



February 22, 2021

Connell Resources, Inc.  
7785 Highland Meadows Parkway, Suite 100  
Fort Collins, Colorado 80528

Attn: Mr. Ed Wells ([ewells@connellresources.com](mailto:ewells@connellresources.com))

Re: Connell Resources, Inc. - 2021 Asphalt Mix Designs  
Mix #20150, Grading S 75 (Jebro 64-22) with Lime  
EEC Project No. 1215002A-4

Mr. Wells:

Earth Engineering Consultants, LLC (EEC) personnel have completed the requested laboratory Superpave mix design for the referenced asphaltic concrete mix. The mix design was carried out in general accordance with Colorado Department of Transportation, Asphalt Institute, and/or Larimer County Urban Area Street Standards mix design procedures. The mix design was performed using a Superpave Gyratory Compactor with a compaction angle of 1.25 degrees and 100-mm molds. In addition, specified tests were completed on the component aggregate. Results of the testing completed for this mix and recommendations for the job mix formula are included on the attached mix design summary sheets.

The asphaltic concrete job mix formula provided with this report is based on testing completed with specific materials, gradations, and design procedures. Variation in laboratory test results can occur due to multi-laboratory precision, variation in materials and slight changes in design procedures. These factors should be considered when job mix verification of laboratory mixes is performed. The physical properties of the mix should be retested and re-evaluated for hot plant produced material. It is often necessary to make adjustments to the job mix formula to account for the changed environment between the laboratory and field produced material. Should the source or physical characteristics of the materials change substantially, the development of a new or revised job mix formula is recommended.

We appreciate the opportunity to be of service to you. If you have any questions regarding this report, or if we can be of further service to you in any other way, please do not hesitate to contact us.

Very truly yours,  
Earth Engineering Consultants, LLC



Ethan P. Wiechert, P.E.  
Senior Project Engineer

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**EARTH ENGINEERING CONSULTANTS, LLC**  
**ASPHALT MIX DESIGN**  
 Connell Resources, Inc. - Mix No. 20150  
 Superpave Mix Design: Grading S 75 (Jebro PG 64-22) with Lime

**TABLE I - AGGREGATE GRADATIONS**

Sieve Size	Connell	Connell	Connell	Burnco	Connell					Job Mix Tolerance	Target Master Range
	Carr	Carr	Carr	Windsor	Timnath			Pete Lien	Composite		
	3/4"	Crusher Fines	W. Crusher Fines	Washed Sand	RAP AC=4.93%			Lime			
1 1/2" (37.5 mm)	100	100	100	100	100			100	100	100	
1" (25.0 mm)	100	100	100	100	100			100	100	100	100
3/4" (19.0 mm)	100	100	100	100	100			100	100	90 - 100	90 - 100
1/2" (12.5 mm)	64	100	100	100	93			100	89	83 - 95	
3/8" (9.5 mm)	32	100	100	100	88			100	79	73 - 85	
No. 4 (4.75 mm)	4	78	78	100	67			100	60	55 - 65	
No. 8 (2.36 mm)	2	55	50	94	53			100	46	41 - 51	23 - 49
No. 16 (1.18 mm)	2	38	32	72	41			100	34		
No. 30 (600 µm)	2	28	19	45	31			100	24	20 - 28	
No. 50 (300 µm)	2	19	10	20	21			100	15		
No. 100 (150 µm)	1	13	5	7	13			98	9		
No. 200 (75 µm)	1.2	9.2	2.8	2.5	7.4			97.0	5.7	3.7 - 7.7	2 - 8
Used	27%	23%	13%	16%	20%			1%	100%		
Combined	Dry Sp. Gr.	2.644	2.637	2.629	2.609	2.669		2.380	2.637		
	Apparent Sp. Gr.	2.698	2.689	2.681	2.678	2.712		2.380	2.690		
	Water Absorption (%)	0.7	0.7	0.8	1.0				0.6		
Coarse	Dry Sp. Gr.	2.644	2.635	2.622		2.669			2.645		
	Apparent Sp. Gr.	2.698	2.685	2.669		2.712			2.697		
	Water Absorption (%)	0.7	0.7	0.7					0.6		
Fine	Dry Sp. Gr.	2.644	2.637	2.631	2.609	2.669		2.380	2.631		
	Apparent Sp. Gr.	2.698	2.690	2.685	2.678	2.712		2.380	2.685		
	Water Absorption (%)	0.7	0.7	0.8	1.0				0.6		
Effective Mix Sp. Gr.								2.668			
LA Abrasion (%)	19							19		45 Max.	
Liquid Limit		NL	NL	NL				NL			
Plasticity Index		NP	NP	NP				NP		NP	

Note: The RAP specific gravity was back-calculated using an assumed aggregate asphalt absorption.

