JOINT TRANSPORTATION
RESEARCH PROGRAM
INDIANA DEPARTMENT OF TRANSPORTATION
AND PURDUE UNIVERSITY

Seal Coat Productivity

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SPR-3753 • Report Number: FHWA/IN/JTRP-2014/12 • DOI: 10.5703/1288284315512

RECOMMENDED CITATION

Padfield, J., Handy, J., & Stephens, J. (2014). *Seal coat productivity* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2014/12). West Lafayette, IN: Purdue University. http://dx.doi.org/10.5703/1288284315512

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JOINT TRANSPORTATION RESEARCH PROGRAM

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Print ISBN: 978-1-62260-313-8
ePUB ISBN: 978-1-62260-314-5

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA/IN/JTRP-2014/12		

4. Title and Subtitle	5. Report Date
Seal Coat Productivity	September 2014
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Jon Padfield, Jim Handy, Jim Stephens	FHWA/IN/JTRP-2014/12

9. Performing Organization Name and Address	10. Work Unit No.
Joint Transportation Research Program Purdue University 550 Stadium Mall Drive West Lafayette, IN 47907-2051	
	11. Contract or Grant No. SPR-3753

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Indiana Department of Transportation State Office Building 100 North Senate Avenue Indianapolis, IN 46204	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes

Prepared in cooperation with the Indiana Department of Transportation and Federal Highway Administration.

16. Abstract

The Indiana Department of Transportation (INDOT) conducts chip seal operations on state highways to prolong the life of the road. The chip seal operation is labor, equipment and material intensive. A typical chip seal operation may involve 35 or more INDOT employees including truck drivers, flagmen, and equipment operators (brooms, rollers, aggregate spreader, and distributors).

This project was launched to better understand and document variations in how each of the six INDOT districts, approach the planning and execution of their respective chip seal operations. The goal was to identify areas in the operation where there were differences between districts and to determine best practices that could be shared among the districts.

Two observers joined the chip seal operations in all six districts. The observers spent a total of 10 days with the chip seal crews (2 days each with the crews from Fort Wayne, La Porte, Greenfield, and Seymour and 1 day each with the crews from Vincennes and Crawfordsville). One additional day was spent in Crawfordsville observing the Fog Seal operation that takes place a few days following chip seal.

During the initial phases of this project, many differences were observed regarding various aspects of the operation including the stone and equipment used, truck loading procedures, traffic control, and covering raised pavement markers (RPNs).

These observations were shared with key stakeholders on November 4, 2013 and with a second group of stakeholders on January 22, 2014. With the help of stakeholders, best practices were identified from the observations and a list of 14 recommendations was created to be shared across all districts. A series of meetings were then scheduled to share the recommendations with each district and to determine which recommendations they were interested in piloting.

The three ideas found during this project that provide the greatest opportunities for improving the overall operational efficiency of the chip seal operation are (1) the importance of closing roads during chip seal whenever possible, (2) the importance of choosing the best locations for stone stockpiles and oil tanker deliveries, and (3) the importance of fully loading dump trucks to their maximum safe and legal limit.

17. Key Words	18. Distribution Statement
chip seal, chipper, connector bar, stone, stockpile, oil distributor, trucks, downtime	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	26	

Form DOT F 1700.7 (8-69)

EXECUTIVE SUMMARY

SEAL COAT PRODUCTIVITY

Introduction

The Indiana Department of Transportation is divided into six districts with district offices located in LaPorte, Fort Wayne, Crawfordsville, Greenfield, Vincennes, and Seymour.

The total statewide, annual cost for the chip seal operations in Fiscal Year 2013 was $11,854,882.66. This figure includes $9,720,347.60 for material (stone and oil), $1,251,672.13 for equipment (no fuel), and $882,862.93 for 59,940 hours of labor.

The aggregate spreaders (chippers) in the Vincennes and Seymour districts have a 12′ fixed box and are the oldest chippers among the six districts. The chippers in the other four districts are variable width, with some having a maximum span of 20′.

In an effort to reduce the cost of the chip seal operation, this project was launched to find ways to improve the efficiency of the chip seal process by identifying and sharing best practices across the districts. The goal is to reduce the number of labor hours per lane mile for the operation. This project was not intended as a "head count reduction" project, but rather as a way to boost the efficiency of the overall operation and increase the number of lane miles that can be chip sealed per day so as to minimize the inconvenience to the driving public.

Another advantage of this project is related to the temperature and moisture sensitivity of the chip seal operation. The chip seal "season" varies by geography within the state with the southern districts being able to start chip sealing typically four to six weeks earlier in the year than the northern districts. Because the chip seal operation is sensitive to moisture, the road must be dry for the emulsion (oil) to properly adhere to the road and the aggregate. Ideally, the road would stay dry for two days between the time the aggregate is spread on the road and the time the fog seal is applied over the aggregate. Currently, some districts struggle to complete their planned lane miles of chip seal during particularly rainy summers. By increasing the number of miles that can be chip sealed per day, the districts should be better able to complete their planned lane miles even in years with unusually frequent rain fall.

Findings

Based on the 10 days of observation, the average chip seal operation is only adding value (the chipper is spreading stone) 41.9% of the time. While there are numerous reasons for the 58.1% of downtime, 74% of that downtime is caused by just three factors (switching trucks, waiting for trucks, and waiting for a distributor).

By taking steps to reduce the downtime, it should be possible to increase the uptime of the chipper from 41.9% to possibly 50% or 55%. An increase from 41.9% to 55% would yield an increase of approximately 31% more lane miles covered in the same amount of time.

While it is impossible to eliminate the time spent changing trucks, the 18.8% of downtime today should be able to be reduced by standardizing the connector bar height and maximizing the amount of stone delivered to the safe and legal limit. Today the trucks are typically loaded with 11 to 12 tons of stone but could be delivering 15 tons or more. By maximizing the stone delivery, the 18.8% of downtime could be reduced by approximately 20%, which would increase the chipper uptime to approximately 45%.

In addition, by closing roads to minimize the delays in getting trucks in and out of the chip seal operation and finding better locations for stone stock piles, the 13.1% of downtime caused by waiting for trucks could be virtually eliminated. If the downtime associated with waiting for trucks was reduced by 75%, it would improve the chipper uptime by about an additional 9%, which would bring the overall uptime to about 54%.

Implementation

In FY 2013, INDOT spent $882,862.93 for 59,940 hours of labor. This equates to an average of $14.73 per hour. Based upon the 10 days of observation, the average chipper uptime across the state is currently 41.9%. The labor savings will be a function of how much the chipper uptime is increased. The table below is an estimate of how much money could be saved by increasing the chipper uptime assuming the total lane miles to be chipped are similar to the FY 2013 total miles.

Chipper uptime	Hours of labor	Labor cost	Cost saving
42%	59,940	882,862	0
44%	57,215	842,784	40,078
46%	54,728	806,141	76,721
48%	52,448	772,552	110,310
50%	50,350	741,650	141,212
52%	48,413	713,125	169,737
54%	46,620	686,713	196,149
56%	44,955	662,187	220,675
58%	43,405	639,353	243,509
60%	41,958	618,041	264,821
62%	40,605	598,105	284,757
64%	39,336	579,414	303,448
66%	38,144	561,856	321,006

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1. INTRODUCTION

The Indiana Department of Transportation is divided into 6 districts with district offices located in Crawfordsville, Fort Wayne, Greenfield, LaPorte, Seymour, and Vincennes.

The total statewide, annual cost for the chip seal operations in Fiscal year 2013 was $11,083,488. This figure includes $9,720,348 for material (stone and oil), and $1,363,140 for 59,940 hours of labor (includes benefits calculated at 54.4%).

The aggregate spreaders (chippers) in the Vincennes and Seymour districts have a 12′ fixed box and are the oldest chippers among the six districts. The chippers in the other four districts are variable width with some having a maximum span of 20′.

In an effort to reduce the cost of the chip seal operation, this project was launched to find ways to improve the efficiency of the chip seal process by identifying and sharing best practices across the districts. The goal is to reduce the number of labor hours per lane mile for the operation. This project was not intended as a "head count reduction" project but rather as a way to boost the efficiency of the overall operation and increase the number of lane miles that can be chip sealed per day so as to minimize the inconvenience to the driving public.

Another advantage of this project is related to the temperature and moisture sensitivity of the chip seal operation. The chip seal "season" varies by geography within the state with the Southern districts being able to start chip sealing typically 4–6 weeks earlier in the year than the Northern districts. Because the chip seal operation is sensitive to moisture, the road must be dry for the emulsion (oil) to properly adhere to the road and the aggregate. Ideally, the road would stay dry for 2 days between the time the aggregate is spread on the road and the time the fog seal is applied over the aggregate. Currently, some districts struggle to complete their planned lane miles of chip seal during particularly rainy summers. By increasing the number of miles that can be chip sealed per day, the districts should be better able to complete their planned lane miles even in years with unusually frequent rain fall.

2. PROBLEM STATEMENT

The chip seal operation is one of the most labor, equipment and material intense operations conducted by INDOT. Because of its complexity and expense, ways need to be found to improve the efficiency of the chip seal operation as measured by accomplishment/man-hour chip sealed.

3. OBJECTIVES

1. Document differences in the way each district approaches chip seal.
2. Identify best practices among the districts and convert them to specific recommendations to improve operational efficiency in chip seal operations.
3. Share the recommendations with each district and seek their buy-in to pilot the recommendations this chip seal season.

4. WORK PLAN

In order to systematically and objectively collect data about the chip seal operations, the two observers spent a total of 10 days in the field with the chip seal crews plus 1 additional day in the field observing the Fog Seal operation. The details of the days observed are shown in Figure 4.1.

The observations and data collected were used to create a Value Stream Map (VSM) for each district. Those maps are shown in Appendix A. The primary pieces of equipment used in the chip seal operation are shown in Figure 4.2 through Figure 4.5.

In addition to the brooms, oil distributors, chipper, and trucks, the chip seal operation also uses rollers and several pickup trucks for moving people and material throughout the day.

During the days of observation, notes and photographs were taken to document the processes used by each district as well as any problems encountered. Time studies were also conducted to determine what percentage of the available time the chipper was actually spreading aggregate. Whenever the chipper was not spreading aggregate, the reason for the stoppage/downtime was documented for further analysis (see Chapter 5, "Analysis of Data," for details).

One of the most common defects in the chip seal process was caused by actuators on the chipper not opening properly which results in exposed streaks of oil that are not covered by aggregate as shown in Figure 4.6.

Another issue observed in multiple districts was trucks that broke their connector bars as shown in Figure 4.7. This problem was often related to less experienced truck drivers who had difficulty connecting to the chipper. In addition to temporarily taking the truck out of service, this problem also damaged the freshly chip sealed portion of the road which required rework to fix.

Another truck related problem frequently observed was damage caused to the chipper due to trucks not backing in properly to connect to the chipper. This can result in damage to the flaps on the chipper box as shown in Figure 4.8. When this occurs, aggregate can leak out of the chipper box and onto the road (wasted material). This situation also creates piles of loose stone that the brooms must then brush off the road.

A less frequent cause of downtime was material quality. The efficiency of the chip seal operation on one of the observation days was negatively impacted due to clumps in the stone that was being spread by the chipper. The small clumps passed through the chipper but left an uneven appearance on the road. The larger clumps clogged the chipper and from time to time the chipper had to stop to remove the clumps from the chipper box as shown in Figure 4.9.

