US-151/S/MP 65.80_2	3	Oct/31/2012	65.80	N42(D)14(M)15(S) and W91(D)10(M)9(S)
US-151/S/MP 64.50	4	Oct/31/2012	64.50	N42(D)13(M)9(S) and W91(D)10(M)24(S)
US-151/S/MP 63.60_1	5	Oct/31/2012	63.60	N42(D)12(M)31(S) and W91(D)10(M)47(S)
US-151/S/MP 63.60_2	5	Oct/31/2012	63.60	N42(D)12(M)31(S) and W91(D)10(M)47(S)
US-151/S/MP 62.90_1	6	Oct/31/2012	62.90	N42(D)12(M)26(S) and W91(D)11(M)34(S)
US-151/S/MP 62.90_2	6	Oct/31/2012	62.90	N42(D)12(M)26(S) and W91(D)11(M)34(S)
US-151/N/MP 64.05	1	Oct/31/2012	64.05	N42(D)12(M)46(S) and W91(D)10(M)25(S)
US-151/N/MP 65.05_1	2	Oct/31/2012	65.05	N42(D)13(M)39(S) and W91(D)10(M)16(S)
US-151/N/MP 65.05_2	2	Oct/31/2012	65.05	N42(D)13(M)39(S) and W91(D)10(M)16(S)
US-151/N/MP 65.95_1	3	Oct/31/2012	65.95	N42(D)14(M)23(S) and W91(D)10(M)3(S)
US-151/N/MP 65.95_2	3	Oct/31/2012	65.95	N42(D)14(M)23(S) and W91(D)10(M)3(S)
US-151/N/MP 66.90_1	4	Oct/31/2012	66.90	N42(D)15(M)7(S) and W91(D)9(M)33(S)
US-151/N/MP 66.90_2	4	Oct/31/2012	66.90	N42(D)15(M)7(S) and W91(D)9(M)33(S)
US-151/N/MP 67.25_1	5	Oct/31/2012	67.25	N42(D)15(M)23(S) and W91(D)9(M)21(S)
US-151/N/MP 67.25_2	5	Oct/31/2012	67.25	N42(D)15(M)23(S) and W91(D)9(M)21(S)
US-151/N/MP 44.80_1	1	Oct/31/2012	44.80	N42(D)3(M)30(S) and W91(D)25(M)14(S)
US-151/N/MP 44.80_2	1	Oct/31/2012	44.80	N42(D)3(M)30(S) and W91(D)25(M)14(S)
US-151/N/MP 43.20_1	2	Oct/31/2012	43.20	N42(D)2(M)57(S) and W91(D)26(M)54(S)
US-151/N/MP 43.20_2	2	Oct/31/2012	43.20	N42(D)2(M)57(S) and W91(D)26(M)54(S)
US-151/N/MP41.00_1	3	Oct/31/2012	41.00	N42(D)2(M)51(S) and W91(D)29(M)29(S)
US-151/N/MP41.00_2	3	Oct/31/2012	41.00	N42(D)2(M)51(S) and W91(D)29(M)29(S)

Table B.2. JPCP drainage outlet inspection location information (continued)

ID	Inspection Location No	Date of Inspection	MP	GPS
US-151/S/MP 73.60_1	1	Oct/31/2012	73.60	N42(D)17(M)35(S) and W91(D)3(M)18(S)
US-151/S/MP 73.60_1	1	Oct/31/2012	73.60	N42(D)17(M)35(S) and W91(D)3(M)18(S)
US-151/S/MP 72.95_1	2	Oct/31/2012	72.95	N42(D)17(M)31(S) and W91(D)3(M)51(S)
US-151/S/MP 72.95_2	2	Oct/31/2012	72.95	N42(D)17(M)31(S) and W91(D)3(M)51(S)
US-151/S/MP 72.00_1	3	Oct/31/2012	72.00	N42(D)17(M)12(S) and W91(D)4(M)50(S)
US-151/S/MP 72.00_2	3	Oct/31/2012	72.00	N42(D)17(M)12(S) and W91(D)4(M)50(S)
US-151/S/MP 70.85_1	4	Oct/31/2012	70.85	N42(D)17(M)1(S) and W91(D)6(M)13(S)
US-151/S/MP 70.85_2	4	Oct/31/2012	70.85	N42(D)17(M)1(S) and W91(D)6(M)13(S)
US-151/S/MP 70.00_1	5	Oct/31/2012	70.00	N42(D)16(M)58(S) and W91(D)7(M)9(S)
US-151/S/MP 70.00_2	5	Oct/31/2012	70.00	N42(D)16(M)58(S) and W91(D)7(M)9(S)
US-151/S/MP 68.55	6	Oct/31/2012	68.55	N42(D)16(M)17(S) and W91(D)8(M)29(S)
US-151/S/MP 68.00_1	7	Oct/31/2012	68.00	N42(D)15(M)53(S) and W91(D)8(M)48(S)
US-151/S/MP 68.00_2	7	Oct/31/2012	68.00	N42(D)15(M)53(S) and W91(D)8(M)48(S)
US-151/S/MP 67.70	8	Oct/31/2012	67.70	N42(D)15(M)41(S) and W91(D)5(M)5(S)
US-151/S/MP 67.10_1	1	Oct/31/2012	67.10	N42(D)15(M)21(S) and W91(D)9(M)27(S)
US-151/S/MP 67.10_2	1	Oct/31/2012	67.10	N42(D)15(M)21(S) and W91(D)9(M)27(S)
US-151/S/MP 66.70	2	Oct/31/2012	66.70	N42(D)14(M)57(S) and W91(D)9(M)43(S)
US-151/S/MP 65.80_1	3	Oct/31/2012	65.80	N42(D)14(M)15(S) and W91(D)10(M)9(S)
US-151/S/MP 65.80_2	3	Oct/31/2012	65.80	N42(D)14(M)15(S) and W91(D)10(M)9(S)
US-151/S/MP 64.50	4	Oct/31/2012	64.50	N42(D)13(M)9(S) and W91(D)10(M)24(S)
US-151/S/MP 63.60_1	5	Oct/31/2012	63.60	N42(D)12(M)31(S) and W91(D)10(M)47(S)
US-151/S/MP 63.60_2	5	Oct/31/2012	63.60	N42(D)12(M)31(S) and W91(D)10(M)47(S)
US-151/S/MP 62.90_1	6	Oct/31/2012	62.90	N42(D)12(M)26(S) and W91(D)11(M)34(S)
US-151/S/MP 62.90_2	6	Oct/31/2012	62.90	N42(D)12(M)26(S) and W91(D)11(M)34(S)
US-151/N/MP 64.05	1	Oct/31/2012	64.05	N42(D)12(M)46(S) and W91(D)10(M)25(S)
US-151/N/MP 65.05_1	2	Oct/31/2012	65.05	N42(D)13(M)39(S) and W91(D)10(M)16(S)
US-151/N/MP 65.05_2	2	Oct/31/2012	65.05	N42(D)13(M)39(S) and W91(D)10(M)16(S)
US-151/N/MP 65.95_1	3	Oct/31/2012	65.95	N42(D)14(M)23(S) and W91(D)10(M)3(S)
US-151/N/MP 65.95_2	3	Oct/31/2012	65.95	N42(D)14(M)23(S) and W91(D)10(M)3(S)
US-151/N/MP 66.90_1	4	Oct/31/2012	66.90	N42(D)15(M)7(S) and W91(D)9(M)33(S)
US-151/N/MP 66.90_2	4	Oct/31/2012	66.90	N42(D)15(M)7(S) and W91(D)9(M)33(S)
US-151/N/MP 67.25_1	5	Oct/31/2012	67.25	N42(D)15(M)23(S) and W91(D)9(M)21(S)
US-151/N/MP 67.25_2	5	Oct/31/2012	67.25	N42(D)15(M)23(S) and W91(D)9(M)21(S)
US-151/N/MP 44.80_1	1	Oct/31/2012	44.80	N42(D)3(M)30(S) and W91(D)25(M)14(S)
US-151/N/MP 44.80_2	1	Oct/31/2012	44.80	N42(D)3(M)30(S) and W91(D)25(M)14(S)
US-151/N/MP 43.20_1	2	Oct/31/2012	43.20	N42(D)2(M)57(S) and W91(D)26(M)54(S)
US-151/N/MP 43.20_2	2	Oct/31/2012	43.20	N42(D)2(M)57(S) and W91(D)26(M)54(S)
US-151/N/MP41.00_1	3	Oct/31/2012	41.00	N42(D)2(M)51(S) and W91(D)29(M)29(S)
US-151/N/MP41.00_2	3	Oct/31/2012	41.00	N42(D)2(M)51(S) and W91(D)29(M)29(S)

Table B.2. JPCP drainage outlet inspection location information (continued)

ID	Inspection Location No	Date of Inspection	MP	GPS
US-30/W/MP 262.90_1	1	Oct/31/2012	262.90	N42(D)55(M)5(S) and W91(D)28(M)32(S)
US-30/W/MP 262.90_2	1	Oct/31/2012	262.90	N42(D)55(M)5(S) and W91(D)28(M)32(S)
US-30/W/MP 261.35	2	Oct/31/2012	261.35	N41(D)56(M)23(S) and W91(D)30(M)15(S)
US-30/W/MP 260.80	3	Oct/31/2012	260.80	N41(D)55(M)33(S) and W91(D)31(M)3(S)
US-30/W/MP 260.20	4	Oct/31/2012	260.20	N41(D)55(M)33(S) and W91(D)31(M)31(S)
I-80/W/MP 203.50	1	Nov/1/2012	203.50	N41(D)41(M)44(S) and W92(D)19(M)28(S)
I-80/W/MP 202.65	2	Nov/1/2012	202.65	N41(D)41(M)44(S) and W92(D)20(M)27(S)
I-80/W/MP 201.55	3	Nov/1/2012	201.55	N41(D)41(M)45(S) and W92(D)21(M)43(S)
I-80/W/MP 197.70	4	Nov/1/2012	197.70	N41(D)41(M)45(S) and W92(D)26(M)11(S)
I-80/W/MP 197.15_1	5	Nov/1/2012	197.15	N41(D)41(M)45(S) and W92(D)26(M)50(S)
I-80/W/MP 197.15_2	5	Nov/1/2012	197.15	N41(D)41(M)45(S) and W92(D)26(M)50(S)
I-80/W/MP 194.45_1	6	Nov/1/2012	194.45	N41(D)41(M)41(S) and W92(D)29(M)55(S)
I-80/W/MP 194.45_2	6	Nov/1/2012	194.45	N41(D)41(M)41(S) and W92(D)29(M)55(S)
I-80/W/MP 193.60_1	7	Nov/1/2012	193.60	N41(D)41(M)43(S) and W92(D)30(M)55(S)
I-80/W/MP 193.60_2	7	Nov/1/2012	193.60	N41(D)41(M)43(S) and W92(D)30(M)55(S)
I-80/W/MP 193.00_1	8	Nov/1/2012	193.00	N41(D)41(M)46(S) and W92(D)31(M)38(S)
I-80/W/MP 193.00_2	8	Nov/1/2012	193.00	N41(D)41(M)46(S) and W92(D)31(M)38(S)
I-80/W/MP 173.75	1	Nov/1/2012	173.75	N41(D)40(M)59(S) and W92(D)53(M)44(S)
I-80/W/MP 171.95	2	Nov/1/2012	171.95	N41(D)40(M)51(S) and W92(D)55(M)48(S)
I-80/W/MP 170.35	3	Nov/1/2012	170.35	N41(D)40(M)52(S) and W92(D)57(M)41(S)
I-80/W/MP 167.30	4	Nov/1/2012	167.30	N41(D)40(M)58(S) and W93(D)01(M)10(S)
I-80/W/MP 163.55	5	Nov/1/2012	163.55	N41(D)40(M)53(S) and W93(D)05(M)03(S)
I-80/W/MP 159.59	6	Nov/1/2012	159.95	N41(D)41(M)07(S) and W93(D)09(M)40(S)
I-80/W/MP 157.70-1	7	Nov/1/2012	157.70	N41(D)41(M)56(S) and W93(D)12(M)03(S)
I-80/W/MP 157.70-2	7	Nov/1/2012	157.70	N41(D)41(M)56(S) and W93(D)12(M)03(S)
I-80/W/MP 151.35	1	Nov/1/2012	151.35	N41(D)40(M)54(S) and W93(D)19(M)13(S)
I-80/W/MP 150.85	2	Nov/1/2012	150.85	N41(D)40(M)53(S) and W93(D)19(M)46(S)
I-80/W/MP 150.10	3	Nov/1/2012	150.10	N41(D)40(M)52(S) and W93(D)20(M)39(S)
IA-60/E/MP 47.75	1	Nov/7/2012	47.75	N43(D)22(M)10(S) and W95(D)45(M)47(S)
IA-60/E/MP 48.35_1	2	Nov/7/2012	48.35	N43(D)22(M)38(S) and W95(D)45(M)29(S)
IA-60/E/MP 48.35_2	2	Nov/7/2012	48.35	N43(D)22(M)38(S) and W95(D)45(M)29(S)
IA-60/E/MP 49.06_1	3	Nov/7/2012	49.06	N43(D)22(M)59(S) and W95(D)44(M)49(S)
IA-60/E/MP 49.06_2	3	Nov/7/2012	49.06	N43(D)22(M)59(S) and W95(D)44(M)49(S)
IA-60/E/MP 51.10	4	Nov/7/2012	51.10	N43(D)23(M)50(S) and W93(D)43(M)01(S)
IA-60/W/MP 51.15	1	Nov/7/2012	51.15	N43(D)23(M)51(S) and W95(D)43(M)03(S)
IA-60/W/MP 50.20_1	2	Nov/7/2012	50.20	N43(D)23(M)09(S) and W95(D)43(M)32(S)
IA-60/W/MP 50.20_2	2	Nov/7/2012	50.20	N43(D)23(M)09(S) and W95(D)43(M)32(S)
IA-60/W/MP 47.75	3	Nov/7/2012	47.75	N43(D)23(M)09(S) and W95(D)43(M)31(S)