**TABLE II - PHYSICAL PROPERTIES OF AGGREGATE**

Test Description and Designation	Composite Results		Mix Design Target
Micro-Deval (CP-L 4211) (%)	5.3		18 Max.
Fractured Face Count (Two Faces) (CP 45) (%)	100		90 Min.
Fine Aggregate Angularity (AASHTO T 304)	45.0		45.0 Min.
Flat And Elongated Particles (5:1) (ASTM D 4791) (%)	None		10 Max.
Sand Equivalent (AASHTO T 176 / CP 37) (%)	81		45 Min.
Clay Lumps & Friable Particles (AASHTO T 112) (%)	<1		--
Adherent Coating (ASTM D 5711) (%)	0.36		--
Magnesium Sulfate Soundness (5 cycles) (AASHTO T 104) (%)	Coarse: 4	Fine: 7	--

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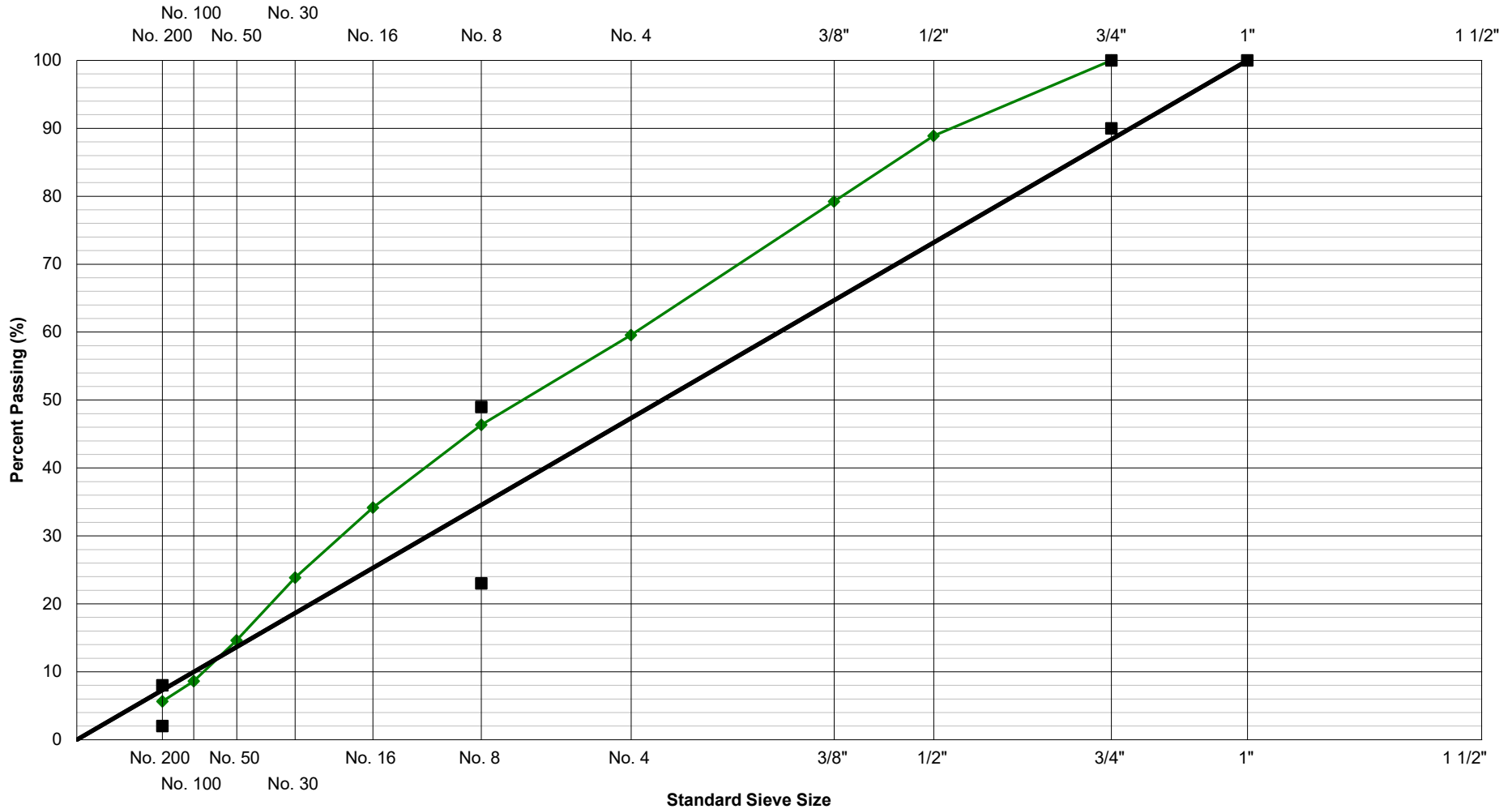
**EARTH ENGINEERING CONSULTANTS, LLC**