District	LaPorte	Fort Wayne	Crawfordsville	Greenfield	Seymour	Vincennes
Day 1	23-Jul	5-Aug	7-Aug	21-Aug	6-Aug	17-Sep
Road location	SR 110 & US 31	SR 18 & SR 19	SR 28 & SR 63	SR 38 Newcastle	SR 421 & SR 229	SR 168 Ft. Branch
Lane Width	12'	14'	13'	14'	12'	12'
Stone used	SC16 (gravel)	#12	SC16	SC12	#11	SC16
Stone location	Drop @ SR 110 & SR 25	Quarry in Peru	Carbondale maintenance	Drop @ Cambridge City s	Napoleon quarry	Princeton Sub
Chipping rate	18.5 lb / yd2	13 - 14 lb/yd2	20.4 lb / yd2	13 lb / yd2	23.9 lb/yd2	
Distributor rate	.36 gal / yd2	.34 gal / yd2	.33 gal / yd2	.28 gal / yd2	.38 gal / yd2	.34 gal / yd2
With or against traffic	With	With	Against	With	With	With
Day 2	13-Aug	12-Aug	22-Aug (Fog Seal)	4-Sep	20-Aug	
Road location	US 41 & SR 2	SR 13 & SR 14	SR 18 & I-65	SR 140 & US 40	US 31 Scottsburg	
Road width	14'	16', 19'	12'	12'	11' 8"	
Stone used	#12 (doulimite)	#12	N/A (Fog Seal)	SC12	#12	
Stone location	Drop @ INDOT Sub	Quarry in Huntington	N/A (Fog Seal)	Quarry in Pendleton	Clark State Forest	
Chipping rate	17 lb / yd2	13-14 lb / yd2	N/A (Fog Seal)	14.5 lb / yd2	25.1 lb / yd2	
Distributor rate	.31 gal / yd2	.33 gal / yd2	.12 gal / yd2	.29 gal / yd2	.33 gal / yd2	
With	Against (4 ln)	With	Against	With	With	

Figure 4.1 Details of the observation days.

Figure 4.2 View of an oil distributor from the front of the chipper.

Figure 4.4 Chip seal operation (oil distributor, chipper and multi-purpose truck).

Figure 4.3 View of the multi-purpose truck from the back of the chipper.

Figure 4.5 Brooms used to clear the road of debris prior to chip seal.

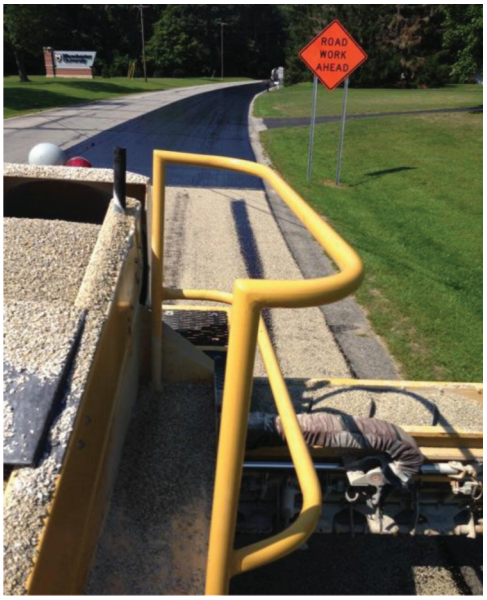


Figure 4.6 Defect from chipper actuator not working properly.

Figure 4.8 Damage to the chipper box.

Figure 4.7 Broken connector bar on two trucks within minutes of each other.

Figure 4.9 Problems caused by clumps in the stone.

5. ANALYSIS OF DATA

The time studies of the 10 days of observing the chip seal operations were combined into one graph shown in Figure 5.1. On average, the chipper was only spreading aggregate 41.9% of the time.

When looking at the number of lane miles a chip seal operation can cover in a day, there are really only two key variables: the percentage of time the chipper is dispensing stone and the speed the chipper is moving while dispensing stone. It is important to note that these two variables are related. It would be relatively easy to increase the % of time the chipper is running by simply slowing down the chipper but that would defeat the purpose of trying to cover more lane miles per day (thereby lowering the labor hours per lane mile chip sealed).

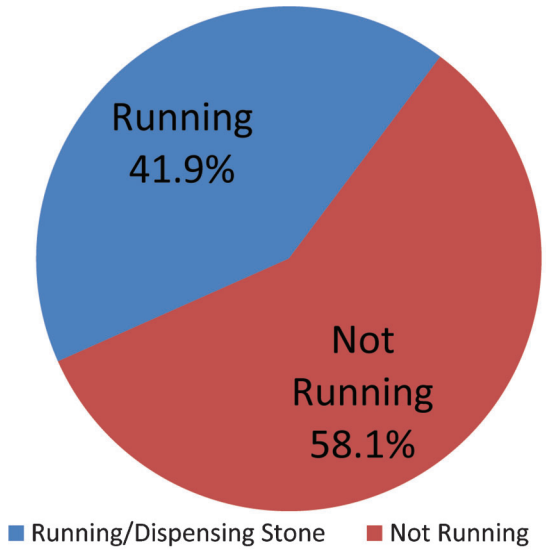


Figure 5.1 Chipper uptime vs. downtime.

In order to improve the productivity of the chip seal operation, it is necessary to reduce the amount of downtime when the chipper is not dispensing stone. The graph shown in Figure 5.2 provides more insight into the factors that influence the amount of time the chipper was stopped.

5.1 Downtime from Switch Trucks (18.8%)

The single biggest contribution to chipper downtime comes from the time required to release one dump truck and connect the next dump truck in line. Part of this time is unavoidable as it takes time to lower the bed of the truck that has just filled the chipper box, disconnect it from the chipper, let it drive out of the way so the next truck can back up, then connect to the next truck, release the gate and start raising the bed.

However, some districts were consistently able to change their trucks a little quicker than others. One issue that slowed some districts down in changing trucks was that they frequently had to make multiple attempts to connect the truck to the chipper because the connector bar on their trucks varied significantly from one truck to the next. Other districts had more consistency from truck to truck and were nearly always able to connect to the chipper on their first try. While the multiple attempts required to connect the truck to the chipper generally only added 15–20 seconds to the switch, that lost time was repeated 50–70 times per day.

Another factor influencing the time required to switch trucks was empty trucks having to wait for traffic to clear before they could move out of the way to allow the next truck in line to connect to the chipper. During the days of observation it was noted that when the road being chip sealed was closed to all but local

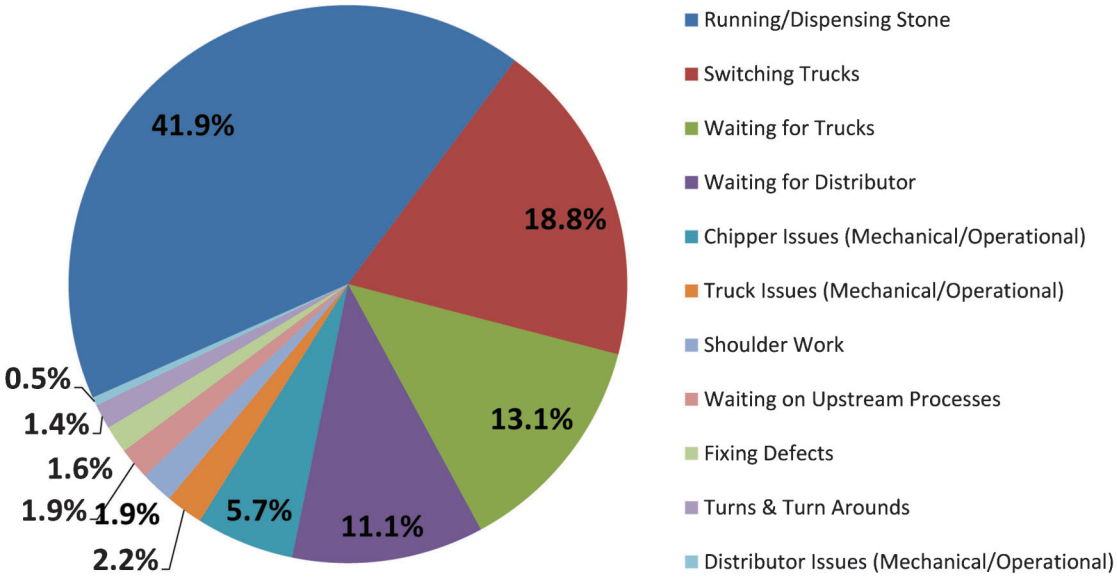


Figure 5.2 Relative contribution of factors influencing chipper downtime.

traffic (see Figure 5.3), the trucks were able to move out more quickly and allow the next truck in line to connect quicker than possible when the road was not closed.

Closing a road had several other benefits as well including worker safety, trucks not getting stuck in traffic going to and from quarries/stockpiles, and reduced tort claims. The reduction in tort claims is actually twofold: (1) there are fewer vehicles on the road so there are fewer opportunities for vehicle damage, and (2) there are a lot less trucks on the road which reduces the likelihood of loose stone being thrown by their tires.

A final benefit to closing the road during chip seal is that it allows the road to fully cure before heavy traffic drives on the freshly chipped road.

In addition to standardizing connector bar height and closing roads whenever possible for chip seal, a third way of reducing the lost time due to truck changes is to minimize the number of times trucks must be switched by delivering the maximum safe and legal load each time the truck delivers stone to the chipper. This could be accomplished by requesting the higher capacity trucks from the sub-districts for chip seal and adding side boards to the trucks if necessary to enable them to deliver the maximum legal limit.

5.2 Downtime from Waiting for Trucks (13.1%)

The second leading cause of chipper downtime was waiting for stone to be delivered. This is different from switching trucks, this is the time when the empty truck has already disconnected but there is no truck in line to connect to the chipper.

There are many contributing factors that influence how often the chipper is down due to waiting for trucks such as the number of trucks being used, the distance to the quarry/stockpile, the availability of a loader to load the truck, the time required to weigh the truck before it leaves the quarry (Figure 5.4), and the amount of traffic on the road being chip sealed.

During the 10 days of observation, only one district had 0 downtime caused by waiting for trucks. That

Figure 5.3 Closing a road to all but local traffic during chip seal.

Figure 5.4 Waiting in line to weigh a truck at a quarry.

district was drawing from well-placed stockpiles so the trucks had a minimal drive to reload and a dedicated loader to fill the trucks as soon as they arrived. The districts that loaded directly from quarries frequently ran into delays in getting the loader to load the trucks and additional delays with trucks waiting in line to weigh before leaving the quarry.

An Excel spreadsheet was created to help estimate the number of trucks needed to keep the chipper running continuously. The single biggest factor in determining the number of trucks required was the distance to the quarry/stock pile. All districts reported that they tried to find good locations for stockpiles when they did not load directly from a quarry but that they often had difficulty getting property owners to grant permission to use their land. Based on the amount of productivity, labor and fuel costs incurred by having to drive extra miles to pick up stone, a business case could be developed to determine the dollar savings associated with putting a stock pile in a more optimized location and a budget could be determined for offering compensation to property owners for a temporary easement to use their land.

