AHTD TRC TRANSPORTATION RESEARCH COMMITTEE

TRC0207

Monitoring Hot Mix Asphalt on the Interstate Rehabilitation Program

Mark W. Frazier, Davin M. Webb

Final Report

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TRC-0207
Monitoring Hot Mix Asphalt on the Interstate Rehabilitation Program

By

Mark W. Frazier
Engineering Research Technician
And
Davin M. Webb
Research Information Coordinator

Planning & Research Division
Arkansas State Highway and Transportation Department

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INTRODUCTION

The Interstate Rehabilitation Program (IRP) involves the reconstruction of a large number of miles of Interstate within a five-year period. With leadership from the Arkansas General Assembly, the Governor's Office, and the Arkansas Highway Commission, voters approved the program in 1999. The rehabilitation on Arkansas' Interstates uses future federal and state funds through the sale of innovative GARVEE (Grant Anticipation Revenue Vehicles) bonds.

The construction began under the IRP in the late spring of 2000 and will rebuild over 300 of Arkansas' 655-mile Interstate highway system. Through the financing of GARVEE bonds, the Arkansas Highway Commission will use future federal funds to retire $575 million worth of bonds to be issued over 3 years. Repayment will also come from required state matching funds and the proceeds from a phased-in four-cent-a-gallon increase of the state diesel fuel tax.

This presents the Arkansas State Highway and Transportation Department with the opportunity to monitor the design and production of large quantities of Hot Mix Asphalt (HMA) and the immediate and long-term impact of Interstate traffic. All of the designs in the final pavement will be of the same gyration levels, but material sources, and HMA producers, and pavement contractors will vary.

The TRC project "Monitoring Hot Mix Asphalt on Interstate Bond Program" was implemented in 2001 with the following.

1. Monitor projects constructed under the IRP from the design of HMA used on projects through construction.
2. Utilize design mix values and Acceptance Sampling and Independent Assurance Sampling results to build a database.
3. Utilize this data to predict performance based on national Superpave research.
4. Monitor in-service performance.
5. Indicators of "what not to do" may prove to give timely results that can be used on other IRP projects.

The results of this study would provide an in-depth look at the mix design, production, lay down process and performance of HMA on the Interstate. With such a vast amount of data being collected in a short period of time, the overall quantity of data would allow the Department to quickly and more accurately evaluate each job. It was anticipated that this research would also be an aid in more efficiently collecting field data for processing and analysis.

PROJECT HISTORY

In accordance with the Constitution and By-Laws of the Transportation Research Committee (TRC), a Research Subcommittee for TRC-0207 "Monitoring Hot Mix Asphalt on Interstate Bond Program" was formed in January 2001. Those members were Allan Holmes, Chairman, Frank Russenberger, Mike Limbird, Brad Fryer, Brent Dather, FHWA, and Davin Webb, Project Coordinator.

The first subcommittee meeting was held February 6, 2001 with all members present but Brent Dather, FHWA. Alan Meadors, the current Staff Research Engineer was also present.

During this meeting discussion covered whether or not this would be an in-house project or a contracted project. It was agreed that an in-house project could attain the goals of the project especially since the Department was close to implementation of the new SiteManager Program.

Fields needed for the database were discussed and it was agreed that a version patterned after the Superpave database (Appendix A) presented at the meeting would be acceptable. There were also concerns raised over the ability to accurately and easily convert station numbers over to log miles or would it be in the best interest of the Department's long range goals to go ahead and collect the limits using Global Positioning System (GPS) and get the latitude and longitude of each job limit.

Another question discussed was collecting the data from the field since there were no computer laptops assigned to any of the asphalt plant inspectors. The subcommittee agreed on the possibility of purchasing approximately ten laptops for this project in order to get the data electronically. David Henning, Staff Construction Engineer, would also be contacted to see where the Department stands on the implementation of the new SiteManager Program.

SiteManager is a Windows-based client/server application that will work with any State Highway Agency's existing database. SiteManager is compatible with the other software in AASHTO's Trns*Port family of software, and can exchange data with mainstream business software applications such as word processors and spreadsheets.

SiteManager is basically an integrated series of computerized forms for entering and viewing all information needed for a contract. Information entered on these forms is stored in a central database, so when a user calls up a report or record, it reflects the most up-to-date information available.