Table B.2. JPCP drainage outlet inspection location information (continued)

ID	Inspection Location No	Date of Inspection	MP	GPS
I-80/W/MP 49.30_1	1	Nov/19/2012	49.30	N41(D)29(M)54(S) and W95(D)09(M)47(S)
I-80/W/MP 49.30_2	2	Nov/19/2012	49.30	N41(D)29(M)54(S) and W95(D)09(M)47(S)
I-80/W/MP 49.03	3	Nov/19/2012	49.03	N41(D)29(M)53(S) and W95(D)10(M)04(S)
I-80/W/MP 48.50_1	4	Nov/19/2012	48.50	N41(D)29(M)53(S) and W95(D)10(M)40(S)
I-80/W/MP 48.50_2	4	Nov/19/2012	48.50	N41(D)29(M)53(S) and W95(D)10(M)40(S)
I-80/W/MP 48.30_1	5	Nov/19/2012	48.30	N/A
I-80/W/MP 48.30_2	5	Nov/19/2012	48.30	N/A
I-80/W/MP 47.70_1	6	Nov/19/2012	47.70	N41(D)29(M)51(S) and W95(D)11(M)36(S)
I-80/W/MP 47.70_2	6	Nov/19/2012	47.70	N41(D)29(M)51(S) and W95(D)11(M)36(S)
I-80/W/MP 46.70_1	7	Nov/19/2012	46.70	N41(D)29(M)50(S) and W95(D)12(M)45(S)
I-80/W/MP 46.70_2	7	Nov/19/2012	46.70	N41(D)29(M)50(S) and W95(D)12(M)45(S)
I-80/W/MP 38.20	1	Nov/19/2012	38.20	N41(D)29(M)51(S) and W95(D)22(M)34(S)
I-80/W/MP 37.90	2	Nov/19/2012	37.90	N41(D)25(M)52(S) and W95(D)22(M)55(S)
I-80/W/MP 37.35	3	Nov/19/2012	37.35	N41(D)29(M)52(S) and W95(D)23(M)37(S)
I-80/W/MP 36.05	4	Nov/19/2012	36.05	N41(D)29(M)52(S) and W95(D)23(M)03(S)
I-80/W/MP 34.70	5	Nov/19/2012	34.70	N41(D)29(M)55(S) and W95(D)26(M)35(S)
I-80/W/MP 26.75	1	Nov/19/2012	26.75	N41(D)29(M)13(S) and W95(D)35(M)14(S)
I-80/W/MP 24.90	2	Nov/19/2012	24.90	N41(D)27(M)41(S) and W95(D)35(M)49(S)
I-80/W/MP 23.75	3	Nov/19/2012	23.75	N41(D)26(M)45(S) and W95(D)36(M)16(S)
I-80/W/MP 21.75	4	Nov/19/2012	21.75	N41(D)25(M)37(S) and W95(D)38(M)00(S)
I-80/W/MP 10.50	1	Nov/19/2012	10.50	N41(D)18(M)18(S) and W95(D)46(M)02(S)
I-80/W/MP 9.50	2	Nov/19/2012	9.50	N41(D)17(M)36(S) and W95(D)46(M)32(S)
I-29/N/MP 58.80	1	Nov/19/2012	58.80	N41(D)18(M)51(S) and W95(D)52(M)27(S)
I-29/N/MP 59.85	2	Nov/19/2012	59.85	N41(D)19(M)38(S) and W95(D)53(M)02(S)
I-29/N/MP 60.35	3	Nov/19/2012	60.35	N41(D)20(M)02(S) and W95(D)53(M)13(S)
I-29/N/MP 63.05	4	Nov/19/2012	63.05	N41(D)22(M)14(S) and W95(D)53(M)57(S)
I-29/N/MP 64.45	5	Nov/19/2012	64.45	N41(D)23(M)26(S) and W95(D)53(M)57(S)
I-29/N/MP 65.13_1	6	Nov/19/2012	65.13	N41(D)24(M)02(S) and W95(D)53(M)57(S)
I-29/N/MP 65.13_2	6	Nov/19/2012	65.13	N41(D)24(M)02(S) and W95(D)53(M)57(S)
I-29/S/MP 65.20_1	1	Nov/19/2012	65.20	N41(D)24(M)05(S) and W95(D)53(M)59(S)
I-29/S/MP 65.20_2	1	Nov/19/2012	65.20	N41(D)22(M)05(S) and W95(D)53(M)59(S)
I-29/S/MP 63.35	2	Nov/19/2012	63.35	N41(D)22(M)28(S) and W95(D)53(M)58(S)
I-29/S/MP 60.98	3	Nov/19/2012	60.98	N41(D)20(M)31(S) and W95(D)53(M)30(S)
I-29/S/MP 60.35_1	1	Nov/19/2012	60.80	N41(D)20(M)02(S) and W95(D)53(M)14(S)
I-29/S/MP 60.35_2	1	Nov/19/2012	60.80	N41(D)20(M)02(S) and W95(D)53(M)14(S)
I-29/S/MP 60.20_1	2	Nov/19/2012	60.20	N41(D)19(M)53(S) and W95(D)53(M)10(S)
I-29/S/MP 60.20_2	2	Nov/19/2012	60.20	N41(D)19(M)53(S) and W95(D)53(M)10(S)

Table B.2. JPCP drainage outlet inspection location information (continued)

ID	Inspection Location No	Date of Inspection	MP	GPS
I-29/N/MP 70.90_1	1	Nov/20/2012	70.90	N41(D)28(M)58(S) and W95(D)54(M)00(S)
I-29/N/MP 70.90_2	1	Nov/20/2012	70.90	N41(D)28(M)58(S) and W95(D)54(M)00(S)
I-29/N/MP 71.08_1	2	Nov/20/2012	71.08	N41(D)29(M)14(S) and W95(D)54(M)01(S)
I-29/N/MP 71.08_2	2	Nov/20/2012	71.08	N41(D)29(M)14(S) and W95(D)54(M)01(S)
I-29/N/MP 71.65_1	3	Nov/20/2012	71.65	N41(D)29(M)46(S) and W95(D)54(M)03(S)
I-29/N/MP 71.65_2	3	Nov/20/2012	71.65	N41(D)29(M)46(S) and W95(D)54(M)03(S)
I-29/N/MP 72.15_1	4	Nov/20/2012	72.15	N41(D)30(M)07(S) and W95(D)54(M)05(S)
I-29/N/MP 72.15_2	4	Nov/20/2012	72.15	N41(D)30(M)07(S) and W95(D)54(M)05(S)
I-29/N/MP 72.90_1	1	Nov/20/2012	72.90	N41(D)30(M)41(S) and W95(D)54(M)34(S)
I-29/N/MP 72.90_2	1	Nov/20/2012	72.90	N41(D)30(M)41(S) and W95(D)54(M)34(S)
I-29/N/MP 74.25_1	2	Nov/20/2012	74.25	N41(D)31(M)43(S) and W95(D)55(M)02(S)
I-29/N/MP 74.25_2	2	Nov/20/2012	74.25	N41(D)31(M)43(S) and W95(D)55(M)02(S)
I-29/N/MP 74.60_1	3	Nov/20/2012	74.60	N41(D)32(M)00(S) and W95(D)55(M)02(S)
I-29/N/MP 74.60_2	3	Nov/20/2012	74.60	N41(D)32(M)00(S) and W95(D)55(M)02(S)
I-29/N/MP 76.25_1	4	Nov/20/2012	76.25	N41(D)33(M)30(S) and W95(D)55(M)01(S)
I-29/N/MP 76.25_2	4	Nov/20/2012	76.25	N41(D)33(M)30(S) and W95(D)55(M)01(S)
I-29/N/MP 77.30_1	1	Nov/20/2012	77.30	N41(D)34(M)16(S) and W95(D)55(M)25(S)
I-29/N/MP 77.30_2	1	Nov/20/2012	77.30	N41(D)34(M)16(S) and W95(D)55(M)25(S)
I-29/N/MP 79.05	2	Nov/20/2012	79.05	N/A
I-29/N/MP 82.90_1	3	Nov/20/2012	82.90	N41(D)37(M)44(S) and W95(D)59(M)57(S)
I-29/N/MP 82.90_2	3	Nov/20/2012	82.90	N41(D)37(M)44(S) and W95(D)59(M)57(S)
I-29/N/MP 85.35_1	4	Nov/20/2012	85.35	N41(D)39(M)22(S) and W96(D)01(M)43(S)
I-29/N/MP 85.35_2	4	Nov/20/2012	85.35	N41(D)39(M)22(S) and W96(D)01(M)43(S)
I-29/N/MP 87.15	5	Nov/20/2012	87.15	N41(D)40(M)50(S) and W96(D)02(M)25(S)
I-29/N/MP 90.15	6	Nov/20/2012	90.15	N/A
I-29/S/MP 76.40_1	1	Nov/20/2012	76.54	N41(D)33(M)34(S) and W95(D)55(M)03(S)
I-29/S/MP 76.40_2	1	Nov/20/2012	76.54	N41(D)33(M)34(S) and W95(D)55(M)03(S)
I-29/S/MP 75.00_1	2	Nov/20/2012	75.00	N41(D)32(M)21(S) and W95(D)55(M)04(S)
I-29/S/MP 75.00_2	2	Nov/20/2012	75.00	N41(D)32(M)21(S) and W95(D)55(M)04(S)
I-29/S/MP 73.90	3	Nov/20/2012	73.90	N41(D)31(M)24(S) and W95(D)55(M)04(S)
I-29/S/MP 71.90	1	Nov/20/2012	71.09	N41(D)29(M)54(S) and W95(D)54(M)06(S)
I-29/S/MP 71.15_1	2	Nov/20/2012	71.15	N41(D)29(M)16(S) and W95(D)54(M)03(S)
I-29/S/MP 71.15_2	2	Nov/20/2012	71.15	N41(D)29(M)16(S) and W95(D)54(M)03(S)
I-29/S/MP 70.80_1	3	Nov/20/2012	70.80	N41(D)28(M)58(S) and W95(D)54(M)01(S)
I-29/S/MP 70.80_2	3	Nov/20/2012	70.80	N41(D)28(M)58(S) and W95(D)54(M)01(S)

Table B.2. JPCP drainage outlet inspection location information (continued)

ID	Inspection Location No	Date of Inspection	MP	GPS
I-80/E/MP 5.90	1	Nov/20/2012	5.90	N41(D)14(M)53(S) and W95(D)48(M)48(S)
I-80/E/MP 6.10	2	Nov/20/2012	6.10	N41(D)15(M)04(S) and W95(D)48(M)37(S)
I-80/E/MP 7.40	3	Nov/20/2012	7.40	N41(D)16(M)00(S) and W95(D)47(M)49(S)
I-80/E/MP 9.65	4	Nov/20/2012	9.65	N41(D)17(M)43(S) and W95(D)46(M)28(S)
I-80/E/MP 10.40	5	Nov/20/2012	10.40	N41(D)18(M)15(S) and W95(D)46(M)05(S)
I-80/E/MP 10.50	6	Nov/20/2012	10.50	N41(D)18(M)19(S) and W95(D)46(M)01(S)
I-80/E/MP 22.40	1	Nov/20/2012	22.40	N41(D)26(M)03(S) and W95(D)37(M)28(S)
I-80/E/MP 24.10	2	Nov/20/2012	24.10	N41(D)27(M)02(S) and W95(D)36(M)07(S)
I-80/E/MP 25.85	3	Nov/20/2012	25.85	N41(D)28(M)28(S) and W95(D)35(M)25(S)
I-80/E/MP 28.00	4	Nov/20/2012	28.00	N41(D)29(M)55(S) and W95(D)34(M)17(S)
I-80/E/MP 35.10_1	1	Nov/21/2012	35.10	N41(D)29(M)53(S) and W95(D)26(M)09(S)
I-80/E/MP 35.10_2	1	Nov/21/2012	35.10	N41(D)29(M)53(S) and W95(D)26(M)09(S)
I-80/E/MP 35.25_1	2	Nov/21/2012	35.10	N41(D)29(M)53(S) and W95(D)25(M)59(S)
I-80/E/MP 35.25_2	2	Nov/21/2012	35.10	N41(D)29(M)53(S) and W95(D)25(M)59(S)
I-80/E/MP 36.20_1	3	Nov/21/2012	35.10	N41(D)29(M)51(S) and W95(D)24(M)52(S)
I-80/E/MP 36.20_2	3	Nov/21/2012	35.10	N41(D)29(M)51(S) and W95(D)24(M)52(S)
I-80/E/MP 37.23	4	Nov/21/2012	35.10	N41(D)29(M)51(S) and W95(D)23(M)41(S)
I-80/E/MP 38.05_1	5	Nov/21/2012	35.10	N41(D)29(M)51(S) and W95(D)23(M)43(S)
I-80/E/MP 38.05_2	5	Nov/21/2012	35.10	N41(D)29(M)51(S) and W95(D)23(M)43(S)
I-80/E/MP 38.37_1	6	Nov/21/2012	35.10	N41(D)29(M)51(S) and W95(D)22(M)22(S)
I-80/E/MP 38.37_2	6	Nov/21/2012	35.10	N41(D)29(M)51(S) and W95(D)22(M)22(S)
I-80/E/MP 45.70	1	Nov/21/2012	45.70	N41(D)29(M)49(S) and W95(D)13(M)54(S)
I-80/E/MP 46.35	2	Nov/21/2012	46.35	N41(D)29(M)49(S) and W95(D)13(M)08(S)
I-80/E/MP 47.65	3	Nov/21/2012	47.65	N41(D)29(M)50(S) and W95(D)11(M)39(S)
I-80/E/MP 48.40	4	Nov/21/2012	48.40	N41(D)29(M)51(S) and W95(D)10(M)45(S)
I-80/E/MP 49.55	5	Nov/21/2012	49.55	N41(D)29(M)53(S) and W95(D)09(M)28(S)