5.3 Downtime from Waiting for a Distributor (11.1%)

The third most common reason for chipper downtime was waiting for an oil distributor. Several chipper operators claimed they rarely had to wait for oil but based upon the days of observation, it is likely the only reason they don't wait more frequently for oil is because they are already down waiting for stone. The two districts with the least amount of chipper downtime waiting for oil were the two districts that use three distributors. These districts also did a good job of finding locations to place the oil tankers to minimize the drive time for their distributors. It was noted that under good conditions (i.e., the chipper was kept supplied with stone and did not have any mechanical issues) it often took less time to empty a distributor than it did to fill it. When travel time is taken into account, it is impossible to consistently keep the chipper running with just two distributors.

5.4 Downtime from Chipper Mechanical/Operational Issues (5.7%)

The final major contributor to chipper downtime was mechanical issues on the chipper itself. The majority of mechanical issues observed were related to either truck driver damage to the chipper box (i.e., torn flaps) or material quality (clumps in the stone).

The chip seal operation uses the same chipper operators and distributor drivers across the entire district but the truck drivers vary from one job to the next based on what sub district the operation is working in at the time. Due to relatively high turnover among drivers, there is a constant stream of new drivers who have not done chip seal before and other drivers who have not done it recently. Additional driver training may be appropriate prior to showing up to work on a chip seal operation to ensure the drivers are prepared to be able to work in an environment where they are being pulled backward, especially in areas where the road may curve.

6. CONCLUSIONS

Based on the 10 days of observation, the average chip seal operation is only adding value (the chipper is spreading stone) 41.9% of the time. While there are numerous reasons for the 58.1% of downtime, 74% of that downtime is caused by just three factors (switching trucks, waiting for trucks, and waiting for a distributor).

By taking steps to reduce the downtime, it should be possible to increase the uptime of the chipper from 41.9% to possibly 50 or 55%. An increase from 41.9 to 55% would yield an increase of approximately 31% more lane miles covered in the same amount of time (55%/41.9% = 1.31).

While it is impossible to eliminate the time spent changing trucks, the 18.8% of downtime today should be able to be reduced by standardizing the connector bar height and maximizing the amount of stone delivered to the safe and legal limit. Today the trucks are typically loaded with 11 to 12 tons of stone but could be delivering 15 tons or more. By maximizing the stone delivery to 15 tons per load, four trucks would deliver the same 60 tons of stone that five trucks deliver today. This would reduce the number of truck changes by 20%. Because truck changes account for 18.8% of the downtime today, a reduction of 20% of the truck changes would reduce the downtime by 20% and yield an improvement of 3.7% more uptime. Because the current average uptime is 41.9%, this improvement alone would increase the chipper uptime to approximately 45.6%.

In addition, by closing roads to minimize the delays in getting trucks in and out of the chip seal operation and finding better locations for stone stock piles, the 13.1% of downtime caused by waiting for trucks could be virtually eliminated. If the downtime associated with waiting for trucks was reduced by 75%, the chipper uptime would improve by approximately 9% which would bring the overall uptime to about 54%.

7. RECOMMENDATIONS

1. Hold pre-chip sub meetings covering assignments, job safety, and daily plans and goals.
2. Incorporate daily plans and goals into morning start-up meetings.
3. Reduce travel time of trucks and distributors by pre-planning drop locations along chip seal routes.
4. Work with suppliers to improve incoming oil deliveries (timing, locations, temps).
5. Look into closing roads and setting up detours to minimize traffic on roads.
6. Develop planning tool to estimate number of trucks and tankers needed daily for each job.
7. Hold pre-season chip seal planning meetings for district to discuss schedule, daily mileage goals, and equipment needs to ensure all staffing and equipment are met.
8. Standardize staging of dump trucks behind chipper.
9. Develop training program for dump truck drivers—practice hooking up to chipper and driving staggered in-line.
10. Look into ways to improve distributor fill times (can distributors be filled from the bottom?).
11. Work on incorporating rolling releases of trucks from chipper.
12. Standardize chip-bar height for all trucks.
13. Ensure chipper operator is able to communicate with distributors—look into headsets.
14. Ensure critical replacement parts are on-hand at all times for chippers—develop standard replacement part list for all districts.

8. EXPECTED BENEFITS, DELIVERABLES, IMPLEMENTATION AND COST SAVINGS

In FY 2013, INDOT spent $882,862.93 for 59,940 hours of labor. This equates to an average of $14.73 per hour. Based upon the 10 days of observation, the average chipper uptime across the state is currently 41.9%. The labor savings will be a function of how much the chipper uptime is increased. Table 8.1 is an estimate of how much could be saved by increasing the chipper uptime assuming the total lane miles to be chipped are similar to the FY 2013 total miles.

9. OBSERVED IMPROVEMENTS AND FURTHER RECOMMENDATIONS

A series of visits were made with chip seal operations in 2014 to observe the effects of the recommendations shared in the recommendation section of this report.

It was observed in Greenfield on July 24, 2014, that the chip seal operation was running at 2.94 mph until the operation entered the city limits of Laurel, IN where they encountered a series of 90 degree curves which slowed down the operation. The Greenfield operation on that day had 0 downtime waiting for stone and 0 downtime waiting for distributors (they were running with 3 distributors). In addition, the average truck load of stone was carrying 13.2 tons of stone. This allowed them to deliver as much stone in 4 loads as other districts (which averaged 10.6 tons/load) would receive in 5 loads. The 20% reduction in truck deliveries meant fewer trucks were needed and less downtime associated with changing trucks.

The Fort Wayne district was observed on August 27, 2014, and it was noted that they had some new trucks which were delivering 16 tons of stone per load. The Fort Wayne district was using a truck calculator (Excel spread sheet) to determine that they needed 13 trucks and they had 0 downtime waiting for stone. Based on the amount of time required to change trucks, the increased capacity of these trucks resulted in approximately 6 minutes per hour of reduced downtime compared to observations with the Fort Wayne district in 2013.

The Fort Wayne district did have 24 minutes of downtime associated with waiting for distributors but that was due to a distributor operator calling in at the last minute, and an inexperienced replacement having to be found to take his place. An experienced operator had to spend time with the inexperienced operator to show him how to load oil from the tanker.

TABLE 8.1
Potential savings based on chipper uptim

Chipper uptime	Hours of labor	Labor cost	Labor cost savings	Labor cost % savings
42%	59,940	$882,862	$0.00	0%
44%	57,215	$842,784	$40,078	4.5%
46%	54,728	$806,141	$76,721	8.8%
48%	52,448	$772,552	$110,310	12.5%
50%	50,350	$741,650	$141,212	16.0%
52%	48,413	$713,125	$169,737	19.3%
54%	46,620	$686,713	$196,149	22.2%
56%	44,955	$662,187	$220,675	24.9%
58%	43,405	$639,353	$243,509	27.6%
60%	41,958	$618,041	$264,821	30.0%
62%	40,605	$598,105	$284,757	32.3%
64%	39,336	$579,414	$303,448	34.3%
66%	38,144	$561,856	$321,006	36.4%

Figure 9.1 Sideboards installed on trucks in Seymour District.

A scheduled visit with the LaPorte district in August 2014 was cancelled due to weather. Attempts were made to schedule a visit with the Crawfordsville district but they only ran chip seal a few days in July and early August.

A visit was made with the Vincennes District during their first chip seal job of the year. At that time no changes were observed from the previous year. The stone was being drawn from a stockpile on the other side of Princeton, Indiana, which resulted in frequent delays waiting for trucks. It was later reported that the Vincennes District had started closing roads for chip seal but on the day of the visit no changes were observed from how the operation had run in 2013.

It was noted during a July 16, 2014, visit with the Seymour chip seal operation on Highway 46 that sideboards had been installed on most of their trucks as shown in Figure 9.1.

However, the additional hauling capacity of the trucks was not being utilized and the average load of stone being delivered was only 10.6 tons. The Seymour District was using an Excel based "truck calculator" to determine the number of trucks required for the job and throughout the day there was 0 downtime waiting for trucks.

In spite of the elimination of downtime due to waiting on trucks, there was still the full amount of downtime associated with changing trucks since the trucks still had to be changed just as frequently due to each truck only delivering an average of 10.6 tons. In addition, the operation still had over an hour of downtime waiting on distributors because they were only running two distributors that day. The addition of a third distributor to the operation would have eliminated the downtime associated with waiting for a distributor.

One reason cited for not adding a third distributor was the desire to keep traffic off the freshly chip sealed road for 1 hour and to prevent having a work zone that was too long to safely manage traffic. The exact amount of time required to keep traffic off of a freshly chipped road varies with a number of different factors (road temperature, humidity, etc.) but there seemed to be a general consensus that 1 hour was a reasonable estimate under the conditions that day.

With the addition of a third distributor, the operation would have moved much quicker and keeping traffic off of the road for 1 hour would have resulted in a work zone that was several miles long. The better solution to manage the situation may have been to close the road to all but local traffic.

10. THE CASE FOR CLOSING ROADS DURING CHIP SEAL

There are at least five separate reasons identified for closing roads. These include:

- *Safety:* In July 2014 a head-on collision between a passenger vehicle and an INDOT truck involved in chip seal resulted in a driver being flown to a hospital.
- *Quality:* Allowing the emulsion to cure before traffic is allowed on the road.
- *Productivity:* Trucks can get in and out of the work zone much quicker.
- *Reduced tort claims:* INDOT paid $30,520 in 2013 to settle 58 chip seal tort claims
- *Traffic management:* Closing roads would prevent cars sitting for several minutes waiting to go around the work zone and it reduces the chances for miscommunication which results in two-way traffic meeting head-on in a single lane. (It was observed in one district where traffic management allowed traffic to enter the work zone from both directions at once resulting in passenger vehicles and one semi-trailer to have to drive in the grass to get around oncoming traffic.)

11. RESULTS AS OF MID-YEAR 2014

Table 11.1 shows the comparison of CY 13 and CY 14 through August 18, 2014. The largest improvements were observed in Fort Wayne (7.22%), Seymour (5.27%) and LaPorte (3.29%). Not all the recommendations have been implemented in all the districts.

As Figure 11.1 shows, the data from the 2014 observations have demonstrated that the recommendations implemented are making a difference in reduced downtime (i.e., Seymour, Greenfield and Fort Wayne having 0 downtime waiting on stone and Fort Wayne eliminating 6 minutes of downtime per hour changing trucks by using higher capacity trucks).

It is not known at this time why some districts had lower accomplishments/man hour in 2014 than 2013 but it may be due in part to the 2014 data not being complete. Some road segments are further away from stone quarries or may contain more 90 degree turns than others. These road segments typically take longer and if a district began with the more challenging roads in 2014, those numbers may improve over the remainder of the chip seal season.