SiteManager eliminates the need to enter duplicate information; the program automatically transfers information from one form to all other forms and reports that use the same information.

The subcommittee agreed that there would be a draft work plan ready for review at the next meeting. The work plan included four phases:

Phase I – Data Collection. The data would be collected on all IRP projects that are active during this phase. All other IRP projects were added as necessary to give an adequate representation for statistical purposes. It was anticipated that the project would rely heavily on data gathered electronically by construction project level staff. Each inspector would complete a *Report of Inspection at Asphalt Plant* form and the *Verification of Contractor's Tests for Asphalt Concrete Hot Mix* form. These forms

would be e-mailed to the Project Coordinator serving as Principal Investigator (PI) in the research office. There would also be random on-site field inspections at which time the PI/Research personnel would make digital video of the asphalt lay down process. The Coordinator would also periodically acquire various other data taken at each site for updating the database.

Phase II – Site Inspections. Research and District personnel would monitor each site. Research staff would take digital photographs and the video of the sites during each monitoring visit. The Global Positioning System (GPS) would be used to locate features, coring locations and any paving irregularities found. If a problem area were detected, personnel would immediately attempt to locate the failure source and provide data and documentation to support the findings.

Phase III – Data Analysis. Data analysis will include collecting, compiling, sorting and verifying the data as well as the data collection process. A database would be created from the data received via e-mail from the Resident Engineers. Once the data has been imported into the database, any number of various queries could be run on the data to quickly and efficiently compare like data. This comparison could show if there are similar problems on any other jobs.

Phase IV – Reports. A final report would be written that includes all findings from this research effort. An implementation report or recommendations for the project would be developed from the findings.

The Transportation Research Committee (TRC) approved this project on May 24, 2001 for inclusion in the fiscal year 2002 Research Program. The work plan for "Monitoring Hot Mix Asphalt on Interstate Rehabilitation" was submitted at the Spring TRC for fiscal year 2002. It was approved as project TRC-0207. The work plan included the total budget for this project and a line item appropriation. The plan also contained competitive bid prices for laptop computers and a digital camera.

Laptop computers were purchased for use in the project in July 2001. There was still work to be done by Materials Division on standardizing some of the forms and spreadsheets that would be installed on the computers.

Asphalt plant inspectors in Districts 1, 4, 6, and 8 received new laptop computers purchased for this project in September 2001. The new SiteManager Program was not installed at this time because the Materials Components of the program were not worked out yet. The laptops were issued with only standard forms from the Materials and Construction directory and the option was left to the Resident Engineer to determine which forms he wished his inspectors to use.

Contact with the Resident Engineers on the IRP projects would need to be made first because they would need to review and approve the data forms before being forwarded to the Research office from the field.

There was not a current timetable for implementation of the SiteManager Program because only the Construction Management side of the program was the focus at this time. Also focus on the actual contractor payment through SiteManager was being developed.

The complete distribution of the laptop computers for the bond project materials inspectors was done in October of 2001. They were provided with the standard forms from the AHTD Materials and Construction directories. Also another share folder in the Construction directory provided some of the different verification/tracking forms that various Resident Engineer (RE) offices had created. Contact was needed with the bond project REs to arrange the lot reports for the ACHM mixes to be e-mailed to the Research office after being reviewed and approved.

At a subcommittee meeting held October 16th Mark Frazier was assigned to this project to replace Davin Webb as Project Coordinator September of 2002. Mr. Webb would still assist with the project because of his early involvement with the start of the project. Jerry Trotter replaced Brad Fryer on the subcommittee and shortly after Mark Bradley replaced Alan Meadors as Staff Research Engineer on the subcommittee.

A memo was sent out to the Resident Engineer (RE) offices that had IRP jobs assigned to them. The memo asked for information about mixes used on the IRP jobs and their content, plant suppliers, aggregate used, location in log miles and/or stations of IRP jobs and where mixes are used, and if the mixes were changed during the IRP job.

Rochelle Blue, RE 32 from District 3, responded with information on IRP job BX0100 (Appendix B). In lieu of entering data on the spreadsheet electronically she sent copies of the mix designs used, locations where each mix was placed and the typical sections, special details and plan and profiles for the project. She sent information on IRP jobs B30100 and B30101 the middle of October. The data was similar to what was sent on IRP job BX0100.