Table B.3. JPCP drainage outlet inspection results

ID	Type of Outlet Pipe	Size of Outlet Pipe (in.)	Condition of Outlet Pipe (% Block)	Condition of Outlet Pipe (Description)	Water Presence inside Outlet Pipe	Type of Rodent Guard	Tufa/Dead Zone (due to tufa) Presence	Embankment Slop Condition	Pavement Distress Condition
I-35/N/MP140.22	Corrugated steel	6	50	ufa block/Damaged	Yes (standing)	Fork	Yes	Less than 30 degree	No distress
I-35/N/MP140.35	Corrugated steel	6	100	Soil block	Yes (standing)	Fork	No	Less than 30 degree	No distress
I-35/N/MP140.60	Corrugated steel	6	20	Tufa block	Yes (standing)	Fork	Yes	More than 30 degree	No distress
I-35/N/MP140.80	Corrugated steel	6	40	Tufa block	No	Fork	Yes	Less than 30 degree	No distress
I-35/N/MP141.30	Corrugated steel	6	100	ufa block/Damaged	Yes (standing)	Gate screen	Yes	Less than 30 degree	No distress
I-35/N/MP143.30	Corrugated plastic	4	60	Tufa block	Yes (standing)	Fork	Yes	Less than 30 degree	No distress
I-35/N/MP143.45	Corrugated steel	6	100	ufa block/Damaged	No	N/A	Yes	Less than 30 degree	No distress
I-35/N/MP143.65	Corrugated steel	6	0	No block	No	Fork	No	More than 30 degree	No distress
I-35/S/MP 129.00	Corrugated steel	6	0	No block	No	Fork	Yes	More than 30 degree	No distress
I-35/S/MP 128.00	Corrugated steel	6	5	Tufa block	No	Fork	Yes	More than 30 degree	No distress
I-35/S/MP 127.90	Corrugated steel	6	0	No block	No	Fork	Yes	Less than 30 degree	No distress
I-35/S/MP 127.85	Corrugated steel	6	70	Soil block	No	Gate screen	No	Less than 30 degree	No distress
I-35/S/MP 127.50	Corrugated steel	6	20	Soil block/Damaged	No	Fork	No	Less than 30 degree	No distress
I-35/S/MP 127.20	Corrugated steel	6	0	No block/Damaged	No	Fork	No	Less than 30 degree	No distress
I-35/S/MP 126.00	Corrugated steel	6	0	No block/Damaged	No	Fork	Yes	Less than 30 degree	No distress
I-35/S/MP 123.70	Corrugated steel	6	50	diment block/Damag	No	Fork	Yes	Less than 30 degree	No distress
US-30/W/MP 156.50_1	Corrugated steel	6	0	No block	No	N/A	No	More than 30 degree	Transverse crack
US-30/W/MP 156.50_2	Corrugated steel	6	0	No block	No	Gate screen	No	More than 30 degree	Transverse crack
US-30/W/MP 156.00	Corrugated steel	6	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-30/W/MP 155.80	Corrugated steel	6	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-30/W/MP 153.00	Corrugated steel	6	0	No block	No	Gate screen	No	Less than 30 degree	No distress
I-80/W/MP 132.86	Corrugated plastic	4	80	Sediment block	No	Gate screen	No	More than 30 degree	No distress
I-80/W/MP 132.20_1	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
I-80/W/MP 132.20_2	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
I-80/W/MP 131.85	Corrugated plastic	4	80	Sediment block	No	Gate screen	No	More than 30 degree	No distress
I-80/W/MP 131.80	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
US-6/E/MP 121.30	Corrugated steel	6	0	No block	No	Gate screen	No	Less than 30 degree	No distress
I-80/W/MP 104.80	Corrugated steel	6	0	No block/Damaged	Yes (free flowing)	N/A	No	More than 30 degree	No distress
I-80/W/MP 103.95	Corrugated steel	6	30	Tufa block	Yes (free flowing)	N/A	Yes	More than 30 degree	No distress
I-80/W/MP 103.90_1	Corrugated steel	6	20	Sediment block	No	N/A	No	More than 30 degree	No distress
I-80/W/MP 103.90_2	Corrugated steel	6	20	Sediment block	No	Fork	No	More than 30 degree	No distress
I-80/W/MP 103.40	Corrugated steel	6	0	No block	Yes (standing)	N/A	No	Less than 30 degree	No distress

Table B.3. JPCP drainage outlet inspection results (continued)

ID	Type of Outlet Pipe	Size of Outlet Pipe (in.)	Condition of Outlet Pipe (% Block)	Condition of Outlet Pipe (Description)	Water Presence inside Outlet Pipe	Type of Rodent Guard	Tufa/Dead Zone (due to tufa) Presence	Embankment Slop Condition	Pavement Distress Condition
I-80/W/MP 102.35	Corrugated steel	6	20	Sediment block	Yes (standing)	Fork	No	Less than 30 degree	No distress
I-80/W/MP 102.25	Corrugated steel	6	0	No block	Yes (standing)	N/A	Yes	More than 30 degree	No distress
I-80/W/MP 102.07	Corrugated steel	6	0	No block	Yes (free flowing)	N/A	No	More than 30 degree	No distress
I-80/W/MP 102.00_1	Corrugated steel	6	100	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 102.00_2	Corrugated steel	6	50	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 59.90	Corrugated steel	6	0	No block/Damaged	Yes (free flowing)	Gate screen	Yes	Less than 30 degree	No distress
I-80/W/MP 59.60	Corrugated steel	6	0	No block	Yes (free flowing)	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 59.50	Corrugated steel	6	0	No block	No	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 58.75	Corrugated steel	6	0	No block/Damaged	Yes (free flowing)	N/A	Yes	More than 30 degree	No distress
I-80/W/MP 58.25_1	Corrugated steel	6	0	No block	No	N/A	Yes	More than 30 degree	No distress
I-80/W/MP 58.25_2	Corrugated steel	6	100	Tufa block/Damaged	No	N/A	Yes	More than 30 degree	No distress
I-80/W/MP 57.65_1	Corrugated steel	6	0	No block/Damaged	No	Gate screen	Yes	More than 30 degree	No distress
I-80/W/MP 57.65_2	Corrugated steel	6	100	Tufa block/Damaged	Yes (standing)	N/A	Yes	More than 30 degree	No distress
I-80/W/MP 57.10_1	Corrugated steel	6	100	Tufa block	Yes (standing)	Gate screen	Yes	Less than 30 degree	No distress
I-80/W/MP 57.10_2	Corrugated steel	6	100	Tufa block	Yes (standing)	Gate screen	Yes	Less than 30 degree	No distress
I-80/W/MP 56.72_1	Corrugated steel	6	100	Tufa block/Damaged	Yes (standing)	Gate screen	Yes	More than 30 degree	No distress
I-80/W/MP 56.72_2	Corrugated steel	6	100	Tufa block/Damaged	Yes (standing)	Gate screen	Yes	More than 30 degree	No distress
I-80/W/MP 56.00	Corrugated steel	6	100	Tufa block	Yes (standing)	Gate screen	Yes	Less than 30 degree	No distress
I-80/E/MP 55.93	Corrugated steel	6	50	Tufa block/Damaged	Yes (free flowing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 56.53	Corrugated steel	6	0	No block	No	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 57.00	Corrugated steel	6	0	No block	No	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 73.45	Corrugated steel	6	0	No block	Yes (free flowing)	Fork	No	Less than 30 degree	No distress
I-80/E/MP 74.00	Corrugated steel	6	0	No block	Yes (free flowing)	Fork	No	More than 30 degree	No distress
I-80/E/MP 79.04	Corrugated steel	6	30	Tufa block	No	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 79.27	Corrugated steel	6	100	Soil block/Damaged	Yes (standing)	N/A	No	More than 30 degree	No distress
I-80/E/MP 82.27	Corrugated steel	6	0	No block	No	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 84.45	Corrugated steel	6	0	No block/Damaged	Yes (free flowing)	N/A	No	Less than 30 degree	No distress
IA-163/W/MP 20.67	Corrugated plastic	4	0	No block	No	N/A	No	Less than 30 degree	No distress
IA-163/W/MP 19.63_1	Corrugated plastic	4	60	Sediment block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
IA-163/W/MP 19.63_2	Corrugated plastic	4	60	Sediment block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
IA-163/W/MP 18.82_1	Corrugated plastic	4	70	Sediment block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
IA-163/W/MP 18.82_2	Corrugated plastic	4	70	Sediment block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
IA-163/W/MP 17.60	Corrugated plastic	4	90	Sediment block	Yes (standing)	N/A	No	Less than 30 degree	No distress

Table B.3. JPCP drainage outlet inspection results (continued)

ID	Type of Outlet Pipe	Size of Outlet Pipe (in.)	Condition of Outlet Pipe (% Block)	Condition of Outlet Pipe (Description)	Water Presence inside Outlet Pipe	Type of Rodent Guard	Tufa/Dead Zone (due to tufa) Presence	Embankment Slop Condition	Pavement Distress Condition
IA-5/E/MP 87.55_1	Corrugated plastic	4	0	No block	Yes (standing)	N/A	No	Less than 30 degree	No distress
IA-5/E/MP 87.55_2	Corrugated plastic	4	0	No block	Yes (standing)	N/A	No	Less than 30 degree	No distress
IA-5/E/MP 86.50_1	Corrugated plastic	4	80	Sediment block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
IA-5/E/MP 86.50_2	Corrugated plastic	4	50	diment block/Damag	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
IA-5/E/MP 86.25	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
I-80/E/MP 151.60	Corrugated steel	6	20	Tufa block	Yes (free flowing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 152.15_1	Corrugated steel	6	0	No block	Yes (free flowing)	Fork	No	More than 30 degree	gitudinal crack patc
I-80/E/MP 152.15_2	Corrugated steel	6	0	No block	Yes (free flowing)	Fork	No	More than 30 degree	gitudinal crack patc
I-80/E/MP 153.80	Corrugated steel	6	40	Soil block	No	Fork	No	Less than 30 degree	No distress
I-80/E/MP 154.55	Corrugated steel	6	0	No block	Yes (free flowing)	N/A	Yes	Less than 30 degree	gitudinal crack patc
I-80/E/MP 160.65	Corrugated plastic	4	100	Tufa block	Yes (standing)	Gate screen	Yes	More than 30 degree	No distress
I-80/E/MP 161.75_1	Corrugated steel	6	0	No block	Yes (free flowing)	Fork	Yes	More than 30 degree	No distress
I-80/E/MP 161.75_2	Corrugated steel	6	0	No block	Yes (free flowing)	Fork	Yes	More than 30 degree	No distress
I-80/E/MP 164.10	Corrugated steel	6	40	diment block/Damag	No	Fork	No	More than 30 degree	No distress
I-80/E/MP 165.40	Corrugated steel	6	40	Sediment block	Yes (standing)	N/A	No	More than 30 degree	No distress
I-80/E/MP 167.10	Corrugated steel	6	0	No block	Yes (standing)	N/A	No	More than 30 degree	No distress
I-80/E/MP 169.20_1	Corrugated steel	6	50	Tufa block	Yes (standing)	N/A	No	More than 30 degree	No distress
I-80/E/MP 169.20_2	Corrugated steel	6	0	No block	Yes (free flowing)	N/A	No	More than 30 degree	No distress
I-80/E/MP 169.90	Corrugated steel	6	70	Tufa block	Yes (standing)	Fork	Yes	More than 30 degree	No distress
I-80/E/MP 171.90	Corrugated steel	6	80	Sediment block	No	Fork	No	More than 30 degree	No distress
I-80/E/MP 173.90	Corrugated steel	6	30	Sediment block	Yes (standing)	Fork	No	More than 30 degree	No distress
IA-330/W/MP 14.15	Corrugated plastic	4	100	Sediment block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
IA-330/W/MP 13.80_1	Corrugated plastic	4	20	Sediment block	Yes (free flowing)	Gate screen	No	More than 30 degree	No distress
IA-330/W/MP 13.80_2	Corrugated plastic	4	0	No block	Yes (free flowing)	Gate screen	No	More than 30 degree	No distress
IA-330/W/MP 13.65	Corrugated plastic	4	100	Sediment block	No	Gate screen	No	More than 30 degree	No distress
IA-330/W/MP 13.55_1	Corrugated plastic	4	30	Sediment block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
IA-330/W/MP 13.55_2	Corrugated plastic	4	30	Sediment block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
I-80/E/MP 193.07	Corrugated steel	6	100	Sediment block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 193.20_1	Corrugated steel	6	100	Tufa block	Yes (standing)	Gate screen	Yes	More than 30 degree	No distress
I-80/E/MP 193.20_2	Corrugated steel	6	100	Tufa block	Yes (standing)	Gate screen	Yes	More than 30 degree	No distress
I-80/E/MP 195.10	Corrugated steel	6	60	Sediment block	No	Gate screen	No	Less than 30 degree	No distress
I-80/E/MP 198.05	Corrugated steel	6	0	No block	No	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 202.35	Corrugated steel	6	80	Tufa block	Yes (standing)	N/A	Yes	More than 30 degree	No distress

Table B.3. JPCP drainage outlet inspection results (continued)