TABLE 11.1
Comparison of CY2013 and CY2014 through 8/18/2014

District	CY 13/Acc/MH	CY 2013 amount	CY 14 Acc/MH	CY 2014 amount	Acc/MH difference	Acc/MH % difference
610	0.0230	176.20	0.0223	98.52	−0.0007	−2.98%
620	0.0330	343.12	0.0354	104.68	0.0024	7.22%
630	0.0259	236.86	0.0237	83.00	−0.0022	−8.61%
640	0.0341	378.16	0.0352	137.80	0.0011	3.29%
650	0.0224	327.90	0.0236	135.84	0.0012	5.27%
660	0.0218	142.63	0.0171	149.44	−0.0047	−21.37%
State	**0.0221**	**1,604.87**	**0.0242**	**709.28**		

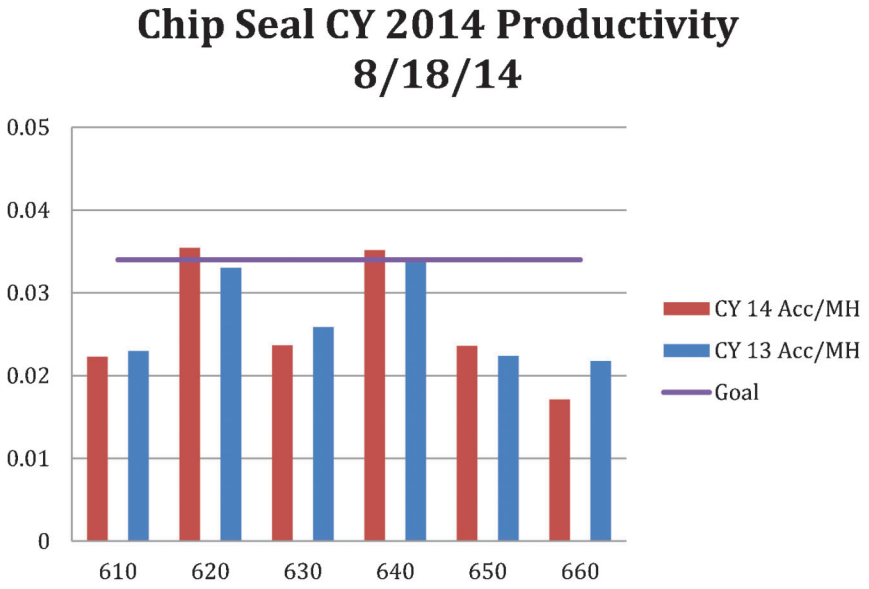


Figure 11.1 Chip seal calendar year 2014 productivity as of 08/18/14.

12. FINAL RECOMMENDATIONS

The results observed through August 18, 2014, show that when implemented, the recommendations shared with the districts in the fall of 2013 have been effective in eliminating the downtime associated with waiting for stone (13.1%) and waiting for distributors (11.1%). The recommendations have also reduced the downtime associated with changing trucks behind the distributor (reduced from 18.8 to approximately 15%).

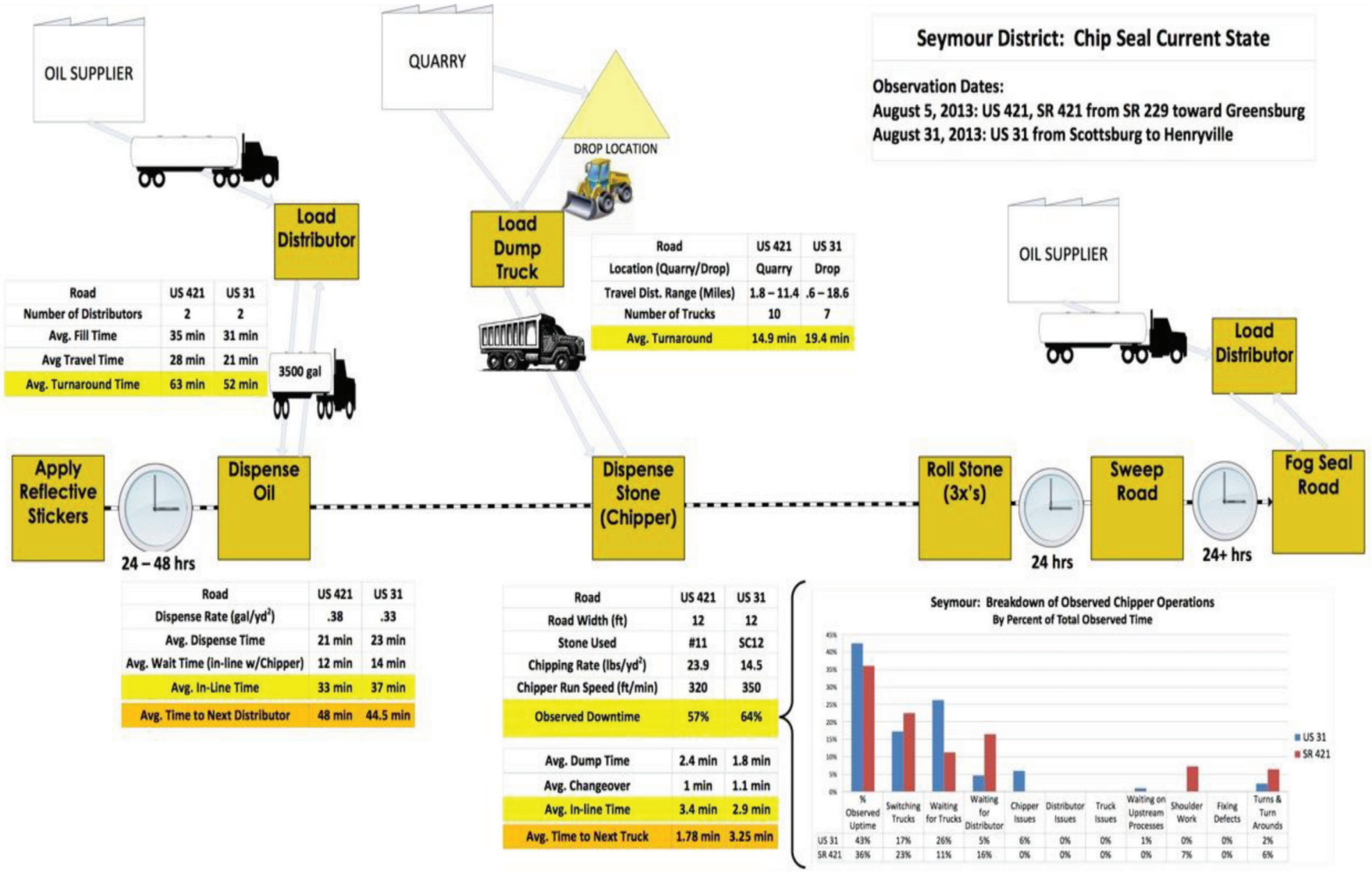
In 2013 the time average time spent waiting for stone and distributors alone accounted for 24.2% of the production day. By turning this time from downtime to uptime the amount of uptime could be increased from approximately 42% to 66%.

Based upon this increase in uptime, four chip seal crews could accomplish as much as the six crews accomplished in 2013. INDOT has fourteen distributors spread across the six districts so by reducing the number of chip seal crews from six to four, each crew could have three distributors (twelve total) and the remaining two distributors could be dedicated for use for Fog Seal or could be held in reserve in the event one of the other twelve was unavailable due to maintenance issues.

Additionally, four of the districts (LaPorte, Fort Wayne, Crawfordsville, and Greenfield) have newer, wider, faster chippers while Vincennes and Seymour have older, slower, 12′ wide chippers. By reducing the number of chip seal crews from six to four, the four newer chippers could be better utilized by starting at the Southern end of the state early in the year as soon as the weather allows then moving north in the early summer (and possibly moving South again in the fall as the weather turns colder). The two older chippers could be sold or held in reserve in case one of the four newer chippers was unavailable due to maintenance issues or if a fifth chipper was needed to make up for an especially rainy summer.

By more fully utilizing the four newer chippers and "retiring" the two older ones, INDOT could avoid the replacement cost of the two older chippers currently in use in Seymour and Vincennes.