Tim Baber, RE 64 from District 6 sent in a spreadsheet with data on IRP job B60115 (Appendix C) the third week of October. Information from District 8 about IRP jobs B80104 (Appendix D) and B80105 (Appendix E) were sent also from Mike Hays and Joseph Knight, from the RE 86 office. Breakdown of tonnage per lot and mix design was received for Job B10102 (Appendix F).

The data was received from Districts 1, 3, 6, and 8 and entered into the database. The amount and format of information varied from one IRP job to another and consumed vast amounts of time to sort. After these responses there was no more follow-up or data turned in even though the IRP jobs have continued to be let, worked, and completed.

During the summer of 2003, a subcommittee meeting was held to decide the status of this research project and its future. Everyone (including new members Jerry Trotter and Mark Bradley) except Brent Dather, FHWA representative were present. The consensus was to finalize this project.

PROJECT RESULTS

The collection of data from the field was not uniform from district to district. Much of the data is in hard copy format and very detailed. There are inspector's diaries available to review but these are handwritten and contain large volumes of notes to review.

Some information is kept at the Resident Engineer's office and some is forwarded to the main building for storage. Various divisions and sections have data available but may be stored in different formats.

Materials Division has approximately 1,000 mix designs listed on the Materials intranet. The Pavement Management group in the Research Section of the Planning and Research Division has information on International Roughness Index and Ride Number. The plans for various jobs are available through the Programs and Contracts Division. The Construction Division has additional information related to ongoing construction jobs.

If a problem occurs on a particular IRP job the data is available in various offices of the Department. Also the experience and knowledge of our Resident Engineers, inspectors, and other professional personnel is available for input.

Troubleshooting and researching the problem area has been standardized for a long time and many field and laboratory tests would still be performed as they have in the past to resolve the problem.

Field review would include a physical inspection of the problem area and surrounding terrain. The grade and sub-grade make-up of the terrain and its affect on the site are considered. Core samples of materials from the site would be taken and tested in the laboratory to confirm quality and assurance testing.

Asphalt plants and quarry/pit operations and procedures are reviewed to ensure specification materials were used in the construction project and the contractors' proper handling and application of the materials are also considered.

Hopefully because many on-going quality and assurance tests are performed on the materials used during the construction the problem stage is never reached. It is noted that no pavement problems have arisen during the course of this project.

Without the standardized electronic collection format (SiteManager) fully completed and on-line, the collection of available data for the database creates a vast amount of work in manually entering the data and is extremely time consuming. The inconsistency in data submitted is also a problem.

SUMMARY

The potential and scope of having one database with all the information pertaining to mix designs and acceptance and assurance sampling results was an excellent idea but difficulties developed with collection of field data without the use of a standardize electronic software medium (SiteManager).

RECOMMENDATIONS

1. Complete the development of the SiteManager Program. Though some features of SiteManager are being utilized (i.e.-construction, payment tracking to contractor); the Materials Management Module of SiteManager is not fully developed for use yet. The Materials Module would include analysis, design, development, testing, beta testing, and warranty phases. The Materials Division has estimated that this may take as much as three years to implement.

2. In the interim, forms should be standardized for use in the field by inspectors. Not all forms utilized now are the same from job to job. These forms need to be standardized to accommodate transfer to the SiteManager Program format.

3. A review needs to be made on the retention of records kept by the Department. Because of a recommendation by a QIP committee in 1997, the life expectancy of materials records pertaining to finalized jobs kept at the RE offices is three years. After that it is up to the Resident Engineer decision to keep or destroy the records.

4. In the future the problem statement should be resubmitted with appropriate changes after the SiteManager Program has been implemented.

Appendix A
Database Titles

APPROVED_DATE	MIX_DSN_NO	COMMENTS	FIELD_DATA_SHEETS	RUT_AVERAGE	MAX_RUT	JOB #	COUNTY	ROUTE	SECTION

		BASE		BINDER		LEVELING		SURFACE	
BEG. L.M. / STATION #	END L.M. / STATION #	LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER

INSIDE LANE WIDENING/BASE		INSIDE LANE WIDENING/BINDER		INSIDE LANE WIDENING/LEVELING		INSIDE LANE WIDENING/SURFACE		OUTSIDE LANE WIDENING/BASE	
LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER

OUTSIDE LANE WIDENING/BINDER		OUTSIDE LANE WIDENING/LEVELING		OUTSIDE LANE WIDENING/SURFACE		INSIDE SHOULDER/BASE		INSIDE SHOULDER/BINDER	
LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER

INSIDE SHOULDER/LEVELING		INSIDE SHOULDER/SURFACE		OUTSIDE SHOULDER/BASE		OUTSIDE SHOULDER/BINDER		OUTSIDE SHOULDER/LEVELING	
LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER	LBS. PER SQ. YD	KGS. PER SQ. METER

OUTSIDE SHOULDER/SURFACE		
LBS. PER SQ. YD	KGS. PER SQ. METER	Layer Data Comments

Surface BX0100

Mix Design # SP280C-01

2487+00 - 2536+83.5 LML - Rt & Lt Lns & Shlds
2539+66.5 - 2552+13.5 LML - Rt & Lt Lns & Shlds
2558+26.5 - 2575+03.42 LML - Rt & Lt Lns & Shlds
2585+36.5 - 2625+46 LML - Rt Ln & Shld
2585+36.5 - 2627+50 LML - Lt Ln
2585+36.5 - 2625+50 LML - Lt Shld
2487+00 - 2536+83.5 RML - Lt & Rt Lns & Shlds
2539+66.5 - 2552+13.5 RML - Lt & Rt Lns & Shlds
2558+26.5 - 2575+03.42 RML - Lt & Rt Lns & Shlds
2585+36.5 - 2630+73 RML - Rt Shld
2585+36.5 - 2619+30 RML - Rt Ln
2585+36.5 - 2670+30 RML - Lt Ln & Sh
2595+45 - 2612+90 Ramp 1
2594+25 - 2598+50 Ramp 1 Decel
2598+50 - 2601+70 Ramp 1 Trans
2592+30 - 2605+15 Ramp 4 Accel
2604+75 - 2615+00 Ramp 4
2610+99 - 2628+30 Ramp 3 2nd Lift
2608+00 - 2620+00 Ramp 2 2nd Lift
2620+00 - 2631+25 Ramp 2 Accel
2743+70 - 2794+00 Ramp C
2746+71 - 2747+61 Ramp C Gore
2549+10 - 2552+50 RML Lt Guardrail Widening
2585+36.5 - 2588+36 LML Lt Guardrail Widening
2536+83 - 2544+00 LML Lt Guardrail Widening
2585+36.5 - 2588+85 LML Rt Guardrail Widening
2558+26 - 2561+15 LML Lt Guardrail Widening
2558+26.5 - 2561+79 LML Rt Guardrail Widening

Appendix C
B60115

JOB_NO	OLD_JOB_NO	RESIDENT_ENGINEER	CONTRACTOR	DIST	COUNTY	ROUTE	SECT
B60115	R60045	T BABER	ROGERS GROUP, INC.	6	Hot Spring	30	21

BEGIN	END	LENGTH	GPS Coordinates				LET_MO
			BEG_LAT	BEG_LONG	END_LAT	END_LONG	
85.96	92.84	6.88					6

LET_YR	COMP_MO	COMP_YR	JOB_STATUS	TYPE_WORK	JOB_NAME	EXISTING CONDITION	TYPE WORK
00	8	2002	Let	Rubblize & Overlay	Social Hill-West (Resurfacing)		

LANE_WIDTH	NO_LANES	DIRECTION	N_MAX	SUPPLIER_AND_DATA	AC%	SUPPLIER	SUPPLIER_CHANGED
12	2	EB	205	Rogers Group - Friendship			
		WB	205	Rogers Group - Friendship			
		EB	205	Martin Marietta - Jones Mill			
		EB	205	Rogers Group - Friendship			
		WB	205	Rogers Group - Friendship			
		WB	205	Rogers Group - Friendship			
		EB	205	Martin Marietta - Jones Mill			
		WB	205	Rogers Group - Friendship			
		EB	205	Martin Marietta - Jones Mill			

Appendix D
B80104

Job No.	Job Name	Old Job No.	Resident Engineer	Contractor	District	County	Route	Section	Begin	End	Length	Month Let	Year Let	Month Completed	Year Completed	Job Status
B80104	Johnson Co. Line-Mill Creek (F)	R80038, R80039	McAlister, Burnett, Tolleson	Gilbert Central	8	Pope	40	22	71.51	76.85	5.34	4	2001	6	2002	Complete