ID	Type of Outlet Pipe	Size of Outlet Pipe (in.)	Condition of Outlet Pipe (% Block)	Condition of Outlet Pipe (Description)	Water Presence inside Outlet Pipe	Type of Rodent Guard	Tufa/Dead Zone (due to tufa) Presence	Embankment Slop Condition	Pavement Distress Condition
I-80/E/MP 206.26	Corrugated steel	6	0	No block	Yes (standing)	Fork	Yes	More than 30 degree	No distress
I-80/E/MP 207.10	Corrugated steel	6	0	No block	Yes (standing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 207.43	Corrugated steel	6	60	Tufa block	Yes (standing)	Fork	Yes	More than 30 degree	No distress
I-80/E/MP 208.45	Corrugated steel	6	100	Tufa block/Damaged	No	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 221.60	Corrugated steel	6	70	Tufa block	Yes (standing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 222.23	Corrugated steel	6	100	Tufa block	Yes (standing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 223.65	Corrugated steel	6	10	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 224.18	Corrugated steel	6	80	Tufa block	Yes (standing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 248.35	Corrugated steel	6	60	Tufa block/Damaged	No	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 250.00	Corrugated steel	6	0	No block	No	N/A	Yes	More than 30 degree	No distress
I-80/E/MP 250.50	Corrugated steel	6	100	Tufa block/Damaged	No	Fork	No	Less than 30 degree	No distress
I-80/E/MP 252.15	Corrugated steel	6	100	Tufa block/Damaged	No	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 253.80	Corrugated steel	6	100	Tufa block/Damaged	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 254.85	Corrugated steel	6	60	Sediment block	No	Gate screen	No	Less than 30 degree	No distress
I-80/E/MP 256.53	Corrugated steel	6	70	Tufa block/Damaged	Yes (standing)	N/A	No	Less than 30 degree	No distress
I-80/E/MP 266.37	Corrugated steel	6	0	No block	No	Fork	No	Less than 30 degree	No distress
I-80/E/MP 266.50	Corrugated steel	6	0	No block	No	Fork	No	Less than 30 degree	No distress
I-80/E/MP 266.60	Corrugated steel	6	0	No block	No	Fork	No	Less than 30 degree	No distress
I-80/E/MP 266.85	Corrugated steel	6	0	No block	Yes (free flowing)	N/A	No	Less than 30 degree	No distress
I-80/E/MP 267.40	Corrugated steel	6	90	Sediment block	No	Fork	No	Less than 30 degree	No distress
I-80/E/MP 267.65	Corrugated steel	6	20	Sediment block	No	Fork	No	Less than 30 degree	No distress
I-80/E/MP 268.03	Corrugated steel	6	100	Tufa block	Yes (standing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 268.13	Corrugated steel	6	0	No block	No	N/A	No	Less than 30 degree	No distress
I-80/E/MP 268.85	Corrugated steel	6	20	Sediment block	No	N/A	No	Less than 30 degree	No distress
I-80/E/MP 269.63	Corrugated steel	6	70	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 270.60	Corrugated steel	6	80	Tufa block	Yes (standing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 270.90	Corrugated steel	6	80	Sediment block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 271.03	Corrugated steel	6	80	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 271.30	Corrugated steel	6	70	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 272.07	Corrugated steel	6	90	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 273.00	Corrugated steel	6	70	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 273.17	Corrugated steel	6	70	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 273.70	Corrugated steel	6	90	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 274.13	Corrugated steel	6	0	No block/Damaged	No	N/A	No	Less than 30 degree	No distress
I-80/E/MP 274.50	Corrugated steel	6	100	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 275.25	Corrugated steel	6	40	Tufa block	Yes (standing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 276.10	Corrugated steel	6	100	Tufa block	Yes (standing)	Fork	Yes	Less than 30 degree	No distress

Table B.3. JPCP drainage outlet inspection results (continued)

ID	Type of Outlet Pipe	Size of Outlet Pipe (in.)	Condition of Outlet Pipe (% Block)	Condition of Outlet Pipe (Description)	Water Presence inside Outlet Pipe	Type of Rodent Guard	Tufa/Dead Zone (due to tufa) Presence	Embankment Slop Condition	Pavement Distress Condition
I-80/E/MP 276.43_1	Corrugated steel	6	40	Tufa block/Damaged	Yes (free flowing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 276.43_2	Corrugated steel	6	40	Tufa block/Damaged	Yes (free flowing)	Gate screen	Yes	Less than 30 degree	No distress
I-80/E/MP 277.65	Corrugated steel	6	100	Tufa block	Yes (standing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 278.20	Corrugated steel	6	70	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 278.30	Corrugated steel	6	70	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 278.60	Corrugated steel	6	30	Tufa block	Yes (free flowing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 278.97	Corrugated steel	6	100	Tufa block/Damaged	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 278.60	Corrugated steel	6	60	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
US-61/E/MP 107.50	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	Corner crack
US-61/E/MP 108.40_1	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
US-61/E/MP 108.40_2	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
US-61/E/MP 109.00	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	Longitudinal crack
I-80/E/MP 296.85	Corrugated steel	6	80	Tufa block	Yes (free flowing)	Fork	Yes	More than 30 degree	No distress
I-80/E/MP 297.60	Corrugated steel	6	100	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 298.40	Corrugated steel	6	100	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
US-151/S/MP 73.60_1	Corrugated plastic	4	70	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 73.60_1	Corrugated plastic	4	70	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 72.95_1	Corrugated plastic	4	50	Soil block	No	Gate screen	No	More than 30 degree	No distress
US-151/S/MP 72.95_2	Corrugated plastic	4	50	Soil block	No	Gate screen	No	More than 30 degree	No distress
US-151/S/MP 72.00_1	Corrugated plastic	4	30	Sediment block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 72.00_2	Corrugated plastic	4	100	Tufa block	Yes (standing)	Gate screen	Yes	Less than 30 degree	No distress
US-151/S/MP 70.85_1	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 70.85_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 70.00_1	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 70.00_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 68.55	Corrugated plastic	4	20	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 68.00_1	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 68.00_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 67.70	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 67.10_1	Corrugated plastic	4	10	Sediment block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 67.10_2	Corrugated plastic	4	10	Sediment block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 66.70	Corrugated plastic	4	100	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 65.80_1	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
US-151/S/MP 65.80_2	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
US-151/S/MP 64.50	Corrugated plastic	4	100	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 63.60_1	Corrugated plastic	4	0	No block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 63.60_2	Corrugated plastic	4	0	No block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 62.90_1	Corrugated plastic	4	0	No block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
US-151/S/MP 62.90_2	Corrugated plastic	4	0	No block	Yes (standing)	N/A	No	Less than 30 degree	No distress

Table B.3. JPCP drainage outlet inspection results (continued)

ID	Type of Outlet Pipe	Size of Outlet Pipe (in.)	Condition of Outlet Pipe (% Block)	Condition of Outlet Pipe (Description)	Water Presence inside Outlet Pipe	Type of Rodent Guard	Tufa/Dead Zone (due to tufa) Presence	Embankment Slop Condition	Pavement Distress Condition
US-151/N/MP 64.05	Corrugated plastic	4	20	Sediment block	No	Gate screen	No	More than 30 degree	No distress
US-151/N/MP 65.05_1	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
US-151/N/MP 65.05_2	Corrugated plastic	4	20	Tufa block	No	Gate screen	Yes	More than 30 degree	No distress
US-151/N/MP 65.95_1	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-151/N/MP 65.95_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-151/N/MP 66.90_1	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-151/N/MP 66.90_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-151/N/MP 67.25_1	Corrugated plastic	4	80	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-151/N/MP 67.25_2	Corrugated plastic	4	80	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-151/N/MP 44.80_1	Corrugated steel	6	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-151/N/MP 44.80_2	Corrugated steel	6	0	No block	No	N/A	No	Less than 30 degree	No distress
US-151/N/MP 43.20_1	Corrugated steel	6	20	Sediment block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
US-151/N/MP 43.20_2	Corrugated steel	6	20	Sediment block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
US-151/N/MP41.00_1	Corrugated steel	6	0	No block	No	N/A	No	Less than 30 degree	No distress
US-151/N/MP41.00_2	Corrugated steel	6	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-30/W/MP 262.90_1	Corrugated plastic	4	30	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-30/W/MP 262.90_2	Corrugated plastic	4	30	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-30/W/MP 261.35	Corrugated plastic	4	50	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-30/W/MP 260.80	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	Transverse crack
US-30/W/MP 260.20	Corrugated plastic	4	30	Soil block	No	Gate screen	No	Less than 30 degree	No distress
I-80/W/MP 203.50	Corrugated steel	6	10	Tufa block	Yes (free flowing)	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 202.65	Corrugated steel	6	100	Tufa block	No	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 201.55	Corrugated steel	6	40	Sediment block	No	Fork	No	Less than 30 degree	No distress
I-80/W/MP 197.70	Corrugated steel	6	30	Soil block	No	Gate screen	No	Less than 30 degree	No distress
I-80/W/MP 197.15_1	Corrugated steel	6	10	Sediment block	No	Gate screen	No	More than 30 degree	No distress
I-80/W/MP 197.15_2	Corrugated steel	6	20	Sediment block	No	Gate screen	No	More than 30 degree	No distress
I-80/W/MP 194.45_1	Corrugated steel	6	50	Soil block	No	Gate screen	No	More than 30 degree	No distress
I-80/W/MP 194.45_2	Corrugated steel	6	50	Soil block	No	Gate screen	No	More than 30 degree	No distress
I-80/W/MP 193.60_1	Corrugated steel	6	40	Sediment block	No	Fork	No	More than 30 degree	No distress
I-80/W/MP 193.60_2	Corrugated steel	6	30	Sediment block	No	Fork	No	More than 30 degree	No distress
I-80/W/MP 193.00_1	Corrugated steel	6	20	Sediment block	No	Gate screen	No	Less than 30 degree	No distress
I-80/W/MP 193.00_2	Corrugated steel	6	30	Sediment block	No	Gate screen	No	Less than 30 degree	No distress
I-80/W/MP 173.75	Corrugated steel	6	30	Sediment block	No	Gate screen	No	Less than 30 degree	No distress
I-80/W/MP 171.95	Corrugated steel	6	10	Sediment block	Yes (free flowing)	Fork	No	Less than 30 degree	No distress
I-80/W/MP 170.35	Corrugated steel	6	40	Tufa block	No	N/A	Yes	More than 30 degree	No distress
I-80/W/MP 167.30	Corrugated steel	6	30	Tufa block	Yes (free flowing)	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 163.55	Corrugated steel	6	50	Soil block	No	Fork	No	More than 30 degree	No distress
I-80/W/MP 159.59	Corrugated steel	6	0	No block/Damaged	No	Fork	No	More than 30 degree	No distress
I-80/W/MP 157.70-1	Corrugated steel	6	90	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 157.70-2	Corrugated steel	6	70	Tufa block	Yes (standing)	Fork	Yes	Less than 30 degree	No distress

Table B.3. JPCP drainage outlet inspection results (continued)

ID	Type of Outlet Pipe	Size of Outlet Pipe (in.)	Condition of Outlet Pipe (% Block)	Condition of Outlet Pipe (Description)	Water Presence inside Outlet Pipe	Type of Rodent Guard	Tufa/Dead Zone (due to tufa) Presence	Embankment Slop Condition	Pavement Distress Condition
I-80/W/MP 151.35	Corrugated plastic	4	40	Soil block	No	Gate screen	No	Less than 30 degree	No distress
I-80/W/MP 150.85	Corrugated steel	6	10	Sediment block	Yes (free flowing)	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 150.10	Corrugated steel	6	80	Soil block	No	N/A	No	Less than 30 degree	No distress
IA-60/E/MP 47.75	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
IA-60/E/MP 48.35_1	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
IA-60/E/MP 48.35_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
IA-60/E/MP 49.06_1	Corrugated plastic	4	80	Sediment block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
IA-60/E/MP 49.06_2	Corrugated plastic	4	50	Sediment block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
IA-60/E/MP 51.10	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
IA-60/W/MP 51.15	Corrugated plastic	4	100	Soil block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
IA-60/W/MP 50.20_1	Corrugated plastic	4	0	No block	Yes (free flowing)	Gate screen	No	Less than 30 degree	No distress
IA-60/W/MP 50.20_2	Corrugated plastic	4	30	Soil block	Yes (free flowing)	Gate screen	No	Less than 30 degree	No distress
IA-60/W/MP 47.75	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
I-80/W/MP 49.30_1	Corrugated steel	6	100	Tufa block	Yes (standing)	Gate screen	Yes	Less than 30 degree	No distress
I-80/W/MP 49.30_2	Corrugated steel	6	0	No block	Yes (standing)	Gate screen	Yes	Less than 30 degree	No distress
I-80/W/MP 49.03	Corrugated steel	6	100	Tufa block	No	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 48.50_1	Corrugated steel	6	60	Tufa block	No	Gate screen	Yes	Less than 30 degree	No distress
I-80/W/MP 48.50_2	Corrugated steel	6	5	Tufa block	No	Gate Screen	Yes	Less than 30 degree	No distress
I-80/W/MP 48.30_1	Corrugated steel	6	100	Tufa block	Yes (standing)	Gate Screen	Yes	More than 30 degree	No distress
I-80/W/MP 48.30_2	Corrugated steel	6	20	Tufa block	Yes (standing)	Gate Screen	Yes	More than 30 degree	No distress
I-80/W/MP 47.70_1	Corrugated steel	6	35	Tufa block	No	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 47.70_2	Corrugated steel	6	0	No block	No	Gate screen	No	Less than 30 degree	No distress
I-80/W/MP 46.70_1	Corrugated steel	6	100	Tufa block	No	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 46.70_2	Corrugated steel	6	0	No block	No	Gate screen	Yes	Less than 30 degree	No distress
I-80/W/MP 38.20	Corrugated steel	6	30	Tufa block	No	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 37.90	Corrugated steel	6	90	Tufa block	No	Fork	Yes	More than 30 degree	No distress
I-80/W/MP 37.35	Corrugated steel	6	0	No block	No	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 36.05	Corrugated steel	6	100	Tufa block	No	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 34.70	Corrugated plastic	4	20	Tufa block/Damaged	Yes (standing)	N/A	Yes	More than 30 degree	No distress
I-80/W/MP 26.75	Corrugated steel	6	80	Soil block	No	N/A	No	Less than 30 degree	No distress
I-80/W/MP 24.90	Corrugated steel	6	0	No block	Yes (free flowing)	N/A	No	Less than 30 degree	No distress
I-80/W/MP 23.75	Corrugated plastic	4	0	No block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/W/MP 21.75	Corrugated plastic	4	0	No block	Yes (standing)	N/A	No	Less than 30 degree	No distress