APPENDIX A. VALUE STREAM MAPS FOR EACH DISTRICT

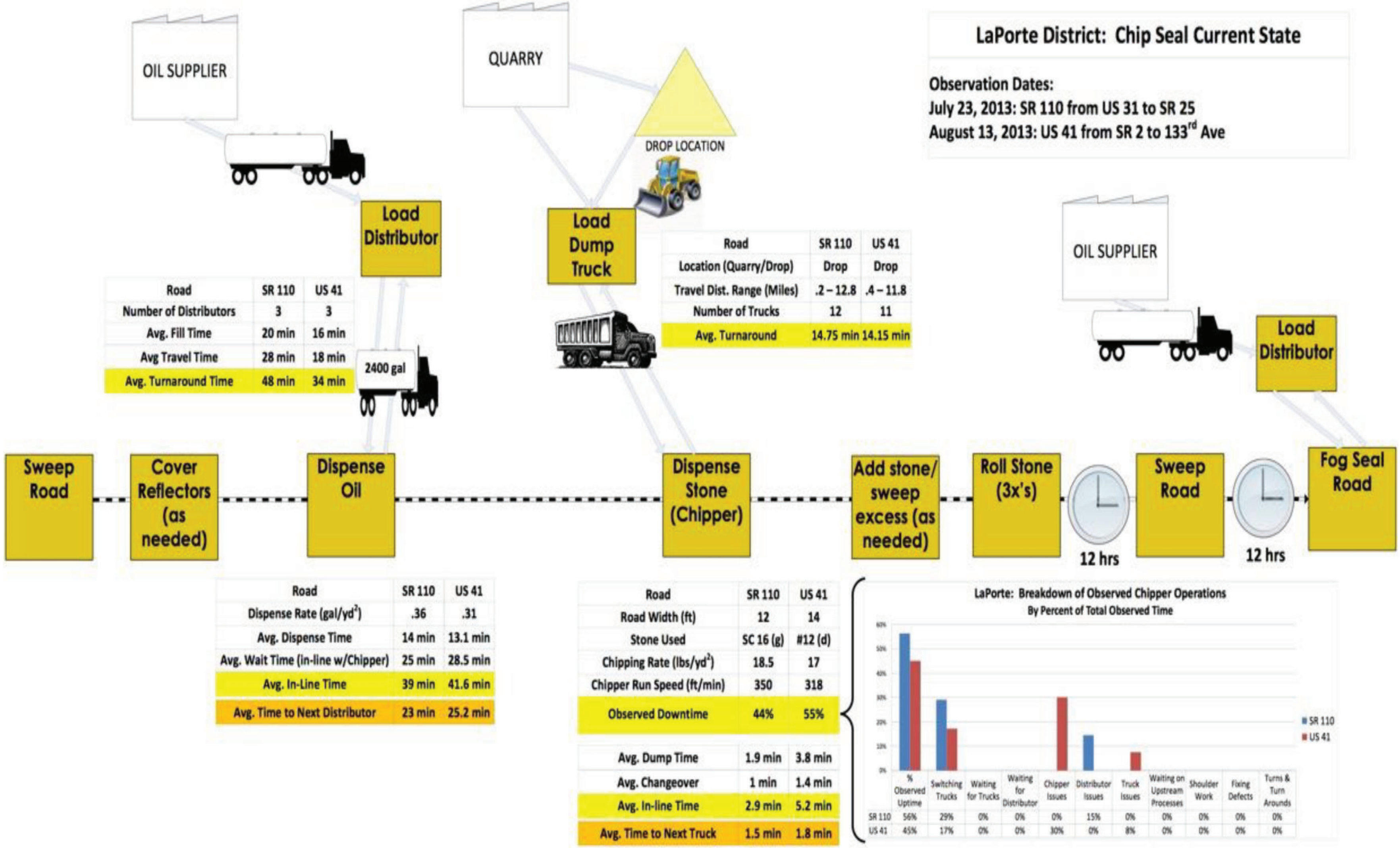


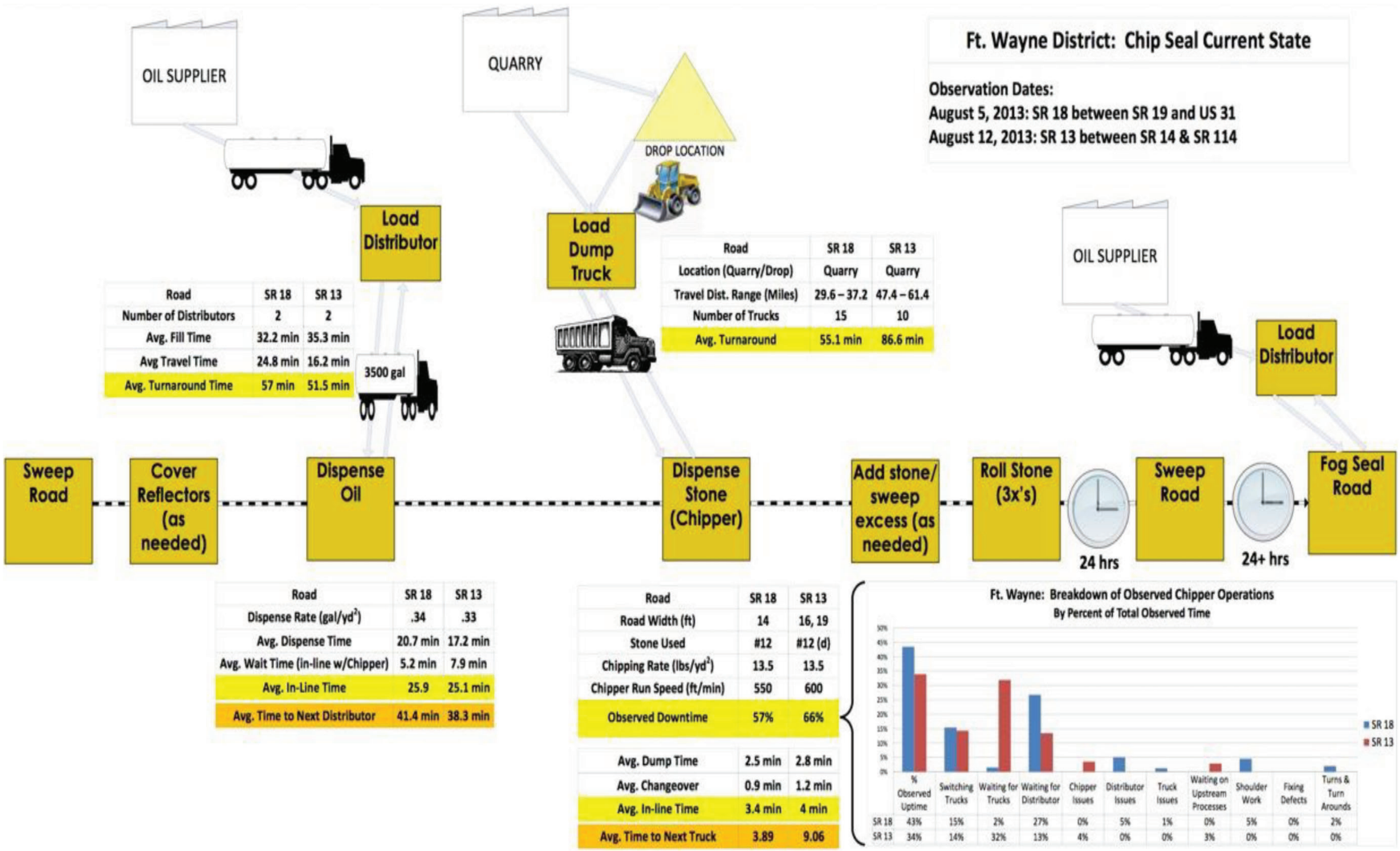
Road	US 421	US 31
Number of Distributors	2	2
Avg. Fill Time	35 min	31 min
Avg Travel Time	28 min	21 min
Avg. Turnaround Time	63 min	52 min

Road	US 421	US 31
Location (Quarry/Drop)	Quarry	Drop
Travel Dist. Range (Miles)	1.8 – 11.4	.6 – 18.6
Number of Trucks	10	7
Avg. Turnaround	14.9 min	19.4 min

Road	US 421	US 31
Dispense Rate (gal/yd^2)	.38	.33
Avg. Dispense Time	21 min	23 min
Avg. Wait Time (in-line w/Chipper)	12 min	14 min
Avg. In-Line Time	33 min	37 min
Avg. Time to Next Distributor	48 min	44.5 min

Road	US 421	US 31
Road Width (ft)	12	12
Stone Used	#11	SC12
Chipping Rate (lbs/yd^2)	23.9	14.5
Chipper Run Speed (ft/min)	320	350
Observed Downtime	57%	64%
Avg. Dump Time	2.4 min	1.8 min
Avg. Changeover	1 min	1.1 min
Avg. In-line Time	3.4 min	2.9 min
Avg. Time to Next Truck	1.78 min	3.25 min


LaPorte District: Chip Seal Current State
Observation Dates:
July 23, 2013: SR 110 from US 31 to SR 25
August 13, 2013: US 41 from SR 2 to 133rd Ave
OIL SUPPLIER
QUARRY
DROP LOCATION
OIL SUPPLIER
Load Distributor
Load Dump Truck
Load Distributor
2400 gal
Road | SR 110 | US 41
Number of Distributors | 3 | 3
Avg. Fill Time | 20 min | 16 min
Avg Travel Time | 28 min | 18 min
Avg. Turnaround Time | 48 min | 34 min
Road | SR 110 | US 41
Location (Quarry/Drop) | Drop | Drop
Travel Dist. Range (Miles) | .2 – 12.8 | .4 – 11.8
Number of Trucks | 12 | 11
Avg. Turnaround | 14.75 min | 14.15 min
Sweep Road
Cover Reflectors (as needed)
Dispense Oil
Dispense Stone (Chipper)
Add stone/ sweep excess (as needed)
Roll Stone (3x's)
12 hrs
Sweep Road
12 hrs
Fog Seal Road
Road | SR 110 | US 41
Dispense Rate (gal/yd²) | .36 | .31
Avg. Dispense Time | 14 min | 13.1 min
Avg. Wait Time (in-line w/Chipper) | 25 min | 28.5 min
Avg. In-Line Time | 39 min | 41.6 min
Avg. Time to Next Distributor | 23 min | 25.2 min
Road | SR 110 | US 41
Road Width (ft) | 12 | 14
Stone Used | SC 16 (g) | #12 (d)
Chipping Rate (lbs/yd²) | 18.5 | 17
Chipper Run Speed (ft/min) | 350 | 318
Observed Downtime | 44% | 55%
Avg. Dump Time | 1.9 min | 3.8 min
Avg. Changeover | 1 min | 1.4 min
Avg. In-line Time | 2.9 min | 5.2 min
Avg. Time to Next Truck | 1.5 min | 1.8 min
LaPorte: Breakdown of Observed Chipper Operations
By Percent of Total Observed Time
SR 110
US 41
| % Observed Uptime | Switching Trucks | Waiting for Trucks | Waiting for Distributor | Chipper Issues | Distributor Issues | Truck Issues | Waiting on Upstream Processes | Shoulder Work | Fixing Defects | Turns & Turn Arounds
SR 110 | 56% | 29% | 0% | 0% | 0% | 15% | 0% | 0% | 0% | 0% | 0%
US 41 | 45% | 17% | 0% | 0% | 30% | 0% | 8% | 0% | 0% | 0% | 0%



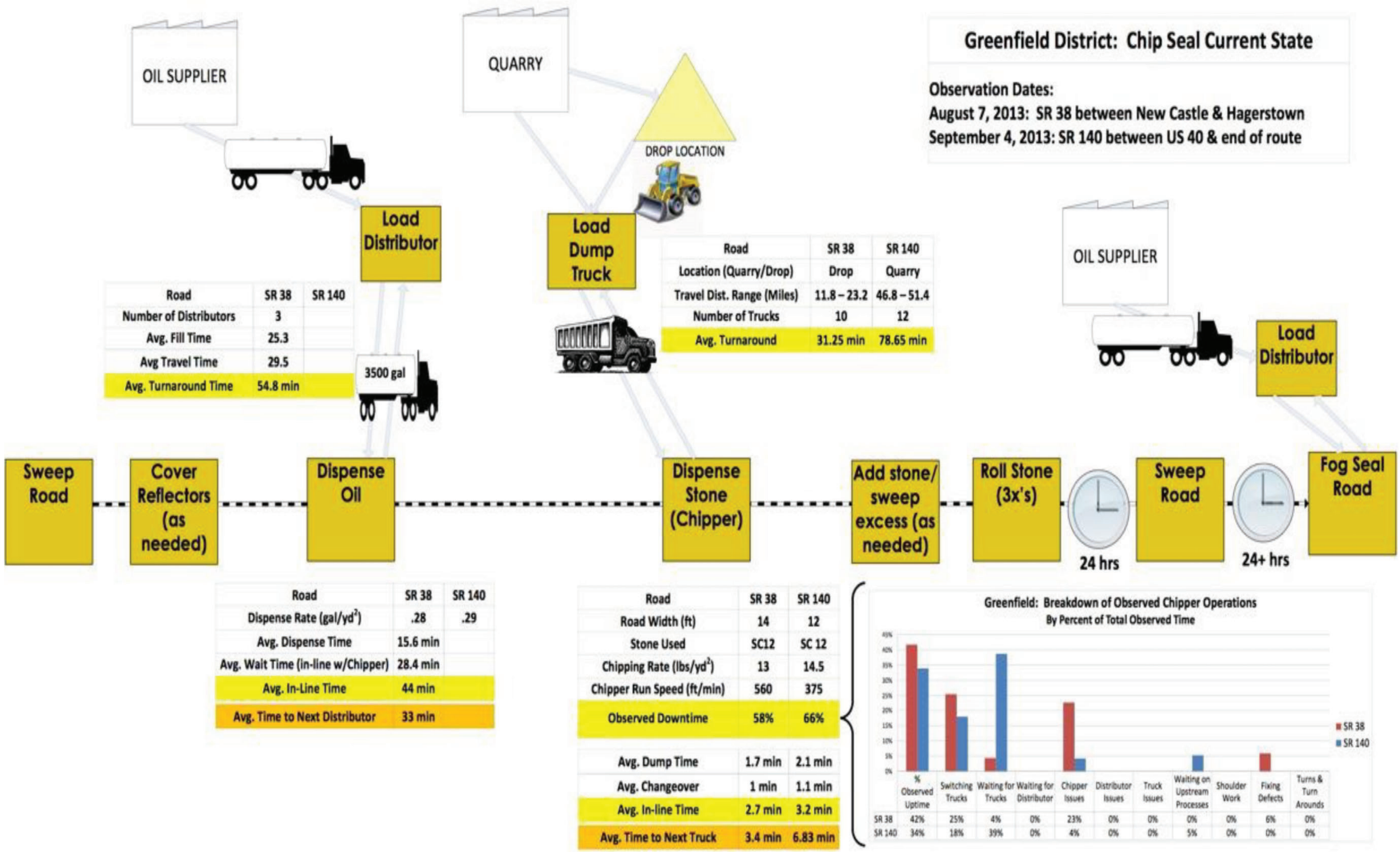
Road	SR 18	SR 13
Number of Distributors	2	2
Avg. Fill Time	32.2 min	35.3 min
Avg Travel Time	24.8 min	16.2 min
Avg. Turnaround Time	57 min	51.5 min