				Base									Rates		
Existing Condition	Lane Width	No. Lanes	Direction	MIX_DSN_NO	AC%	AC SUPPLIER	PG	%AV	%VMA	%VFA	N_MAX	PLANT	Station	Station	Location
Poor	12	4	E-W	SP363C-01	4.3	Royal	76	4	12.3	68.2	205	London	3986+80	4040+80	WB-in/sh
													3930+70	3986+80	WB-in/sh
													3793+02	3848+26	WB-in/sh
													3848+26	3891+92	WB-in/sh
													3932+40	4023+57	WB-out
													4023+57	4060+25	WB-out
													3956+95	4047+46	WB-out
													3831+20	3901+10	WB-out
													4060+20	4071+12	WB-in/sh
													4060+25	4071+12	WB-out
													3831+20	3891+30	WB-out
													3789+30	3831+20	WB-out
													3788+20	3813+60	WB-out
				SP425C-01	4.2	Royal	76	4	12	66.7	205	London	3901+10	3919+00	WB-in/sh
													3790+25	3814+00	WB-in/sh
													3814+70	3874+25	EB-in/sh
													3874+25	3909+36	EB-in/sh
													3931+76	3961+50	EB-in/sh
													3961+50	3993+25	EB-in/sh
													3790+35	3869+75	EB-out
													3868+79	3908+13	EB-out
													3931+80	4004+00	EB-out
													4015+75	4054+80	EB-out
													3993+25	4060+00	EB-in/sh

Binder									Rates							
MIX_DSN_NO	AC%	AC SUPPLIER	PG	%AV	%VMA	%VFA	N_MAX	PLANT	Station	Station	Location	Rate	MIX_DSN_NO	AC%	AC SUPPLIER	PG
SP107-02	4.5	Royal	76	4	13.3	71.2	205	London	3826+35	3858+60	EB-in/sh	333	SP384C-01	5.1	Royal	76
									3858+60	3908+80	EB-in/sh	334				
									3791+70	3827+25	EB-out	325				
									3827+25	3908+50	EB-out	312				
SP392C-01	4.6	Royal	76	4	12.6	67.7	205	London	3810+03	3901+25	WB-in/sh	321				
									3962+95	4071+12	WB-in/sh	350				
									3931+94	3962+95	WB-in/sh	348				
									3930+67	4071+12	WB-out	354				
									3865+10	3901+00	WB-out	405				
									3818+60	3865+10	WB-out	398				
SP434C-01	4.5	Royal	76	4	13.1	69.4	205	London	3931+95	4047+25	EB-in/sh	340	SP443C-01	5.1	Royal	76
									3932+00	3986+50	EB-out	327				
									3986+50	4054+50	EB-out	348				
									3801+00	3826+35	EB-in/sh	328				

Appendix D
B80104

Type Work	Rate
R/O	683
	610
	666
	666
	615
	615
	679
	565
	575
	522
	720
	597
	700
	770
	613
	592
	565
	621
	489
	466
	500
	479
	592
	515

Surface					Rates			
%AV	%VMA	%VFA	N_MAX	PLANT	Station	Station	Location	Rate
4	14.6	72.8	205	London	4001+10	4071+12	WB-in/sh	243
					3932+00	4001+10	WB-in/sh	233
					3811+80	3901+00	WB-in/sh	193
					3782+50	3881+00	WB-out	212
					3931+00	4071+12	WB-out	221
					3782+50	3811+80	WB-in/sh	302
4	14.6	72.9	205	London	3932+20	4053+50	EB-in/sh	242
					3936+75	4052+80	EB-out	284
					3791+80	3877+00	EB-in/sh	239
					3792+15	3903+20	EB-out	237

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B80104

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Binder									Rates							
MIX_DSN_NO	AC%	AC SUPPLIER	PG	%AV	%VMA	%VFA	N_MAX	PLANT	Station	Station	Location	Rate	MIX_DSN_NO	AC%	AC SUPPLIER	PG
SP107-02	4.5	Royal	76	4	13.3	71.2	205	London	3826+35	3858+60	EB-in/sh	333	SP384C-01	5.1	Royal	76
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SP392C-01	4.6	Royal	76	4	12.6	67.7	205	London	3810+03	3901+25	WB-in/sh	321				
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Appendix D
B80104