Table B.3. JPCP drainage outlet inspection results (continued)

ID	Type of Outlet Pipe	Size of Outlet Pipe (in.)	Condition of Outlet Pipe (% Block)	Condition of Outlet Pipe (Description)	Water Presence inside Outlet Pipe	Type of Rodent Guard	Tufa/Dead Zone (due to tufa) Presence	Embankment Slop Condition	Pavement Distress Condition
I-29/N/MP 77.30_1	Corrugated steel	6	100	Soil block	No	Gate screen	No	Less than 30 degree	No distress
I-29/N/MP 77.30_2	Corrugated steel	6	0	No block	No	Gate screen	No	Less than 30 degree	No distress
I-29/N/MP 79.05	Corrugated steel	6	100	liment block/Damag	No	Gate screen	No	Less than 30 degree	No distress
I-29/N/MP 82.90_1	Corrugated steel	6	100	Soil block	No	Gate screen	No	Less than 30 degree	No distress
I-29/N/MP 82.90_2	Corrugated steel	6	80	Soil block/Damaged	No	Gate screen	No	Less than 30 degree	No distress
I-29/N/MP 85.35_1	Corrugated steel	6	0	No block	No	Fork	No	Less than 30 degree	No distress
I-29/N/MP 85.35_2	Corrugated steel	6	0	No block	No	Fork	No	Less than 30 degree	No distress
I-29/N/MP 87.15	Corrugated steel	6	50	Soil block	No	Gate screen	No	Less than 30 degree	No distress
I-29/N/MP 90.15	Corrugated steel	6	50	liment block/Damag	Yes (free flowing)	Gate screen	No	Less than 30 degree	No distress
I-29/S/MP 76.40_1	Corrugated steel	6	50	liment block/Damag	No	Gate screen	No	Less than 30 degree	No distress
I-29/S/MP 76.40_2	Corrugated steel	6	40	liment block/Damag	No	Gate screen	No	Less than 30 degree	No distress
I-29/S/MP 75.00_1	Corrugated plastic	4	60	Sediment block	No	Fork	No	Less than 30 degree	No distress
I-29/S/MP 75.00_2	Corrugated steel	6	30	diment block/Damg	No	Gate screen	No	Less than 30 degree	No distress
I-29/S/MP 73.90	Corrugated plastic	4	0	No block	No	N/A	No	Less than 30 degree	No distress
I-29/S/MP 71.90	Corrugated steel	6	30	Tufa block	No	Gate screen	Yes	Less than 30 degree	No distress
I-29/S/MP 71.15_1	Corrugated steel	6	100	Tufa block	No	Gate screen	Yes	Less than 30 degree	No distress
I-29/S/MP 71.15_2	Corrugated steel	6	100	Tufa block	No	Gate screen	Yes	Less than 30 degree	No distress
I-29/S/MP 70.80_1	Corrugated plastic	4	50	Soil block	No	N/A	Yes	Less than 30 degree	No distress
I-29/S/MP 70.80_2	Corrugated steel	6	100	Tufa block/Damaged	No	Gate screen	Yes	Less than 30 degree	No distress
I-80/E/MP 5.90	Corrugated steel	6	100	Tufa block	No	Gate screen	Yes	Less than 30 degree	No distress
I-80/E/MP 6.10	Corrugated plastic	4	40	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 7.40	Corrugated steel	6	0	No block	No	Gate screen	No	Less than 30 degree	No distress
I-80/E/MP 9.65	Corrugated plastic	4	0	No block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 10.40	Corrugated plastic	4	0	No block	Yes (standing)	N/A	Yes	Less than 30 degree	Transverse crack
I-80/E/MP 10.50	Corrugated plastic	4	50	Tufa block	Yes (standing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 22.40	Corrugated steel	6	50	Tufa block	Yes (free flowing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 24.10	Corrugated steel	6	40	Tufa block	No	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 25.85	Corrugated steel	6	10	Tufa block	No	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 28.00	Corrugated steel	6	0	No block	No	N/A	No	Less than 30 degree	No distress

Table B.3. JPCP drainage outlet inspection results (continued)

ID	Type of Outlet Pipe	Size of Outlet Pipe (in.)	Condition of Outlet Pipe (% Block)	Condition of Outlet Pipe (Description)	Water Presence inside Outlet Pipe	Type of Rodent Guard	Tufa/Dead Zone (due to tufa) Presence	Embankment Slop Condition	Pavement Distress Condition
I-80/E/MP 35.10_1	Corrugated steel	6	100	Tufa block	No	Gate screen	Yes	Less than 30 degree	No distress
I-80/E/MP 35.10_2	Corrugated steel	6	0	No block/Damaged	No	Gate screen	Yes	Less than 30 degree	No distress
I-80/E/MP 35.25_1	Corrugated steel	6	100	Tufa block /Damaged	No	Gate screen	Yes	Less than 30 degree	No distress
I-80/E/MP 35.25_2	Corrugated steel	6	50	Tufa block/Damaged	Yes (free flowing)	Gate screen	Yes	Less than 30 degree	No distress
I-80/E/MP 36.20_1	Corrugated steel	6	90	Soil block	No	N/A	No	Less than 30 degree	No distress
I-80/E/MP 36.20_2	Corrugated steel	6	90	Soil block	No	N/A	No	Less than 30 degree	No distress
I-80/E/MP 37.23	Corrugated steel	6	95	Tufa block /Damaged	No	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 38.05_1	Corrugated steel	6	100	Tufa block /Damaged	No	Gate screen	Yes	Less than 30 degree	No distress
I-80/E/MP 38.05_2	Corrugated steel	6	85	Tufa block /Damaged	No	Gata screen	Yes	Less than 30 degree	No distress
I-80/E/MP 38.37_1	Corrugated steel	6	90	Soil block /Damaged	No	N/A	No	Less than 30 degree	No distress
I-80/E/MP 38.37_2	Corrugated steel	6	90	Soil block /Damaged	No	N/A	No	Less than 30 degree	No distress
I-80/E/MP 45.70	Corrugated steel	6	40	Tufa block	Yes (standing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 46.35	Corrugated steel	6	60	Tufa block /Damaged	Yes (free flowing)	N/A	Yes	Less than 30 degree	No distress
I-80/E/MP 47.65	Corrugated steel	6	100	Tufa block	Yes (free flowing)	Fork	Yes	Less than 30 degree	No distress
I-80/E/MP 48.40	Corrugated steel	6	0	No block	No	N/A	No	Less than 30 degree	No distress
I-80/E/MP 49.55	Corrugated steel	6	90	Tufa block	Yes (free flowing)	Fork	Yes	Less than 30 degree	No distress

Table B.4. Pavement distress records for JPCP sites in PMIS

ID	IRI (in/mile)	PCI (%)	Faulting (in)	Longitudinal crack (ft/mile)	Transverse crack (number/mile)
I-35/N/MP140.22	90.0	91.0	0.3	8.0	2
I-35/N/MP140.35	90.0	91.0	0.3	8.0	2
I-35/N/MP140.60	90.0	91.0	0.3	8.0	2
I-35/N/MP140.80	90.0	91.0	0.3	8.0	2
I-35/N/MP141.30	90.0	91.0	0.3	8.0	2
I-35/N/MP143.30	114.0	92.0	0.2	42.2	62
I-35/N/MP143.45	114.0	92.0	0.2	42.2	62
I-35/N/MP143.65	114.0	92.0	0.2	42.2	62
I-35/S/MP 129.00	81.7	86.0	0.2	0.0	0
I-35/S/MP 128.00	81.7	86.0	0.2	0.0	0
I-35/S/MP 127.90	81.7	86.0	0.2	0.0	0
I-35/S/MP 127.85	81.7	86.0	0.2	0.0	0
I-35/S/MP 127.50	81.7	86.0	0.2	0.0	0
I-35/S/MP 127.20	81.7	86.0	0.2	0.0	0
I-35/S/MP 126.00	92.5	86.0	0.2	0.0	0
I-35/S/MP 123.70	92.5	86.0	0.2	0.0	0
US-30/W/MP 156.50_1	93.8	89.0	0.2	0.0	12
US-30/W/MP 156.50_2	93.8	89.0	0.2	0.0	12
US-30/W/MP 156.00	93.8	89.0	0.2	0.0	12
US-30/W/MP 155.80	93.8	89.0	0.2	0.0	12
US-30/W/MP 153.00	93.8	89.0	0.2	0.0	12
I-80/W/MP 132.86	103.3	76.0	0.2	0.0	2
I-80/W/MP 132.20_1	103.3	76.0	0.2	0.0	2
I-80/W/MP 132.20_2	103.3	76.0	0.2	0.0	2
I-80/W/MP 131.85	103.3	76.0	0.2	0.0	2
I-80/W/MP 131.80	103.3	76.0	0.2	0.0	2
US-6/E/MP 121.30	96.3	67.0	0.3	81.8	22
I-80/W/MP 104.80	93.1	67.0	0.3	23.8	4
I-80/W/MP 103.95	93.1	67.0	0.3	23.8	4
I-80/W/MP 103.90_1	93.1	67.0	0.3	23.8	4
I-80/W/MP 103.90_2	93.1	67.0	0.3	23.8	4
I-80/W/MP 103.40	93.1	67.0	0.3	23.8	4
I-80/W/MP 102.35	98.8	68.0	0.4	0.0	0
I-80/W/MP 102.25	98.8	68.0	0.4	0.0	0
I-80/W/MP 102.07	98.8	68.0	0.4	0.0	0
I-80/W/MP 102.00_1	98.8	68.0	0.4	0.0	0
I-80/W/MP 102.00_2	98.8	68.0	0.4	0.0	0

Table B.4. Pavement distress records for JPCP sites in PMIS (continued)

ID	IRI (in/mile)	PCI (%)	Faulting (in)	Longitudinal crack (ft/mile)	Transverse crack (number/mile)
I-80/W/MP 59.90	84.3	71.0	0.2	0.0	0
I-80/W/MP 59.60	84.3	71.0	0.2	0.0	0
I-80/W/MP 59.50	84.3	71.0	0.2	0.0	0
I-80/W/MP 58.75	84.3	71.0	0.2	0.0	0
I-80/W/MP 58.25_1	84.3	71.0	0.2	0.0	0
I-80/W/MP 58.25_2	84.3	71.0	0.2	0.0	0
I-80/W/MP 57.65_1	84.3	71.0	0.2	0.0	0
I-80/W/MP 57.65_2	84.3	71.0	0.2	0.0	0
I-80/W/MP 57.10_1	84.3	71.0	0.2	0.0	0
I-80/W/MP 57.10_2	84.3	71.0	0.2	0.0	0
I-80/W/MP 56.72_1	84.3	71.0	0.2	0.0	0
I-80/W/MP 56.72_2	84.3	71.0	0.2	0.0	0
I-80/W/MP 56.00	84.3	71.0	0.2	0.0	0
I-80/E/MP 55.93	86.8	66.0	0.3	108.2	1.6
I-80/E/MP 56.53	86.8	66.0	0.3	108.2	1.6
I-80/E/MP 57.00	86.8	66.0	0.3	108.2	1.6
I-80/E/MP 73.45	102.0	82.0	0.2	18.5	96.6
I-80/E/MP 74.00	102.0	82.0	0.2	18.5	96.6
I-80/E/MP 79.04	102.0	82.0	0.2	18.5	96.6
I-80/E/MP 79.27	102.0	82.0	0.2	18.5	96.6
I-80/E/MP 82.27	102.0	82.0	0.2	18.5	96.6
I-80/E/MP 84.45	102.0	82.0	0.2	18.5	96.6
IA-163/W/MP 20.67	83.6	95.0	0.0	29.0	12.9
IA-163/W/MP 19.63_1	83.6	95.0	0.0	29.0	12.9
IA-163/W/MP 19.63_2	83.6	95.0	0.0	29.0	12.9
IA-163/W/MP 18.82_1	83.6	95.0	0.0	29.0	12.9
IA-163/W/MP 18.82_2	83.6	95.0	0.0	29.0	12.9
IA-163/W/MP 17.60	83.6	95.0	0.0	29.0	12.9
IA-5/E/MP 87.55_1	86.8	95.0	0.0	10.6	23.3
IA-5/E/MP 87.55_2	86.8	95.0	0.0	10.6	23.3
IA-5/E/MP 86.50_1	86.8	95.0	0.0	10.6	23.3
IA-5/E/MP 86.50_2	86.8	95.0	0.0	10.6	23.3
IA-5/E/MP 86.25	86.8	95.0	0.0	10.6	23.3
I-80/E/MP 151.60	81.7	63.0	0.2	187.4	0.0
I-80/E/MP 152.15_1	81.7	63.0	0.2	187.4	0.0
I-80/E/MP 152.15_2	81.7	63.0	0.2	187.4	0.0
I-80/E/MP 153.80	81.7	63.0	0.2	187.4	0.0
I-80/E/MP 154.55	81.7	63.0	0.2	187.4	0.0

Table B.4. Pavement distress records for JPCP sites in PMIS (continued)