Road	SR 18	SR 13
Location (Quarry/Drop)	Quarry	Quarry
Travel Dist. Range (Miles)	29.6 – 37.2	47.4 – 61.4
Number of Trucks	15	10
Avg. Turnaround	55.1 min	86.6 min

Road	SR 18	SR 13
Dispense Rate (gal/yd^2)	.34	.33
Avg. Dispense Time	20.7 min	17.2 min
Avg. Wait Time (in-line w/Chipper)	5.2 min	7.9 min
Avg. In-Line Time	25.9	25.1 min
Avg. Time to Next Distributor	41.4 min	38.3 min

Road	SR 18	SR 13
Road Width (ft)	14	16, 19
Stone Used	#12	#12 (d)
Chipping Rate (lbs/yd^2)	13.5	13.5
Chipper Run Speed (ft/min)	550	600
Observed Downtime	57%	66%
Avg. Dump Time	2.5 min	2.8 min
Avg. Changeover	0.9 min	1.2 min
Avg. In-line Time	3.4 min	4 min
Avg. Time to Next Truck	3.89	9.06

	% Observed Uptime	Switching Trucks	Waiting for Trucks	Waiting for Distributor	Chipper Issues	Distributor Issues	Truck Issues	Waiting on Upstream Processes	Shoulder Work	Fixing Defects	Turns & Turn Arounds
SR 18	43%	15%	2%	27%	0%	5%	1%	0%	5%	0%	2%
SR 13	34%	14%	32%	13%	4%	0%	0%	3%	0%	0%	0%



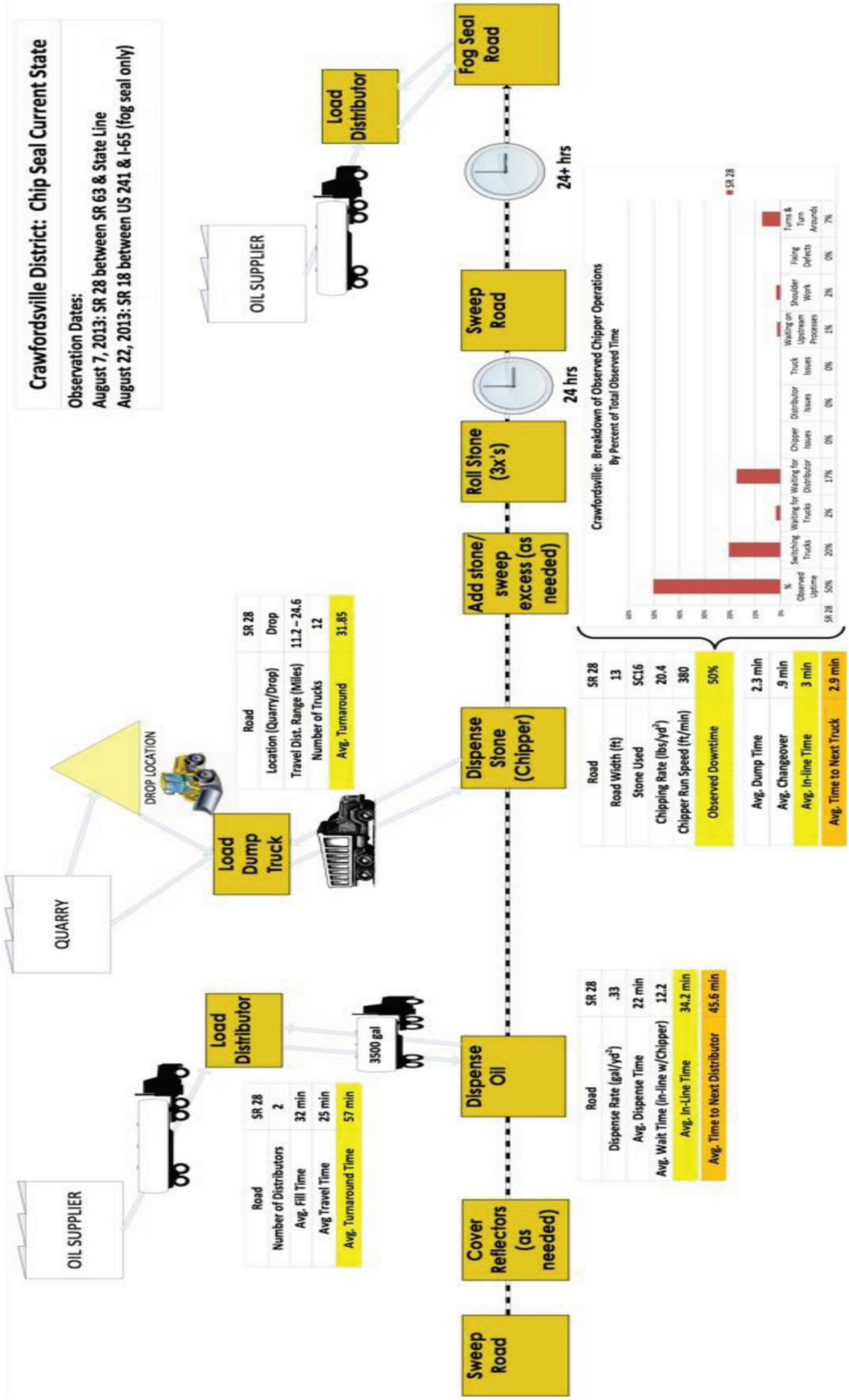
Road	SR 38	SR 140
Number of Distributors	3	
Avg. Fill Time	25.3	
Avg Travel Time	29.5	
Avg. Turnaround Time	54.8 min	

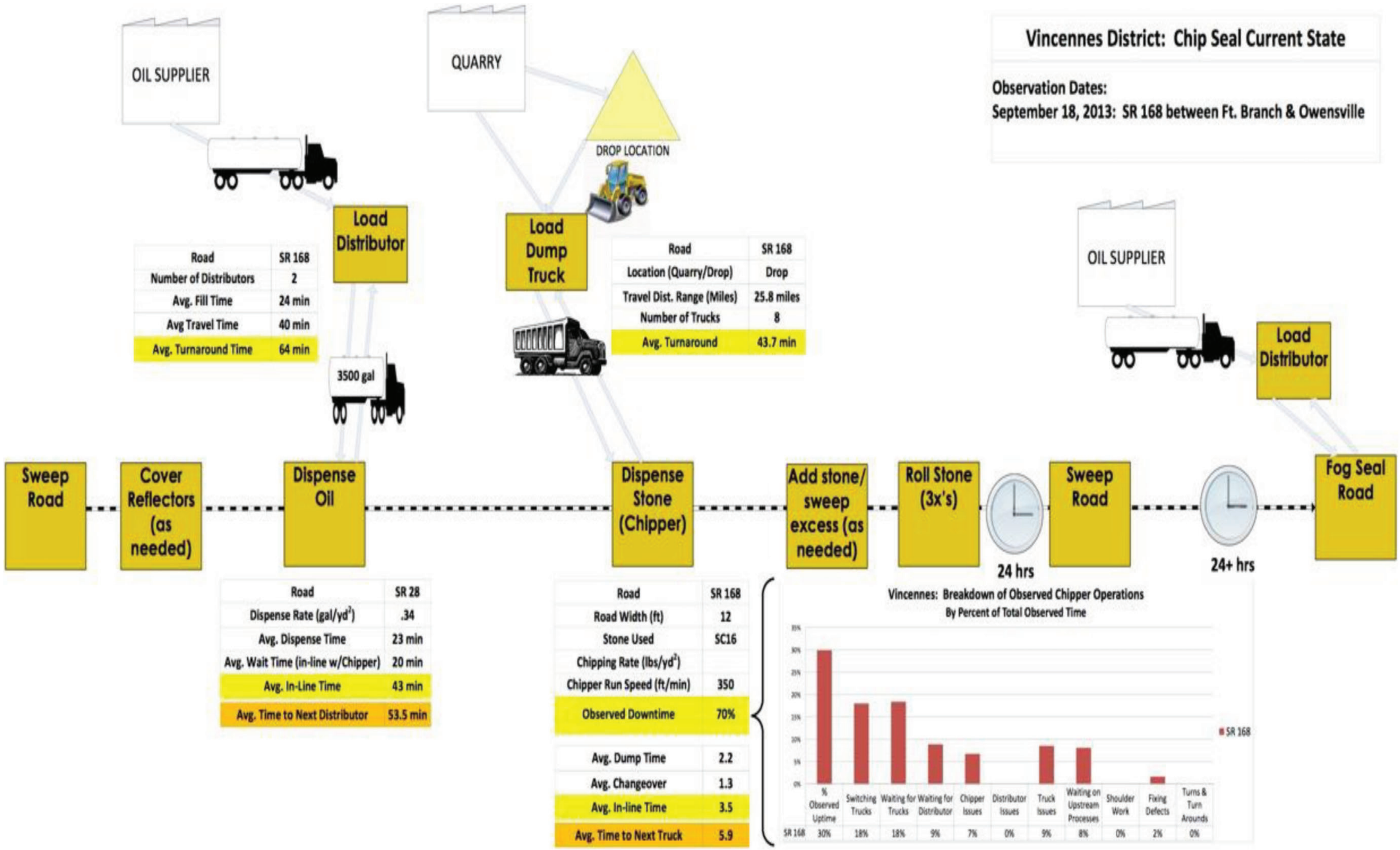
Road	SR 38	SR 140
Location (Quarry/Drop)	Drop	Quarry
Travel Dist. Range (Miles)	11.8 – 23.2	46.8 – 51.4
Number of Trucks	10	12
Avg. Turnaround	31.25 min	78.65 min

Road	SR 38	SR 140
Dispense Rate (gal/yd^2)	.28	.29
Avg. Dispense Time	15.6 min	
Avg. Wait Time (in-line w/Chipper)	28.4 min	
Avg. In-Line Time	44 min	
Avg. Time to Next Distributor	33 min	

Road	SR 38	SR 140
Road Width (ft)	14	12
Stone Used	SC12	SC 12
Chipping Rate (lbs/yd^2)	13	14.5
Chipper Run Speed (ft/min)	560	375
Observed Downtime	58%	66%
Avg. Dump Time	1.7 min	2.1 min
Avg. Changeover	1 min	1.1 min
Avg. In-line Time	2.7 min	3.2 min
Avg. Time to Next Truck	3.4 min	6.83 min

	% Observed Uptime	Switching Trucks	Waiting for Trucks	Waiting for Distributor	Chipper Issues	Distributor Issues	Truck Issues	Waiting on Upstream Processes	Shoulder Work	Fixing Defects	Turns & Turn Arounds
SR 38	42%	25%	4%	0%	23%	0%	0%	0%	0%	6%	0%
SR 140	34%	18%	39%	0%	4%	0%	0%	5%	0%	0%	0%