Type Work	Rate
R/O	683
	610
	666
	666
	615
	615
	679
	565
	575
	522
	720
	597
	700
	770
	613
	592
	565
	621
	489
	466
	500
	479
	592
	515

Surface					Rates			
%AV	%VMA	%VFA	N_MAX	PLANT	Station	Station	Location	Rate
4	14.6	72.8	205	London	4001+10	4071+12	WB-in/sh	243
					3932+00	4001+10	WB-in/sh	233
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					3936+75	4052+80	EB-out	284
					3791+80	3877+00	EB-in/sh	239
					3792+15	3903+20	EB-out	237

Appendix E
B80105

Aggregate Types, Sources, and %

1	%	Source	2	%	Source	3	%	Source	4	%	Source	5	%	Source	6	%
Concrete Rock	40	Duffield Gumlog	3/4"	15	Duffield Russellville	1/2"	17	Duffield Russellville	1/4" Screenings	13	Duffield Russellville	Sand	15	Duffield Russellville		
Concrete Rock	40	Duffield Gumlog	3/4"	15	Duffield Russellville	1/2"	17	Duffield Russellville	1/4" Screenings	13	Duffield Russellville	Sand	15	Duffield Russellville		
Concrete Rock	40	Duffield Gumlog	3/4"	15	Duffield Russellville	1/2"	17	Duffield Russellville	1/4" Screenings	13	Duffield Russellville	Sand	15	Duffield Russellville		
Concrete Rock	40	Duffield Gumlog	3/4"	15	Duffield Russellville	1/2"	17	Duffield Russellville	1/4" Screenings	13	Duffield Russellville	Sand	15	Duffield Russellville		
1 1/2"	37	Duffield Gumlog	3/4" CHIP	25	Duffield Russellville	1/2" CHIP	15	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville	Sand	13	Duffield Russellville		
1 1/2"	37	Duffield Gumlog	3/4" CHIP	25	Duffield Russellville	1/2" CHIP	15	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville	Sand	13	Duffield Russellville		
1 1/2"	35	Duffield Gumlog	3/4" CHIP	24	Duffield Russellville	1/2" CHIP	13	Duffield Russellville	Reg. Res. Scrngs.	7	Duffield Russellville	Sand	11	Duffield Russellville	RAP	10
1 1/2"	35	Duffield Gumlog	3/4" CHIP	24	Duffield Russellville	1/2" CHIP	13	Duffield Russellville	Reg. Res. Scrngs.	7	Duffield Russellville	Sand	11	Duffield Russellville	RAP	10
1 1/2"	35	Duffield Gumlog	3/4" CHIP	24	Duffield Russellville	1/2" CHIP	13	Duffield Russellville	Reg. Res. Scrngs.	7	Duffield Russellville	Sand	11	Duffield Russellville	RAP	10
1 1/2"	37	Duffield Gumlog	3/4" CHIP	25	Duffield Russellville	1/2" CHIP	15	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville	Sand	13	Duffield Russellville		
1 1/2"	37	Duffield Gumlog	3/4" CHIP	25	Duffield Russellville	1/2" CHIP	15	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville	Sand	13	Duffield Russellville		
1 1/2"	37	Duffield Gumlog	3/4" CHIP	25	Duffield Russellville	1/2" CHIP	15	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville	Sand	13	Duffield Russellville		
1 1/2"	37	Duffield Gumlog	3/4" CHIP	25	Duffield Russellville	1/2" CHIP	15	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville	Sand	13	Duffield Russellville		
1 1/2"	35	Duffield Gumlog	3/4" CHIP	24	Duffield Russellville	1/2" CHIP	13	Duffield Russellville	Reg. Res. Scrngs.	7	Duffield Russellville	Sand	11	Duffield Russellville	RAP	10
1 1/2"	35	Duffield Gumlog	3/4" CHIP	24	Duffield Russellville	1/2" CHIP	13	Duffield Russellville	Reg. Res. Scrngs.	7	Duffield Russellville	Sand	11	Duffield Russellville	RAP	10
1 1/2"	35	Duffield Gumlog	3/4" CHIP	24	Duffield Russellville	1/2" CHIP	13	Duffield Russellville	Reg. Res. Scrngs.	7	Duffield Russellville	Sand	11	Duffield Russellville	RAP	10
1 1/2"	37	Duffield Gumlog	3/4" CHIP	25	Duffield Russellville	1/2" CHIP	15	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville	Sand	13	Duffield Russellville		
1 1/2"	37	Duffield Gumlog	3/4" CHIP	25	Duffield Russellville	1/2" CHIP	15	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville	Sand	13	Duffield Russellville		
1 1/2"	37	Duffield Gumlog	3/4" CHIP	25	Duffield Russellville	1/2" CHIP	15	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville	Sand	13	Duffield Russellville		
1 1/2"	37	Duffield Gumlog	3/4" CHIP	25	Duffield Russellville	1/2" CHIP	15	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville	Sand	13	Duffield Russellville		