**ASPHALT MIX DESIGN**

Connell Resources, Inc. - Mix No. 20150

Superpave Mix Design: Grading S 75 (Jebro PG 64-22) with Lime

**FIGURE I: AGGREGATE GRADATION .45 POWER CURVE**



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**TABLE III: SHARP SUPERPAVE PROPERTIES**

Asphalt Content (%)		4.4	4.9	5.4	5.9
Maximum Specific Gravity		2.495	2.477	2.459	2.442
Maximum Unit Weight (pcf)		155.7	154.6	153.4	152.4
N <sub>ini</sub>	Bulk Specific Gravity	2.189	2.204	2.221	2.232
	Voids (%)	12.3	11.0	9.7	8.6
N <sub>des</sub>	Bulk Specific Gravity	2.357	2.378	2.397	2.412
	Unit Weight (pcf)	147.1	148.4	149.6	150.5
	Height (mm)	64.9	64.0	63.6	62.6
	Voids (%)	5.6	4.0	2.5	1.2
	VMA (%)	14.5	14.2	14.0	13.9
	VFA (%)	62	72	82	91
	Hveem Stability	30	30	31	30
Dust to Asphalt Ratio		1.2	1.0	0.9	0.9

**TABLE IV: PROPERTIES AT OPTIMUM ASPHALT CONTENT**

Test	Design Properties	Mix Design Target	
Asphalt Content <sup>1</sup> (%)	4.9	--	
Maximum Specific Gravity	2.477	--	
Maximum Unit Weight (pcf)	154.6	--	
N <sub>ini</sub>	Bulk Specific Gravity	2.204	
	Voids (%)	11.0	
N <sub>des</sub>	Bulk Specific Gravity	2.378	
	Unit Weight (pcf)	148.4	
	Height (mm)	64.0	
	Voids (%)	4.0	3.5 - 4.5
	VMA (%)	14.2	14.0 Min.
	VFA (%)	72	65 - 80
	Hveem Stability	30	28 Min.
Dust to Asphalt Ratio	1.0	0.6 - 1.2	
Mixing Temperature	325 °F	325 ±5 °F	
Compaction Temperature	300 °F	300 ±5 °F	

**TABLE V: RESISTANCE TO MOISTURE-INDUCED DAMAGE  
 AT OPTIMUM ASPHALT CONTENT (CP-L 5109)**

Tensile Strength Retention (%)	95	80 Min.
Dry Tensile Strength (psi)	110.7	30 Min.
Conditioned Tensile Strength (psi)	105.7	--
Average Specimen Saturation (%)	83	--
Average Specimen Voids (%)	7.0	6.0 - 8.0

<sup>1</sup>Asphalt Specific Gravity (Jebro Performance Grade PG 64-22) = 1.039

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**FIGURE II: ASPHALT PROPERTIES VS. ASPHALT CONTENT**