ID	IRI (in/mile)	PCI (%)	Faulting (in)	Longitudinal crack (ft/mile)	Transverse crack (number/mile)
I-80/E/MP 160.65	69.7	73.0	0.3	21.1	3.2
I-80/E/MP 161.75_1	69.7	73.0	0.3	21.1	3.2
I-80/E/MP 161.75_2	69.7	73.0	0.3	21.1	3.2
I-80/E/MP 164.10	69.7	73.0	0.3	21.1	3.2
I-80/E/MP 165.40	49.4	69.0	0.3	13.2	0.0
I-80/E/MP 167.10	49.4	69.0	0.3	13.2	0.0
I-80/E/MP 169.20_1	49.4	69.0	0.3	13.2	0.0
I-80/E/MP 169.20_2	49.4	69.0	0.3	13.2	0.0
I-80/E/MP 169.90	67.8	72.0	0.3	0.0	0.0
I-80/E/MP 171.90	67.8	72.0	0.3	0.0	0.0
I-80/E/MP 173.90	67.8	72.0	0.3	0.0	0.0
IA-330/W/MP 14.15	95.7	95.0	0.2	26.4	24.1
IA-330/W/MP 13.80_1	95.7	95.0	0.2	26.4	24.1
IA-330/W/MP 13.80_2	95.7	95.0	0.2	26.4	24.1
IA-330/W/MP 13.65	95.7	95.0	0.2	26.4	24.1
IA-330/W/MP 13.55_1	95.7	95.0	0.2	26.4	24.1
IA-330/W/MP 13.55_2	95.7	95.0	0.2	26.4	24.1
I-80/E/MP 193.07	86.8	55.0	0.3	44.9	1.6
I-80/E/MP 193.20_1	86.8	55.0	0.3	44.9	1.6
I-80/E/MP 193.20_2	86.8	55.0	0.3	44.9	1.6
I-80/E/MP 195.10	86.8	55.0	0.3	44.9	1.6
I-80/E/MP 198.05	86.8	55.0	0.3	44.9	1.6
I-80/E/MP 202.35	86.8	55.0	0.3	44.9	1.6
I-80/E/MP 206.26	81.1	56.0	0.3	2.6	0.0
I-80/E/MP 207.10	81.1	56.0	0.3	2.6	0.0
I-80/E/MP 207.43	81.1	56.0	0.3	2.6	0.0
I-80/E/MP 208.45	81.1	56.0	0.3	2.6	0.0
I-80/E/MP 221.60	81.7	72.0	0.3	34.3	2.4
I-80/E/MP 222.23	81.7	72.0	0.3	34.3	2.4
I-80/E/MP 223.65	81.7	72.0	0.3	34.3	2.4
I-80/E/MP 224.18	81.7	72.0	0.3	34.3	2.4
I-80/E/MP 248.35	103.9	65.0	0.3	5.3	0.0
I-80/E/MP 250.00	103.9	65.0	0.3	5.3	0.0
I-80/E/MP 250.50	103.9	65.0	0.3	5.3	0.0
I-80/E/MP 252.15	103.9	65.0	0.3	5.3	0.0

Table B.4. Pavement distress records for JPCP sites in PMIS (continued)

ID	IRI (in/mile)	PCI (%)	Faulting (in)	Longitudinal crack (ft/mile)	Transverse crack (number/mile)
I-80/E/MP 253.80	95.0	65.0	0.3	0.0	0.0
I-80/E/MP 254.85	95.0	65.0	0.3	0.0	0.0
I-80/E/MP 256.53	95.0	65.0	0.3	0.0	0.0
I-80/E/MP 266.37	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 266.50	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 266.60	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 266.85	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 267.40	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 267.65	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 268.03	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 268.13	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 268.85	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 269.63	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 270.60	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 270.90	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 271.03	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 271.30	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 272.07	97.6	61.0	0.3	2.6	3.2
I-80/E/MP 273.00	86.8	63.0	0.2	26.4	2.4
I-80/E/MP 273.17	86.8	63.0	0.2	26.4	2.4
I-80/E/MP 273.70	86.8	63.0	0.2	26.4	2.4
I-80/E/MP 274.13	86.8	63.0	0.2	26.4	2.4
I-80/E/MP 274.50	86.8	63.0	0.2	26.4	2.4
I-80/E/MP 275.25	86.8	63.0	0.2	26.4	2.4
I-80/E/MP 276.10	86.8	63.0	0.2	26.4	2.4
I-80/E/MP 276.43_1	86.8	63.0	0.2	26.4	2.4
I-80/E/MP 276.43_2	86.8	63.0	0.2	26.4	2.4
I-80/E/MP 277.65	86.8	63.0	0.2	26.4	2.4
I-80/E/MP 278.20	86.8	63.0	0.2	26.4	2.4
I-80/E/MP 278.30	86.8	63.0	0.2	26.4	2.4
I-80/E/MP 278.60	69.7	73.0	0.3	18.5	0.8
I-80/E/MP 278.97	69.7	73.0	0.3	18.5	0.8
I-80/E/MP 278.60	69.7	73.0	0.3	18.5	0.8
US-61/E/MP 107.50	84.3	90.0	0.0	134.6	3.2
US-61/E/MP 108.40_1	84.3	90.0	0.0	134.6	3.2
US-61/E/MP 108.40_2	84.3	90.0	0.0	134.6	3.2
US-61/E/MP 109.00	84.3	90.0	0.0	134.6	3.2

Table B.4. Pavement distress records for JPCP sites in PMIS (continued)

ID	IRI (in/mile)	PCI (%)	Faulting (in)	Longitudinal crack (ft/mile)	Transverse crack (number/mile)
I-80/E/MP 296.85	72.2	75.0	0.2	10.6	0.0
I-80/E/MP 297.60	72.2	75.0	0.2	10.6	0.0
I-80/E/MP 298.40	72.2	75.0	0.2	10.6	0.0
US-151/S/MP 73.60_1	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 73.60_1	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 72.95_1	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 72.95_2	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 72.00_1	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 72.00_2	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 70.85_1	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 70.85_2	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 70.00_1	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 70.00_2	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 68.55	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 68.00_1	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 68.00_2	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 67.70	101.4	95.0	0.0	37.0	0.0
US-151/S/MP 67.10_1	95.7	96.0	0.0	5.3	0.8
US-151/S/MP 67.10_2	95.7	96.0	0.0	5.3	0.8
US-151/S/MP 66.70	95.7	96.0	0.0	5.3	0.8
US-151/S/MP 65.80_1	95.7	96.0	0.0	5.3	0.8
US-151/S/MP 65.80_2	95.7	96.0	0.0	5.3	0.8
US-151/S/MP 64.50	95.7	96.0	0.0	5.3	0.8
US-151/S/MP 63.60_1	95.7	96.0	0.0	5.3	0.8
US-151/S/MP 63.60_2	95.7	96.0	0.0	5.3	0.8
US-151/S/MP 62.90_1	95.7	96.0	0.0	5.3	0.8
US-151/S/MP 62.90_2	95.7	96.0	0.0	5.3	0.8
US-151/N/MP 64.05	92.5	96.0	0.0	0.0	0.8
US-151/N/MP 65.05_1	92.5	96.0	0.0	0.0	0.8
US-151/N/MP 65.05_2	92.5	96.0	0.0	0.0	0.8
US-151/N/MP 65.95_1	92.5	96.0	0.0	0.0	0.8
US-151/N/MP 65.95_2	92.5	96.0	0.0	0.0	0.8
US-151/N/MP 66.90_1	92.5	96.0	0.0	0.0	0.8
US-151/N/MP 66.90_2	92.5	96.0	0.0	0.0	0.8
US-151/N/MP 67.25_1	92.5	96.0	0.0	0.0	0.8
US-151/N/MP 67.25_2	92.5	96.0	0.0	0.0	0.8

Table B.4. Pavement distress records for JPCP sites in PMIS (continued)

ID	IRI (in/mile)	PCI (%)	Faulting (in)	Longitudinal crack (ft/mile)	Transverse crack (number/mile)
US-151/N/MP 44.80_1	110.2	80.0	0.0	81.8	33.0
US-151/N/MP 44.80_2	110.2	80.0	0.0	81.8	33.0
US-151/N/MP 43.20_1	110.2	80.0	0.0	81.8	33.0
US-151/N/MP 43.20_2	110.2	80.0	0.0	81.8	33.0
US-151/N/MP41.00_1	110.2	80.0	0.0	81.8	33.0
US-151/N/MP41.00_2	110.2	80.0	0.0	81.8	33.0
US-30/W/MP 262.90_1	126.7	89.0	0.0	66.0	12.1
US-30/W/MP 262.90_2	126.7	89.0	0.0	66.0	12.1
US-30/W/MP 261.35	126.7	89.0	0.0	66.0	12.1
US-30/W/MP 260.80	126.7	89.0	0.0	66.0	12.1
US-30/W/MP 260.20	126.7	89.0	0.0	66.0	12.1
I-80/W/MP 203.50	84.3	58.0	0.3	7.9	0.0
I-80/W/MP 202.65	84.3	58.0	0.3	7.9	0.0
I-80/W/MP 201.55	84.3	58.0	0.3	7.9	0.0
I-80/W/MP 197.70	84.3	58.0	0.3	7.9	0.0
I-80/W/MP 197.15_1	84.3	58.0	0.3	7.9	0.0
I-80/W/MP 197.15_2	84.3	58.0	0.3	7.9	0.0
I-80/W/MP 194.45_1	84.3	58.0	0.3	7.9	0.0
I-80/W/MP 194.45_2	84.3	58.0	0.3	7.9	0.0
I-80/W/MP 193.60_1	84.3	58.0	0.3	7.9	0.0
I-80/W/MP 193.60_2	84.3	58.0	0.3	7.9	0.0
I-80/W/MP 193.00_1	84.3	58.0	0.3	7.9	0.0
I-80/W/MP 193.00_2	84.3	58.0	0.3	7.9	0.0
I-80/W/MP 173.75	69.1	70.0	0.3	52.8	2.4
I-80/W/MP 171.95	69.1	70.0	0.3	52.8	2.4
I-80/W/MP 170.35	69.1	70.0	0.3	52.8	2.4
I-80/W/MP 167.30	69.1	70.0	0.3	52.8	2.4
I-80/W/MP 163.55	69.1	70.0	0.3	52.8	2.4
I-80/W/MP 159.59	69.1	70.0	0.3	52.8	2.4
I-80/W/MP 157.70-1	69.1	70.0	0.3	52.8	2.4
I-80/W/MP 157.70-2	69.1	70.0	0.3	52.8	2.4
I-80/W/MP 151.35	100.7	55.0	0.2	84.5	12.9
I-80/W/MP 150.85	100.7	55.0	0.2	84.5	12.9
I-80/W/MP 150.10	100.7	55.0	0.2	84.5	12.9
IA-60/E/MP 47.75	182.5	57.0	0.3	2616.2	166.6
IA-60/E/MP 48.35_1	182.5	57.0	0.3	2616.2	166.6
IA-60/E/MP 48.35_2	182.5	57.0	0.3	2616.2	166.6
IA-60/E/MP 49.06_1	182.5	57.0	0.3	2616.2	166.6
IA-60/E/MP 49.06_2	182.5	57.0	0.3	2616.2	166.6
IA-60/E/MP 51.10	182.5	57.0	0.3	2616.2	166.6

Table B.4. Pavement distress records for JPCP sites in PMIS (continued)

ID	IRI (in/mile)	PCI (%)	Faulting (in)	Longitudinal crack (ft/mile)	Transverse crack (number/mile)
IA-60/W/MP 51.15	0.0	88.0	0.0	0.0	0.0
IA-60/W/MP 50.20_1	0.0	88.0	0.0	0.0	0.0
IA-60/W/MP 50.20_2	0.0	88.0	0.0	0.0	0.0
IA-60/W/MP 47.75	0.0	88.0	0.0	0.0	0.0
I-80/W/MP 49.30_1	93.8	67.0	0.3	216.5	10.5
I-80/W/MP 49.30_2	93.8	67.0	0.3	216.5	10.5
I-80/W/MP 49.03	93.8	67.0	0.3	216.5	10.5
I-80/W/MP 48.50_1	93.8	67.0	0.3	216.5	10.5
I-80/W/MP 48.50_2	93.8	67.0	0.3	216.5	10.5
I-80/W/MP 48.30_1	93.8	67.0	0.3	216.5	10.5
I-80/W/MP 48.30_2	93.8	67.0	0.3	216.5	10.5
I-80/W/MP 47.70_1	93.8	67.0	0.3	216.5	10.5
I-80/W/MP 47.70_2	93.8	67.0	0.3	216.5	10.5
I-80/W/MP 46.70_1	93.8	67.0	0.3	216.5	10.5
I-80/W/MP 46.70_2	93.8	67.0	0.3	216.5	10.5
I-80/W/MP 38.20	100.1	92.0	0.3	0.0	1.6
I-80/W/MP 37.90	100.1	92.0	0.3	0.0	1.6
I-80/W/MP 37.35	100.1	92.0	0.3	0.0	1.6
I-80/W/MP 36.05	100.1	92.0	0.3	0.0	1.6
I-80/W/MP 34.70	100.1	92.0	0.3	0.0	1.6
I-80/W/MP 26.75	87.4	84.0	0.2	0.0	1.6
I-80/W/MP 24.90	87.4	84.0	0.2	0.0	1.6
I-80/W/MP 23.75	87.4	84.0	0.2	0.0	1.6
I-80/W/MP 21.75	87.4	84.0	0.2	0.0	1.6
I-80/W/MP 10.50	119.8	84.0	0.3	26.4	15.3
I-80/W/MP 9.50	119.8	84.0	0.3	26.4	15.3
I-29/N/MP 58.80	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 59.85	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 60.35	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 63.05	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 64.45	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 65.13_1	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 65.13_2	0.0	65.0	0.0	0.0	0.0
I-29/S/MP 65.20_1	83.6	81.0	0.2	5.3	0.0
I-29/S/MP 65.20_2	83.6	81.0	0.2	5.3	0.0
I-29/S/MP 63.35	83.6	81.0	0.2	5.3	0.0
I-29/S/MP 60.98	83.6	81.0	0.2	5.3	0.0