1 1/2"	37	Duffield Gumlog	3/4" CHIP	25	Duffield Russellville	1/2" CHIP	15	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville	Sand	13	Duffield Russellville		
1" Binder Rock	44	Duffield Russellville	3/4"	12	Duffield Russellville	1/2"	25	Duffield Russellville	1/4" Screenings	9	Duffield Russellville	Sand	10	Duffield Russellville		
1" Binder Rock	44	Duffield Russellville	3/4"	12	Duffield Russellville	1/2"	25	Duffield Russellville	1/4" Screenings	9	Duffield Russellville	Sand	10	Duffield Russellville		
1" Binder Rock	44	Duffield Russellville	3/4"	12	Duffield Russellville	1/2"	25	Duffield Russellville	1/4" Screenings	9	Duffield Russellville	Sand	10	Duffield Russellville		
1" Binder Rock	44	Duffield Russellville	3/4"	12	Duffield Russellville	1/2"	25	Duffield Russellville	1/4" Screenings	9	Duffield Russellville	Sand	10	Duffield Russellville		
1" Binder Rock	44	Duffield Russellville	3/4"	12	Duffield Russellville	1/2"	25	Duffield Russellville	1/4" Screenings	9	Duffield Russellville	Sand	10	Duffield Russellville		
1" Binder Rock	44	Duffield Russellville	3/4"	12	Duffield Russellville	1/2"	25	Duffield Russellville	1/4" Screenings	9	Duffield Russellville	Sand	10	Duffield Russellville		
1" Binder Rock	44	Duffield Russellville	3/4"	12	Duffield Russellville	1/2"	25	Duffield Russellville	1/4" Screenings	9	Duffield Russellville	Sand	10	Duffield Russellville		
1" Binder Rock	44	Duffield Russellville	3/4"	12	Duffield Russellville	1/2"	25	Duffield Russellville	1/4" Screenings	9	Duffield Russellville	Sand	10	Duffield Russellville		
3/4"	8	Duffield Russellville	1/2"	33	Duffield Russellville	1/2"	8	Duffield Gumlog	3/8" Screenings	26	Duffield Gumlog	Clean Scrns.	25	Duffield Russellville		
3/4"	8	Duffield Russellville	1/2"	33	Duffield Russellville	1/2"	8	Duffield Gumlog	3/8" Screenings	26	Duffield Gumlog	Clean Scrns.	25	Duffield Russellville		
3/4" Minus	15	Duffield Russellville	1/2" Minus	42	Duffield Russellville	Clean Scrngs.	31	Duffield Russellville	Screening	12	Duffield Russellville					
3/4" Minus	15	Duffield Russellville	1/2" Minus	42	Duffield Russellville	Clean Scrngs.	31	Duffield Russellville	Screening	12	Duffield Russellville					
3/4" Minus	15	Duffield Russellville	1/2" Minus	42	Duffield Russellville	Clean Scrngs.	31	Duffield Russellville	Screening	12	Duffield Russellville					
3/4" Minus	15	Duffield Russellville	1/2" Minus	42	Duffield Russellville	Clean Scrngs.	31	Duffield Russellville	Screening	12	Duffield Russellville					
3/4" Minus	15	Duffield Russellville	1/2" Minus	42	Duffield Russellville	Clean Scrngs.	31	Duffield Russellville	Screening	12	Duffield Russellville					
5/8" Chip	50	Rogers Greenbreir	Ind. Sand	20	Rogers Greenbreir	Screening	20	Rogers Greenbreir	C. Sand	10	Jeffery Sand Conway					
5/8" Chip	50	Rogers Greenbreir	Ind. Sand	20	Rogers Greenbreir	Screening	20	Rogers Greenbreir	C. Sand	10	Jeffery Sand Conway					
3/4" Minus	19	Duffield Russellville	1/2" Chips	35	Duffield Gumlog	Screenings	30	Duffield Gumlog	Sand	6	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville		
3/4" Minus	19	Duffield Russellville	1/2" Chips	35	Duffield Gumlog	Screenings	30	Duffield Gumlog	Sand	6	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville		
3/4" Minus	19	Duffield Russellville	1/2" Chips	35	Duffield Gumlog	Screenings	30	Duffield Gumlog	Sand	6	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville		
3/4" Minus	19	Duffield Russellville	1/2" Chips	35	Duffield Gumlog	Screenings	30	Duffield Gumlog	Sand	6	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville		
3/4" Minus	19	Duffield Russellville	1/2" Chips	35	Duffield Gumlog	Screenings	30	Duffield Gumlog	Sand	6	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville		
3/4" Minus	19	Duffield Russellville	1/2" Chips	35	Duffield Gumlog	Screenings	30	Duffield Gumlog	Sand	6	Duffield Russellville	Reg. Res. Scrngs.	10	Duffield Russellville		