Crawfordsville District: Chip Seal Current State
Observation Dates:
August 7, 2013: SR 28 between SR 63 & State Line
August 22, 2013: SR 18 between US 241 & I-65 (fog seal only)
Sweep Road
Cover Reflectors (as needed)
OIL SUPPLIER
Load Distributor
3500 gal
Dispense Oil
Road | SR 28
Number of Distributors | 2
Avg. Fill Time | 32 min
Avg Travel Time | 25 min
Avg. Turnaround Time | 57 min
Road | SR 28
Dispense Rate (gal/yd²) | .33
Avg. Dispense Time | 22 min
Avg. Wait Time (in-line w/Chipper) | 12.2
Avg. In-Line Time | 34.2 min
Avg. Time to Next Distributor | 45.6 min
QUARRY
DROP LOCATION
Load Dump Truck
Road | SR 28
Location (Quarry/Drop) | Drop
Travel Dist. Range (Miles) | 11.2 – 24.6
Number of Trucks | 12
Avg. Turnaround | 31.85
Dispense Stone (Chipper)
Road | SR 28
Road Width (ft) | 13
Stone Used | SC16
Chipping Rate (lbs/yd²) | 20.4
Chipper Run Speed (ft/min) | 380
Observed Downtime | 50%
Avg. Dump Time | 2.3 min
Avg. Changeover | .9 min
Avg. In-line Time | 3 min
Avg. Time to Next Truck | 2.9 min
Add stone/ sweep excess (as needed)
Roll Stone (3x's)
24 hrs
Sweep Road
OIL SUPPLIER
Load Distributor
24+ hrs
Fog Seal Road
Crawfordsville: Breakdown of Observed Chipper Operations
By Percent of Total Observed Time
% Observed Uptime | Switching Trucks | Waiting for Trucks | Waiting for Distributor | Chipper Issues | Distributor Issues | Truck Issues | Waiting on Upstream Processes | Shoulder Work | Fixing Defects | Turns & Turn Arounds
SR 28 | 50% | 20% | 2% | 17% | 0% | 0% | 0% | 1% | 2% | 0% | 7%
SR 28


Vincennes District: Chip Seal Current State
Observation Dates:
September 18, 2013: SR 168 between Ft. Branch & Owensville
OIL SUPPLIER
QUARRY
DROP LOCATION
Load Distributor
Load Dump Truck
Road SR 168
Number of Distributors 2
Avg. Fill Time 24 min
Avg Travel Time 40 min
Avg. Turnaround Time 64 min
3500 gal
Road SR 168
Location (Quarry/Drop) Drop
Travel Dist. Range (Miles) 25.8 miles
Number of Trucks 8
Avg. Turnaround 43.7 min
OIL SUPPLIER
Load Distributor
Sweep Road
Cover Reflectors (as needed)
Dispense Oil
Dispense Stone (Chipper)
Add stone/ sweep excess (as needed)
Roll Stone (3x's)
24 hrs
Sweep Road
24+ hrs
Fog Seal Road
Road SR 28
Dispense Rate (gal/yd²) .34
Avg. Dispense Time 23 min
Avg. Wait Time (in-line w/Chipper) 20 min
Avg. In-Line Time 43 min
Avg. Time to Next Distributor 53.5 min
Road SR 168
Road Width (ft) 12
Stone Used SC16
Chipping Rate (lbs/yd²)
Chipper Run Speed (ft/min) 350
Observed Downtime 70%
Avg. Dump Time 2.2
Avg. Changeover 1.3
Avg. In-line Time 3.5
Avg. Time to Next Truck 5.9
Vincennes: Breakdown of Observed Chipper Operations
By Percent of Total Observed Time
SR 168
% Observed Uptime 30%
Switching Trucks 18%
Waiting for Trucks 18%
Waiting for Distributor 9%
Chipper Issues 7%
Distributor Issues 0%
Truck Issues 9%
Waiting on Upstream Processes 8%
Shoulder Work 0%
Fixing Defects 2%
Turns & Turn Arounds 0%

CHIP SEAL IMPROVEMENT PLAN **District: Crawfordsville**

	Opportunity for Improvement	District Plan for Trialing & Implementing Improvement	Person Responsible	Target Implementation Date
1	Subdistrict: Hold pre-chip sub meetings covering assignments, job safety, and daily plans and goals (pre-chip seal season)	Clint has developed standard planning tool for sub - will share with Purdue Develop planning checklist to identify amount of oil needed, stone needed, number of trucks, number of workers (operators, road crew), timing of oil tankers, and drop/refill locations Clearly identify who is charge for each day/route		
2	District: Hold pre-season Chip Seal planning meetings for district to discuss schedule, daily mileage goals, and equipment needs to ensure all staffing and equipments are met	Need to review planning tools across all districts to look for best practices; Purdue to join pre-planning sessions in April		
3	Daily: Incorporate daily plans and goals into morning start-up safety meetings	Ensure daily goals are covered in start-up meetings (add to agenda);		
4	Reduce travel time of trucks and distributors by pre-planning drop locations along chip seal routes	Check into paying property owners for using land as drop location for stone	Todd Shields	
5		Tanker locations: pre-scout locations; identify several locations throughout day		
6	Work with suppliers to improve incoming oil deliveries (timing, locations, temps)	Make sure everyone (esp. distributor drivers) is reporting issues to ensure penalties are being applied. Note: No problems from Warsaw, Illinois, issues with Indy location	Todd Shields	
7	Look into closing roads and setting up detours to minimize traffic on roads	Work with LaPorte to share their process with all districts	Purdue	
8		Develop standard for closing roads for Chip Seal process (detour process, when to shut down, when to open). Goal: Pilot closing road this May		
9	Develop planning tool to estimate number of trucks and tankers needed daily for each job	Clint has developed tool for estimating number of trucks, amount of stone, and amount of oil - has sent to Purdue		
10	Standardize staging of dump trucks behind chipper	Trial having a rodeo for truck drivers - focus on hooking up to chipper, being pulled behind chipper (especially curves), staggered driving	Clint B	
11	Develop training program for dump truck drivers - practice hooking up to chipper and driving staggered in-line			
12	Look into ways to improve distributor fill times (can distributors be filled from the bottom?)	Explore with distributor operator, other operators		
13	Work on incorporating rolling releases of trucks from chipper	Already using rolling stop		
14	Standardize chip-bar height for all trucks, diameter of bar	Set standard height for district depending on chip box Modify chipper bars w/bracket to standardize bar location	Clint B.	
15	Ensure chipper operator is able to communicate with distributors - look into headsets	Using radios, trial using headsets to improve communication		
16	Ensure critical replacement parts are on-hand at all times for chippers - develop standard replacement part list for all districts	1) Identify critical parts list for district chippers 2) Create minimum stock levels of parts to be kept by district/state maintenance sites 3) Ensure maintenance operators onsite for each job		
17	Standardize pilot vehicle usage			
18	Standardize sweeping operations			
19	Standardize pop-up reflector usage			
20	Standardize "sand dobbing" - is there a better way to apply sand, is there a different cover than can be used?			
21	Look into standardize going against flow of traffic (better visibility to side of road, easier flow of trucks)			

CHIP SEAL IMPROVEMENT PLAN **District: Fort Wayne**

	Opportunity for Improvement	District Plan for Trialing & Implementing Improvement	Person Responsible	Target Implementation Date
1	Hold pre-chip sub meetings covering assignments, job safety, and daily plans and goals	Currently being done at the sub districts		
2	Incorporate daily plans and goals into morning start-up meetings	Being done on site		
3	Reduce travel time of trucks and distributors by pre-planning drop locations along chip seal routes	Need to work with state on ability to pay for setting up easements on private property, work with quarries to set pricing for delievery of materials Distrirct needs to look into setting up multiple locations for tankers to part along route Will look into increaseing amount of stone in trucsk from 12 to 15 tons		
4	Work with suppliers to improve incoming oil deliveries (timing, locations, temps)	Typically not an issue - oil comes from Warsaw (have been cases of too hot). Some timing issues when tankers are responsible for multiple loads		
5	Look into closing roads and setting up detours to minimize traffic on roads	Have tried in the past, will look into trying on some routes this upcoming season (where it makes sense)		
6	Develop planning tool to estimate number of trucks and tankers needed daily for each job	Purdue to share truck estimator with district		
7	Hold pre-season Chip Seal planning meetings for district to discuss schedule, daily mileage goals, and equipment needs to ensure all staffing and equipments are met	Currently being done		
8	Standardize staging of dump trucks behind chipper			
9	Develop training program for dump truck drivers - practice hooking up to chipper and driving staggered in-line	Currently have new drivers ride along with experienced drivers, will look into holding a "rodeo" for new drivers (or drivers needed a refersher) - possibility of creating a "chip seal driver certification"		
10	Look into ways to improve distributor fill times (can distributors be filled from the bottom?)	Both current distrubitors fill from the bottom		
11	Work on incorporating rolling releases of trucks from chipper	Have done in the past		
12	Standardize chip-bar height for all trucks	Need to inspect currnent trucks to understand variation in height from truck to truck - other factors such as airbags will impact height, need to work with drivers		
13	Ensure chipper operator is able to communicate with distributors - look into headsets	Look into getting a headset for the chipper driver and chipper spotter		
14	Ensure critical replacement parts are on-hand at all times for chippers - develop standard replacement part list for all districts	Currently has a large stock of replacement parts on hand - district will put together a "critical parts list" for both the chipper and distributors of parts that each district needs to have on hand to minimize downtime		

CHIP SEAL IMPROVEMENT PLAN **District: Greenfield**

	Opportunity for Improvement	District Plan for Trialing & Implementing Improvement	Person Responsible	Target Implementation Date
1	Hold pre-chip sub meetings covering assignments, job safety, and daily plans and goals	Each sub district manager holds one already for their people - Jerry takes the chip seal operators to those meetings (usually have several meetings leading up to start of chip seal job)		
2	Incorporate daily plans and goals into morning start-up meetings	Jerry works with sub district managers the day before to work out details of oil & stone orders, start and end points for daily goals		
3	Reduce travel time of trucks and distributors by pre-planning drop locations along chip seal routes	Jerry tries to draw from stock pile rather than quarry. Always tries to have oil tanker ahead of chipper rather than behind to prevent distributor from having to drive on freshly chipped road. Often use county road intersections for oil tankers (where possible - depends on width of road and design of tanker outlets)		
4	Work with suppliers to improve incoming oil deliveries (timing, locations, temps)	Supplier using same truck driver for 1st and 3rd tanker load caused delays in getting the 3rd tanker in time to the job site. Temp issues are normally limited to fog oil - oil comes in too cold sometimes (tankers do not have heaters, if oil is loaded night before it arrives too cold)	State issue rather than district	
5	Look into closing roads and setting up detours to minimize traffic on roads	Greenfield closes roads sometimes on higher traffic roads but drivers (including semis) began ignoring detour after first couple of days.	JD to evaluate which roads will be closed (plan to do more than last year)	30-Apr
6	Develop planning tool to estimate number of trucks and tankers needed daily for each job	No current tool in use.		
7	Hold pre-season Chip Seal planning meetings for district to discuss schedule, daily mileage goals, and equipment needs to ensure all staffing and equipments are met	Done informally already. Greenfield is planning this season to identify the best trucks in the district and dedicating them to Chip Seal for the season (higher capacity, faster hydraulics to raise & lower bed, common bar height)	JD to identify trucks to be dedicated to chip seal for season	30-Apr
8	Standardize staging of dump trucks behind chipper	Greenfield is standardized at 1 on chipper and 2 following, all the rest are staged on county roads.		
9	Develop training program for dump truck drivers - practice hooking up to chipper and driving staggered in-line	Create a chip seal "endorsement" for truck drivers who are qualified to drive for chip seal operation (need to test drivers being pulled in a curve). Also need to train more chipper operators due to anticipated attrition in coming years.	JD to create a program for endorsements (laminated safety card?)	TBD
10	Look into ways to improve distributor fill times (can distributors be filled from the bottom?)	Some distributors can be filled from bottom, some can't - depends on the design of the distributor. Need to maintain ability to refill with trucks back to back rather than side to side (so can refill on county roads)		
11	Work on incorporating rolling releases of trucks from chipper	Will be easier to do with Greenfield's plan to use dedicated trucks (planned) and drivers (being considered) for the season across all subs.	Jerry to implement once trucks are designated and driver endorsement program is created	TBD
12	Standardize chip-bar height for all trucks	This will be done once the dedicated trucks are chosen	Brian Huxley to own	1-Jul
13	Ensure chipper operator is able to communicate with distributors - look into headsets	Will test using open ear Bluetooth headset	JD to get headset to test	31-Mar
14	Ensure critical replacement parts are on-hand at all times for chippers - develop standard replacement part list for all districts	This will be done for Greenfield (i.e. spare rod for hitch on Chipper)	Brian Huxley to own, Jerry to assist by finding out what other districts keep on hand	1-Jul