Table B.4. Pavement distress records for JPCP sites in PMIS (continued)

ID	IRI (in/mile)	PCI (%)	Faulting (in)	Longitudinal crack (ft/mile)	Transverse crack (number/mile)
I-29/S/MP 60.35_1	0.0	69.0	0.0	0.0	0.0
I-29/S/MP 60.35_2	0.0	69.0	0.0	0.0	0.0
I-29/S/MP 60.20_1	0.0	69.0	0.0	0.0	0.0
I-29/S/MP 60.20_2	0.0	69.0	0.0	0.0	0.0
I-29/N/MP 70.90_1	87.4	75.0	0.2	73.9	0.0
I-29/N/MP 70.90_2	87.4	75.0	0.2	73.9	0.0
I-29/N/MP 71.08_1	87.4	75.0	0.2	73.9	0.0
I-29/N/MP 71.08_2	87.4	75.0	0.2	73.9	0.0
I-29/N/MP 71.65_1	87.4	75.0	0.2	73.9	0.0
I-29/N/MP 71.65_2	87.4	75.0	0.2	73.9	0.0
I-29/N/MP 72.15_1	87.4	75.0	0.2	73.9	0.0
I-29/N/MP 72.15_2	87.4	75.0	0.2	73.9	0.0
I-29/N/MP 72.90_1	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 72.90_2	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 74.25_1	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 74.25_2	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 74.60_1	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 74.60_2	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 76.25_1	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 76.25_2	0.0	65.0	0.0	0.0	0.0
I-29/N/MP 77.30_1	74.8	80.0	0.3	345.8	15.3
I-29/N/MP 77.30_2	74.8	80.0	0.3	345.8	15.3
I-29/N/MP 79.05	74.8	80.0	0.3	345.8	15.3
I-29/N/MP 82.90_1	74.8	80.0	0.3	345.8	15.3
I-29/N/MP 82.90_2	74.8	80.0	0.3	345.8	15.3
I-29/N/MP 85.35_1	74.8	80.0	0.3	345.8	15.3
I-29/N/MP 85.35_2	74.8	80.0	0.3	345.8	15.3
I-29/N/MP 87.15	74.8	80.0	0.3	345.8	15.3
I-29/N/MP 90.15	74.8	80.0	0.3	345.8	15.3
I-29/S/MP 76.40_1	83.0	81.0	0.3	2.6	0.0
I-29/S/MP 76.40_2	83.0	81.0	0.3	2.6	0.0
I-29/S/MP 75.00_1	83.0	81.0	0.3	2.6	0.0
I-29/S/MP 75.00_2	83.0	81.0	0.3	2.6	0.0
I-29/S/MP 73.90	83.0	81.0	0.3	2.6	0.0
I-29/S/MP 71.90	98.8	80.0	0.2	44.9	1.6
I-29/S/MP 71.15_1	98.8	80.0	0.2	44.9	1.6
I-29/S/MP 71.15_2	98.8	80.0	0.2	44.9	1.6
I-29/S/MP 70.80_1	98.8	80.0	0.2	44.9	1.6
I-29/S/MP 70.80_2	98.8	80.0	0.2	44.9	1.6

Table B.4. Pavement distress records for JPCP sites in PMIS (continued)

ID	IRI (in/mile)	PCI (%)	Faulting (in)	Longitudinal crack (ft/mile)	Transverse crack (number/mile)
I-80/E/MP 5.90	87.4	91.0	0.3	34.3	4.0
I-80/E/MP 6.10	87.4	91.0	0.3	34.3	4.0
I-80/E/MP 7.40	87.4	91.0	0.3	34.3	4.0
I-80/E/MP 9.65	87.4	91.0	0.3	34.3	4.0
I-80/E/MP 10.40	87.4	91.0	0.3	34.3	4.0
I-80/E/MP 10.50	87.4	91.0	0.3	34.3	4.0
I-80/E/MP 22.40	87.4	84.0	0.2	0.0	1.6
I-80/E/MP 24.10	87.4	84.0	0.2	0.0	1.6
I-80/E/MP 25.85	87.4	84.0	0.2	0.0	1.6
I-80/E/MP 28.00	87.4	84.0	0.2	0.0	1.6
I-80/E/MP 35.10_1	99.5	62.0	0.2	23.8	0.0
I-80/E/MP 35.10_2	99.5	62.0	0.2	23.8	0.0
I-80/E/MP 35.25_1	99.5	62.0	0.2	23.8	0.0
I-80/E/MP 35.25_2	99.5	62.0	0.2	23.8	0.0
I-80/E/MP 36.20_1	99.5	62.0	0.2	23.8	0.0
I-80/E/MP 36.20_2	99.5	62.0	0.2	23.8	0.0
I-80/E/MP 37.23	99.5	62.0	0.2	23.8	0.0
I-80/E/MP 38.05_1	99.5	62.0	0.2	23.8	0.0
I-80/E/MP 38.05_2	99.5	62.0	0.2	23.8	0.0
I-80/E/MP 38.37_1	99.5	62.0	0.2	23.8	0.0
I-80/E/MP 38.37_2	99.5	62.0	0.2	23.8	0.0
I-80/E/MP 45.70	86.8	69.0	0.3	10.6	1.6
I-80/E/MP 46.35	86.8	69.0	0.3	10.6	1.6
I-80/E/MP 47.65	86.8	69.0	0.3	10.6	1.6
I-80/E/MP 48.40	86.8	69.0	0.3	10.6	1.6
I-80/E/MP 49.55	86.8	69.0	0.3	10.6	1.6

Table B.5. HMA pavement site information

ID	Route	Dir	Bpst	Epst	County	Pave Type	Oshld Type	Subbase Agg Typ	Con Yr	Construction Project	AADTT	HMA Surface Thick	Base Thick	Subbase Thick
US-61/E/MP173.30	US-61	2 (South)	172.11	173.43	Jackson County	HMA	Gravel	Vigin Agg	1999	NHS-61-7(46)--19-49	1,211	12.0	0.0	0.0
US-61/E/MP173.00	US-61	2 (South)	172.11	173.43	Jackson County	HMA	Gravel	Vigin Agg	1999	NHS-61-7(46)--19-49	1,211	12.0	0.0	0.0
US-61/E/MP172.75	US-61	2 (South)	172.11	173.43	Jackson County	HMA	Gravel	Vigin Agg	1999	NHS-61-7(46)--19-49	1,211	12.0	0.0	0.0
IA-60/E/MP 40.17	IA-60	1 (East)	39.84	47.69	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.0	0.0	0.0
IA-60/E/MP 41.70	IA-60	1 (East)	39.84	47.69	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.0	0.0	0.0
IA-60/E/MP 42.13_1	IA-60	1 (East)	39.84	47.69	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.0	0.0	0.0
IA-60/E/MP 42.13_2	IA-60	1 (East)	39.84	47.69	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.0	0.0	0.0
IA-60/E/MP 40.00_1	IA-60	1 (East)	39.84	47.69	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.0	0.0	0.0
IA-60/E/MP 40.00_2	IA-60	1 (East)	39.84	47.69	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.0	0.0	0.0
IA-60/E/MP 46.40	IA-60	1 (East)	39.84	47.69	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.0	0.0	0.0
IA-60/W/MP44.30_1	IA-60	2 (West)	42.73	45.05	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.5	0.0	0.0
IA-60/W/MP44.30_2	IA-60	2 (West)	42.73	45.05	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.5	0.0	0.0
IA-60/W/MP44.30_3	IA-60	2 (West)	42.73	45.05	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.5	0.0	0.0
IA-60/W/MP44.30_4	IA-60	2 (West)	42.73	45.05	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.5	0.0	0.0
IA-60/W/MP44.30_5	IA-60	2 (West)	42.73	45.05	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.5	0.0	0.0
IA-60/W/MP43.80_1	IA-60	2 (West)	42.73	45.05	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.5	0.0	0.0
IA-60/W/MP43.80_2	IA-60	2 (West)	42.73	45.05	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.5	0.0	0.0
IA-60/W/MP43.60_1	IA-60	2 (West)	42.73	45.05	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.5	0.0	0.0
IA-60/W/MP43.60_2	IA-60	2 (West)	42.73	45.05	Osceola County	HMA	HMA	Vigin Agg	2006	NHSX-60-4(31)--3H-72	831	14.5	0.0	0.0
US-30/W/MP57.00	US-30	2 (West)	56.21	57.28	Crawford County	HMA	Gravel	Vigin Agg	1999	NHSN-30-2(103)--2R-24	743	12.0	0.0	0.0
US-30/W/MP56.80	US-30	2 (West)	56.21	57.28	Crawford County	HMA	Gravel	Vigin Agg	1999	NHSN-30-2(103)--2R-24	743	12.0	0.0	0.0
US-30/W/MP56.50	US-30	2 (West)	56.21	57.28	Crawford County	HMA	Gravel	Vigin Agg	1999	NHSN-30-2(103)--2R-24	743	12.0	0.0	0.0
US-30/E/MP64.20	US-30	1 (East)	62.2	65.28	Crawford County	HMA	Gravel	Vigin Agg	1998	NHSN-30-2(103)--2R-24	738	9.0	0.0	0.0
US-30/E/MP64.70	US-30	1 (East)	62.2	65.28	Crawford County	HMA	Gravel	Vigin Agg	1998	NHSN-30-2(103)--2R-24	738	9.0	0.0	0.0
US-30/E/MP64.75	US-30	1 (East)	62.2	65.28	Crawford County	HMA	Gravel	Vigin Agg	1998	NHSN-30-2(103)--2R-24	738	9.0	0.0	0.0
US-18/E/MP212.85_1	US-18	1 (East)	212.74	214.39	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--3H-34	1,730	12.0	0.0	0.0
US-18/E/MP212.85_2	US-18	1 (East)	212.74	214.39	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--3H-34	1,730	12.0	0.0	0.0
US-18/E/MP213.05	US-18	1 (East)	212.74	214.39	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--3H-34	1,730	12.0	0.0	0.0
US-18/E/MP213.35	US-18	1 (East)	212.74	214.39	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--3H-34	1,730	12.0	0.0	0.0
US-18/E/MP213.45	US-18	1 (East)	212.74	214.39	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--3H-34	1,730	12.0	0.0	0.0
US-18/E/MP213.90	US-18	1 (East)	212.74	214.39	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--3H-34	1,730	12.0	0.0	0.0
US-18/E/MP214.25	US-18	1 (East)	212.74	214.39	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--3H-34	1,730	12.0	0.0	0.0
US-218/S/MP219.85_1	US-218	2 (South)	219.17	220.29	Chickasaw County	HMA	Gravel	Vigin Agg	2003	NHSN-218-9(94)--2R-19	1,395	13.0	0.0	0.0
US-218/S/MP219.85_2	US-218	2 (South)	219.17	220.29	Chickasaw County	HMA	Gravel	Vigin Agg	2003	NHSN-218-9(94)--2R-19	1,395	13.0	0.0	0.0
US-218/S/MP219.75_1	US-218	2 (South)	219.17	220.29	Chickasaw County	HMA	Gravel	Vigin Agg	2003	NHSN-218-9(94)--2R-19	1,395	13.0	0.0	0.0
US-218/S/MP219.75_2	US-218	2 (South)	219.17	220.29	Chickasaw County	HMA	Gravel	Vigin Agg	2003	NHSN-218-9(94)--2R-19	1,395	13.0	0.0	0.0
US-218/S/MP219.20_1	US-218	2 (South)	219.17	220.29	Chickasaw County	HMA	Gravel	Vigin Agg	2003	NHSN-218-9(94)--2R-19	1,395	13.0	0.0	0.0
US-218/S/MP219.20_2	US-218	2 (South)	219.17	220.29	Chickasaw County	HMA	Gravel	Vigin Agg	2003	NHSN-218-9(94)--2R-19	1,395	13.0	0.0	0.0
US-218/N/MP215.55_1	US-218	1 (North)	231.19	232.79	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--19-34	818	12.0	0.0	0.0
US-218/N/MP215.55_2	US-218	1 (North)	231.19	232.79	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--19-34	818	12.0	0.0	0.0
US-218/N/MP215.10_1	US-218	1 (North)	231.19	232.79	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--19-34	818	12.0	0.0	0.0
US-218/N/MP215.10_2	US-218	1 (North)	231.19	232.79	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--19-34	818	12.0	0.0	0.0
US-218/N/MP214.75_1	US-218	1 (North)	231.19	232.79	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--19-34	818	12.0	0.0	0.0
US-218/N/MP214.75_2	US-218	1 (North)	231.19	232.79	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--19-34	818	12.0	0.0	0.0
US-218/N/MP214.05_1	US-218	1 (North)	231.19	232.79	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--19-34	818	12.0	0.0	0.0
US-218/N/MP214.05_2	US-218	1 (North)	231.19	232.79	Floyd County	HMA	HMA	Vigin Agg	2000	NHS-218-9(88)--19-34	818	12.0	0.0	0.0