Appendix E
B80105

Source

Jack Woods Russellville
Jack Woods Russellville
Jack Woods Russellville

Jack Woods Russellville
Jack Woods Russellville
Jack Woods Russellville

JOB NO. B10102
FAP BIM-B40-0(1)0 7 IMD-40-4(75)216
BRINKLEY - GOODWIN (F)
MONROE & ST. FRANCIS COUNTIES
Forrest City Plant

EXHIBIT S-1

BREAKDOWN OF TONNAGE PER LOT AND MIX DESIGN
ACHM (PG76-22) BASE COURSE (1 1/2")

Lot No.	Lab No.		Date	AB	Air Voids	Densities	VMA
1	SP028C-01	Forrest City	8/22/01	4.6	3.6	93.5	12
2	SP028C-01	Forrest City	9/7/01	4.5	3.8	92.4	12
3	SP028C-01	Forrest City	9/10/01	4.4	4.2	93	12.3
4	SP028C-01	Forrest City	9/10/01	4.6	4	92.7	12.4
5	SP028C-01	Forrest City	9/19/01	4.5	3.6	93.4	12
6	SP028C-01	Forrest City	9/24/01	4.6	4.1	91.5	11.1
7	SP028C-01	Forrest City	9/27/01	4.4	3.8	92.4	11.8
8	SP028C-01	Forrest City	10/1/01	4.5	3.7	92.5	12
9	SP028C-01	Forrest City	10/5/01	4.6	4.2	93.5	12.6
10	SP028C-01	Forrest City	10/24/01	4.5	3.6	93.6	11.8
11	SP028C-01	Forrest City	10/30/01	4.6	3.7	92.4	12.1
12	SP028C-01	Forrest City	10/31/01	4.6	3.2	92.2	11.7
13	SP028C-01	Forrest City	11/10/01	4.5	4	92.7	12.3
14	SP028C-01	Forrest City	11/13/01	4.6	4.1	94.5	12.6
15	SP028C-01	Forrest City	3/12/02	4.6	4.3	92.6	12.8
16	SP028C-01	Forrest City	3/14/02	4.6	4.2	93.1	12.5
17	SP028C-01	Forrest City	3/15/02	4.6	3.8	93.6	12.1
18	SP028C-01	Forrest City	3/16/02	4.5	4.3	92.3	12.4
19	SP028C-01	Forrest City	3/23/02	4.5	3.8	93.6	11.9
20	SP028C-01	Forrest City	3/26/02	4.5	4.2	94	12.3
21	SP028C-01	Forrest City	3/27/02	4.4	3.7	92.4	11.8
22	SP028C-01	Forrest City	3/28/02	4.5	3.7	93.1	11.9
23	SP028C-01	Forrest City	4/3/02	4.4	3.4	92.5	11.6
24	SP028C-01	Forrest City	4/9/02	4.5	3.9	92.3	12.3
25	SP028C-01	Forrest City	4/10/02	4.5	4.5	93.1	12.7
26	SP028C-01	Forrest City	4/15/02	4.5	4.2	93.2	12.4
27	SP028C-01	Forrest City	4/16/02	4.5	3.2	93.7	11.6
28	SP028C-01	Forrest City	4/18/02	4.5	3.8	94	12