CHIP SEAL IMPROVEMENT PLAN **District:** **LaPorte**

	Opportunity for Improvement	District Plan for Trialing & Implementing Improvement	Person Responsible	Target Implementation Date
1	Hold pre-chip sub meetings covering assignments, job safety, and daily plans and goals	Subs currently holding planning meetings - identifing # of trucks, drop locations, other needs		
2	Incorporate daily plans and goals into morning start-up meetings	Currently being done		
3	Reduce travel time of trucks and distributors by pre-planning drop locations along chip seal routes	Always use drop locations and 2 loaders to load trucks		
4	Work with suppliers to improve incoming oil deliveries (timing, locations, temps)	Currently working with supplier to pre-plan load locations		
5	Look into closing roads and setting up detours to minimize traffic on roads	few days in advance (usually after finishing daily chip seal) - just need to flip signs morning of. Detours determined during the planning stages - may need to reorder sequence of roads when detours and chip seal roads are same. Uses one person to coordinate all detours Digital boards set up 3 to 4 days before closure Mailers sent to people that live along the route		
6	Develop planning tool to estimate number of trucks and tankers needed daily for each job	Purdue to send tool to district		
7	Hold pre-season Chip Seal planning meetings for district to discuss schedule, daily mileage goals, and equipment needs to ensure all staffing and equipments are met	Look into SureTrak (scheduling software) for helping in the planning process	Todd S./Indy	
8	Standardize staging of dump trucks behind chipper	Flaggers told that trucks have priority to move into work area (go around other traffic) - all flagger have radios Process requires high level of communication between all operators		
9	Develop training program for dump truck drivers - practice hooking up to chipper and driving staggered in-line	Look into setting up a rodeo/training session before 1st day of running in a new sub district for inexpierienced drivers		
10	Look into ways to improve distributor fill times (can distributors be filled from the bottom?)	Look at tanker options (Wyoming using tankers)		
11	Work on incorporating rolling releases of trucks from chipper	Currently using rolling release		
12	Standardize chip-bar height for all trucks	Need to look at each style of truck		
13	Ensure chipper operator is able to communicate with distributors - look into headsets	2nd person on chipper using radio to commuicate		
14	Ensure critical replacement parts are on-hand at all times for chippers, distributors, rollers, sweepers - develop standard replacement part list for all districts	Develop critical parts list for district - Work with counties, other states to set up programs		
15		Use flags/candlesticks for helping truck drivers back up to chipper		

CHIP SEAL IMPROVEMENT PLAN **District: Seymour**

	Opportunity for Improvement	District Plan for Trialing & Implementing Improvement	Person Responsible	Target Implementation Date
1	Hold pre-chip sub meetings covering assignments, job safety, and daily plans and goals	Implementing weekly progress meetings to monitor tracking against season plan (phone call or webex) (lane miles, # of days estimated, etc.)	Gary	1-May
2	Incorporate daily plans and goals into morning start-up meetings	Pre-project meetings will be led by a district level foreman to help drive consistency across district	District foreman (TBD)	1-May
3	Reduce travel time of trucks and distributors by pre-planning drop locations along chip seal routes	Planning for multiple drop sites per job to optimize this aspect of logistics (stockpiles and tankers)	Maintenance Technical Services	1-May
4	Work with suppliers to improve incoming oil deliveries (timing, locations, temps)	Not much trouble in this area, occassional tanker driver gets lost in remote areas	Dustin	1-May
5	Look into closing roads and setting up detours to minimize traffic on roads	Using "soft closure" of work lane rather than closing the road. District Foreman will have responsibility for taking traffic into account when planning # of trucks needed and for managing traffic flow		
6	Develop planning tool to estimate number of trucks and tankers needed daily for each job			
7	Hold pre-season Chip Seal planning meetings for district to discuss schedule, daily mileage goals, and equipment needs to ensure all staffing and equipments are met	Already holding multiple pre-season planning meetings		
8	Standardize staging of dump trucks behind chipper	incorporated into planning tool (line 8)		
9	Develop training program for dump truck drivers - practice hooking up to chipper and driving staggered in-line	Done in Seymour as On Job Training - pairing experienced driver with rookie driver to learn chip seal driving		
10	Look into ways to improve distributor fill times (can distributors be filled from the bottom?)	Seymour is going to try only filling a 3,500 gallon distributor to 3,000 gallons because you can load quickly (~100 gpm) up to a point then have to fill slower for the last 500 gallons		
11	Work on incorporating rolling releases of trucks from chipper	Seymour already doing this very well		
12	Standardize chip-bar height for all trucks	Already doing this very well - Seymour was best district for standard height		
13	Ensure chipper operator is able to communicate with distributors - look into headsets	Find headphones for chipper operator to be able to talk to distributors	Dustin	
14	Ensure critical replacement parts are on-hand at all times for chippers - develop standard replacement part list for all districts	Seymour does complete bumper to bumper inspection of equipment prior to start of season. Chipper is 12 years old, most replacement parts are special order because no distributor keeps them in stock.		
15		Why isn't hitch on chipper cushioned or spring loaded to prevent damage?		
16		Want to keep traffic off the freshly chipped road for 40+ minutes (depending on weather conditions). If chipper is running "too fast" that turns into a very long work site - maybe 5 miles if running full speed and having to wait 60+ minutes to let traffic on road		
17		If loading trucks to 15 ton (instead of 12) may want to use a larger loader so it can be filled in 2-3 scoops rather than 4-5 scoops. Would be cheaper than adding a 2nd loader to keep up with trucks		
18		Can state buy an active floor semi to connect to a chipper to provide 20+ tons of capacity for flat, straight roads? Probably doesn't make sense for any district but it could be shared amond districts.		

CHIP SEAL IMPROVEMENT PLAN **District: Vincennes**

	Opportunity for Improvement	District Plan for Trialing & Implementing Improvement	Person Responsible	Target Implementation Date
1	Hold pre-chip sub meetings covering assignments, job safety, and daily plans and goals			
2	Incorporate daily plans and goals into morning start-up meetings			
3	Reduce travel time of trucks and distributors by pre-planning drop locations along chip seal routes			
4	Work with suppliers to improve incoming oil deliveries (timing, locations, temps)			
5	Look into closing roads and setting up detours to minimize traffic on roads			
6	Develop planning tool to estimate number of trucks and tankers needed daily for each job			
7	Hold pre-season Chip Seal planning meetings for district to discuss schedule, daily mileage goals, and equipment needs to ensure all staffing and equipments are met			
8	Standardize staging of dump trucks behind chipper			
9	Develop training program for dump truck drivers - practice hooking up to chipper and driving staggered in-line			
10	Look into ways to improve distributor fill times (can distributors be filled from the bottom?)			
11	Work on incorporating rolling releases of trucks from chipper			
12	Standardize chip-bar height for all trucks			
13	Ensure chipper operator is able to communicate with distributors - look into headsets			
14	Ensure critical replacement parts are on-hand at all times for chippers - develop standard replacement part list for all districts			
15	Shorten travel distance between drop locations/quarry and work site	Look into leasing property to drop stone close to work site if drop sites not available	Todd S.	
16	Procurement process may cause delays in chip seal schedule (running out of stone, not available)	Better preplanning of when stone is needed/how much is needed and when stone needs to be picked up or delivered		
17	Increase skill levels of truck drivers	Look into setting up a "truck/chipper rodeo" (training/refresher program for drivers) - What funding source will cover this?		
18	Increase amount of stone per truck	Look into increasing hauling capacity from 4 scoop to 5 scoop (~12 ton to ~15 ton), need to add sideboards		
19	Chipper width of only 12', losing stone	Look into updating, improving current chipper		
20	Public misconception of chip seal process, complaints of "gravel roads" - long gaps between chip and fog	Look into dedicated fog seal crew w/own distributor Check with LaPorte to see how they managed fog seal tankers		
21		Look into dividing long projects into shorter segments of road		
22	Traffic on roads delaying trucks, causing quality issues	Review LaPorte's process for setting up detours and shutting down roads		
23	Preplanning jobs	Develop standard planning checklist for all routes (ID drop locations, number of tankers needed, number of trucks needed...)		
24	Standardize chipper bar height			
25	Standardize startup/shutdown procedures for all equipment			
26	Ensure shop staff on site for all jobs, utilize for flagging	Develop standard tooling and parts list to be stocked on truck when out on site		

About the Joint Transportation Research Program (JTRP)

On March 11, 1937, the Indiana Legislature passed an act which authorized the Indiana State Highway Commission to cooperate with and assist Purdue University in developing the best methods of improving and maintaining the highways of the state and the respective counties thereof. That collaborative effort was called the Joint Highway Research Project (JHRP). In 1997 the collaborative venture was renamed as the Joint Transportation Research Program (JTRP) to reflect the state and national efforts to integrate the management and operation of various transportation modes.

The first studies of JHRP were concerned with Test Road No. 1—evaluation of the weathering characteristics of stabilized materials. After World War II, the JHRP program grew substantially and was regularly producing technical reports. Over 1,500 technical reports are now available, published as part of the JHRP and subsequently JTRP collaborative venture between Purdue University and what is now the Indiana Department of Transportation.

Free online access to all reports is provided through a unique collaboration between JTRP and Purdue Libraries. These are available at: http://docs.lib.purdue.edu/jtrp

Further information about JTRP and its current research program is available at: http://www.purdue.edu/jtrp

About This Report

An open access version of this publication is available online. This can be most easily located using the Digital Object Identifier (doi) listed below. Pre-2011 publications that include color illustrations are available online in color but are printed only in grayscale.

The recommended citation for this publication is:

Padfield, J., Handy, J., & Stephens, J. (2014). *Seal coat productivity* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2014/12). West Lafayette, IN: Purdue University. http://dx.doi.org/10.5703/1288284315512