Table B.6. HMA pavement drainage outlet inspection location information

ID	Inspection Location No	Date of Inspection	MP	GPS
US-61/E/MP173.30	1	Oct/31/2012	173.30	N42(D)16(M)26(S) and W90(D)40(M)46(S)
US-61/E/MP173.00	2	Oct/31/2012	173.00	N42(D)16(M)11(S) and W90(D)40(M)46(S)
US-61/E/MP172.75	3	Oct/31/2012	172.75	N42(D)15(M)57(S) and W90(D)40(M)49(S)
IA-60/E/MP 40.17	1	Nov/7/2012	40.17	N43(D)16(M)07(S) and W95(D)48(M)28(S)
IA-60/E/MP 41.70	2	Nov/7/2012	41.70	N43(D)17(M)21(S) and W95(D)47(M)49(S)
IA-60/E/MP 42.13_1	3	Nov/7/2012	42.13	N43(D)13(M)42(S) and W95(D)47(M)40(S)
IA-60/E/MP 42.13_2	3	Nov/7/2012	42.13	N43(D)13(M)42(S) and W95(D)47(M)40(S)
IA-60/E/MP 40.00_1	4	Nov/7/2012	40.00	N43(D)19(M)02(S) and W95(D)46(M)41(S)
IA-60/E/MP 40.00_2	4	Nov/7/2012	40.00	N43(D)19(M)02(S) and W95(D)46(M)41(S)
IA-60/E/MP 46.40	5	Nov/7/2012	46.40	N43(D)21(M)02(S) and W95(D)46(M)15(S)
IA-60/W/MP44.30_1	1	Nov/7/2012	44.30	N43(D)19(M)16(S) and W95(D)46(M)42(S)
IA-60/W/MP44.30_2	1	Nov/7/2012	44.30	N43(D)19(M)16(S) and W95(D)46(M)42(S)
IA-60/W/MP44.30_3	1	Nov/7/2012	44.30	N43(D)19(M)16(S) and W95(D)46(M)42(S)
IA-60/W/MP44.30_4	1	Nov/7/2012	44.30	N43(D)19(M)16(S) and W95(D)46(M)42(S)
IA-60/W/MP44.30_5	1	Nov/7/2012	44.30	N43(D)19(M)16(S) and W95(D)46(M)42(S)
IA-60/W/MP43.80_1	2	Nov/7/2012	43.80	N43(D)18(M)51(S) and W95(D)46(M)43(S)
IA-60/W/MP43.80_2	2	Nov/7/2012	43.80	N43(D)18(M)51(S) and W95(D)46(M)43(S)
IA-60/W/MP43.60_1	3	Nov/7/2012	43.05	N43(D)16(M)15(S) and W95(D)46(M)57(S)
IA-60/W/MP43.60_2	3	Nov/7/2012	43.05	N43(D)16(M)15(S) and W95(D)46(M)57(S)
US-30/W/MP57.00	1	Nov/7/2012	57.00	N42(D)01(M)06(S) and W95(D)19(M)06(S)
US-30/W/MP56.80	2	Nov/7/2012	56.80	N43(D)01(M)03(S) and W95(D)19(M)15(S)
US-30/W/MP56.50	3	Nov/7/2012	56.50	N42(D)00(M)57(S) and W95(D)19(M)32(S)
US-30/E/MP64.20	1	Nov/7/2012	64.20	N42(D)03(M)41(S) and W95(D)11(M)48(S)
US-30/E/MP64.70	2	Nov/7/2012	64.70	N42(D)04(M)02(S) and W95(D)11(M)14(S)
US-30/E/MP64.75	3	Nov/7/2012	64.75	N42(D)04(M)04(S) and W95(D)11(M)10(S)
US-18/E/MP212.85_1	1	Nov/14/2012	212.85	N43(D)04(M)58(S) and W92(D)43(M)04(S)
US-18/E/MP212.85_2	1	Nov/14/2012	212.85	N43(D)04(M)58(S) and W92(D)43(M)04(S)
US-18/E/MP213.05	2	Nov/14/2012	213.05	N43(D)04(M)48(S) and W92(D)43(M)02(S)
US-18/E/MP213.35	3	Nov/14/2012	213.35	N43(D)04(M)32(S) and W92(D)43(M)01(S)
US-18/E/MP213.45	4	Nov/14/2012	213.45	N43(D)04(M)28(S) and W92(D)43(M)01(S)
US-18/E/MP213.90	5	Nov/14/2012	213.90	N43(D)04(M)05(S) and W92(D)43(M)02(S)
US-18/E/MP214.25	6	Nov/14/2012	214.25	N43(D)03(M)46(S) and W92(D)43(M)03(S)
US-218/S/MP219.85_1	1	Nov/14/2012	219.85	N42(D)57(M)09(S) and W92(D)33(M)03(S)
US-218/S/MP219.85_2	1	Nov/14/2012	219.85	N42(D)57(M)09(S) and W92(D)33(M)03(S)
US-218/S/MP219.75_1	2	Nov/14/2012	219.75	N42(D)57(M)05(S) and W92(D)33(M)01(S)
US-218/S/MP219.75_2	2	Nov/14/2012	219.75	N42(D)57(M)05(S) and W92(D)33(M)01(S)
US-218/S/MP219.20_1	3	Nov/14/2012	219.20	N42(D)56(M)39(S) and W92(D)32(M)48(S)
US-218/S/MP219.20_2	3	Nov/14/2012	219.20	N42(D)56(M)39(S) and W92(D)32(M)48(S)
US-218/N/MP215.55_1	1	Nov/14/2012	215.55	N42(D)02(M)39(S) and W92(D)43(M)05(S)
US-218/N/MP215.55_2	1	Nov/14/2012	215.55	N42(D)02(M)39(S) and W92(D)43(M)05(S)
US-218/N/MP215.10_1	2	Nov/14/2012	215.10	N43(D)03(M)03(S) and W92(D)43(M)04(S)
US-218/N/MP215.10_2	2	Nov/14/2012	215.10	N43(D)03(M)03(S) and W92(D)43(M)04(S)
US-218/N/MP214.75_1	3	Nov/14/2012	214.75	N43(D)03(M)22(S) and W92(D)43(M)02(S)
US-218/N/MP214.75_2	3	Nov/14/2012	214.75	N43(D)03(M)22(S) and W92(D)43(M)02(S)
US-218/N/MP214.05_1	4	Nov/14/2012	214.05	N/A
US-218/N/MP214.05_2	4	Nov/14/2012	214.05	N/A

Table B.7. HMA pavement drainage outlet inspection results

ID	Type of Outlet Pipe	Size of Outlet Pipe (in.)	Condition of Outlet Pipe (% Block)	Condition of Outlet Pipe (Description)	Water Present inside Outlet Pipe	Type of Rodent Guard	(due to tufa) Present	Embankment Slop Condition	Inspection Location
US-61/E/MP173.30	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	ansverse crackir
US-61/E/MP173.00	Corrugated plastic	4	100	Soil block	No	Gate screen	No	More than 30 degree	ansverse crackir
US-61/E/MP172.75	Corrugated plastic	4	30	Soil block	No	Gate screen	No	Less than 30 degree	No distress
IA-60/E/MP 40.17	Corrugated plastic	4	80	Soil block	No	Gate screen	No	Less than 30 degree	No distress
IA-60/E/MP 41.70	Corrugated plastic	4	90	Soil block	No	Gate screen	No	Less than 30 degree	No distress
IA-60/E/MP 42.13_1	Corrugated plastic	4	0	No block/Damaged	No	Gate screen	No	Less than 30 degree	erse cracking pa
IA-60/E/MP 42.13_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	erse cracking pa
IA-60/E/MP 40.00_1	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
IA-60/E/MP 40.00_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
IA-60/E/MP 46.40	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
IA-60/W/MP44.30_1	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
IA-60/W/MP44.30_2	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
IA-60/W/MP44.30_3	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
IA-60/W/MP44.30_4	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
IA-60/W/MP44.30_5	Corrugated plastic	4	0	No block	No	Gate screen	No	More than 30 degree	No distress
IA-60/W/MP43.80_1	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
IA-60/W/MP43.80_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
IA-60/W/MP43.60_1	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
IA-60/W/MP43.60_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-30/W/MP57.00	Corrugated plastic	4	40	Soil block/Damaged	No	N/A	No	More than 30 degree	No distress
US-30/W/MP56.80	Corrugated plastic	4	0	No block	Yes (free flowing)	Gate screen	No	More than 30 degree	No distress
US-30/W/MP56.50	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-30/E/MP64.20	Corrugated plastic	4	100	Soil block/Damaged	No	Gate screen	No	Less than 30 degree	No distress
US-30/E/MP64.70	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-30/E/MP64.75	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-18/E/MP212.85_1	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-18/E/MP212.85_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-18/E/MP213.05	Corrugated plastic	4	0	No block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
US-18/E/MP213.35	Corrugated plastic	4	0	No block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
US-18/E/MP213.45	Corrugated plastic	4	20	Soil block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
US-18/E/MP213.90	Corrugated plastic	4	20	Soil block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
US-18/E/MP214.25	Corrugated plastic	4	20	Soil block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
US-218/S/MP219.85_1	Corrugated plastic	4	100	Soil block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
US-218/S/MP219.85_2	Corrugated plastic	4	80	Soil block	Yes (standing)	Gate screen	No	Less than 30 degree	No distress
US-218/S/MP219.75_1	Corrugated plastic	4	95	Soil block	Yes (free flowing)	Gate screen	No	Less than 30 degree	No distress
US-218/S/MP219.75_2	Corrugated plastic	4	50	Soil block	Yes (free flowing)	Gate screen	No	Less than 30 degree	No distress
US-218/S/MP219.20_1	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-218/S/MP219.20_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-218/N/MP215.55_1	Corrugated plastic	4	50	Sediment block	No	Gate screen	No	Less than 30 degree	No distress
US-218/N/MP215.55_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-218/N/MP215.10_1	Corrugated plastic	4	30	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-218/N/MP215.10_2	Corrugated plastic	4	20	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-218/N/MP214.75_1	Corrugated plastic	4	40	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-218/N/MP214.75_2	Corrugated plastic	4	30	Soil block	No	Gate screen	No	Less than 30 degree	No distress
US-218/N/MP214.05_1	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress
US-218/N/MP214.05_2	Corrugated plastic	4	0	No block	No	Gate screen	No	Less than 30 degree	No distress

Table B.8. Pavement distress records for HMA pavement sites in PMIS

ID	IRI (in/mile)	PCI (%)	RUT, in	LCRACT, ft/mile	ACRACK, ft^2/mile	number/mile
US-61/E/MP173.30	65.9	77.0	0.1	240.2	0	88
US-61/E/MP173.00	65.9	77.0	0.1	240.2	0	88
US-61/E/MP172.75	65.9	77.0	0.1	240.2	0	88
IA-60/E/MP 40.17	66.5	80.0	0.1	0.0	0.0	0
IA-60/E/MP 41.70	66.5	80.0	0.1	0.0	0.0	0
IA-60/E/MP 42.13_1	66.5	80.0	0.1	0.0	0.0	0
IA-60/E/MP 42.13_2	66.5	80.0	0.1	0.0	0.0	0
IA-60/E/MP 40.00_1	66.5	80.0	0.1	0.0	0.0	0
IA-60/E/MP 40.00_2	66.5	80.0	0.1	0.0	0.0	0
IA-60/E/MP 46.40	66.5	80.0	0.1	0.0	0.0	0
IA-60/W/MP44.30_1	75.4	78.0	0.1	21.1	0.0	1
IA-60/W/MP44.30_2	75.4	78.0	0.1	21.1	0.0	1
IA-60/W/MP44.30_3	75.4	78.0	0.1	21.1	0.0	1
IA-60/W/MP44.30_4	75.4	78.0	0.1	21.1	0.0	1
IA-60/W/MP44.30_5	75.4	78.0	0.1	21.1	0.0	1
IA-60/W/MP43.80_1	75.4	78.0	0.1	21.1	0.0	1
IA-60/W/MP43.80_2	75.4	78.0	0.1	21.1	0.0	1
IA-60/W/MP43.60_1	75.4	78.0	0.1	21.1	0.0	1
IA-60/W/MP43.60_2	75.4	78.0	0.1	21.1	0.0	1
US-30/W/MP57.00	112.8	67.0	0.2	2777.3	155.9	89
US-30/W/MP56.80	112.8	67.0	0.2	2777.3	155.9	89
US-30/W/MP56.50	112.8	67.0	0.2	2777.3	155.9	89
US-30/E/MP64.20	97.6	71.0	0.1	4482.7	17.3	71
US-30/E/MP64.70	97.6	71.0	0.1	4482.7	17.3	71
US-30/E/MP64.75	97.6	71.0	0.1	4482.7	17.3	71
US-18/E/MP212.85_1	82.4	70.0	0.3	308.9	34.6	6
US-18/E/MP212.85_2	82.4	70.0	0.3	308.9	34.6	6
US-18/E/MP213.05	82.4	70.0	0.3	308.9	34.6	6
US-18/E/MP213.35	82.4	70.0	0.3	308.9	34.6	6
US-18/E/MP213.45	82.4	70.0	0.3	308.9	34.6	6
US-18/E/MP213.90	82.4	70.0	0.3	308.9	34.6	6
US-18/E/MP214.25	82.4	70.0	0.3	308.9	34.6	6
US-218/S/MP219.85_1	104.5	72.0	0.1	1264.6	0.0	2
US-218/S/MP219.85_2	104.5	72.0	0.1	1264.6	0.0	2
US-218/S/MP219.75_1	104.5	72.0	0.1	1264.6	0.0	2
US-218/S/MP219.75_2	104.5	72.0	0.1	1264.6	0.0	2
US-218/S/MP219.20_1	104.5	72.0	0.1	1264.6	0.0	2
US-218/S/MP219.20_2	104.5	72.0	0.1	1264.6	0.0	2
US-218/N/MP215.55_1	85.5	74.0	0.2	6174.9	0.0	2
US-218/N/MP215.55_2	85.5	74.0	0.2	6174.9	0.0	2
US-218/N/MP215.10_1	85.5	74.0	0.2	6174.9	0.0	2
US-218/N/MP215.10_2	85.5	74.0	0.2	6174.9	0.0	2
US-218/N/MP214.75_1	85.5	74.0	0.2	6174.9	0.0	2
US-218/N/MP214.75_2	85.5	74.0	0.2	6174.9	0.0	2
US-218/N/MP214.05_1	85.5	74.0	0.2	6174.9	0.0	2
US-218/N/MP214.05_2	85.5	74.0	0.2	6174.9	0.0	2