

BuckleRisk

ZETA-TECH's **BuckleRisk** model implements a risk-based methodology for identification of potential track buckling sites using site-specific risk factors. Based on the magnitude of the generated risk values, the potential for a track buckle occurring at each site is determined. By dividing the railway into discrete buckling risk segments, high risk sites on the railway can be identified for inspection and corrective action.

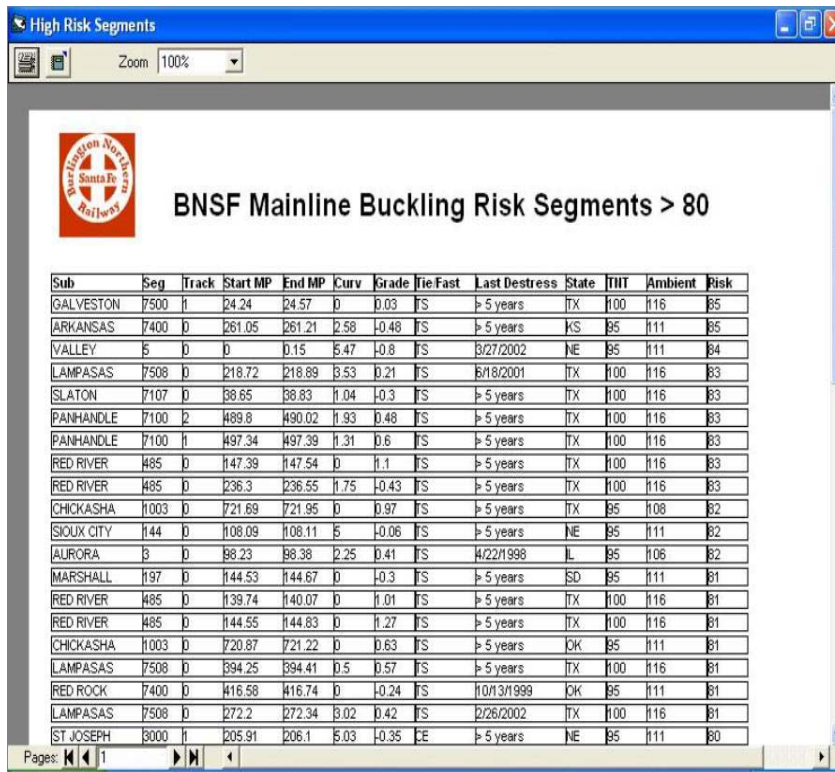
The **BuckleRisk** model utilizes a risk factor based approach, which is applied on a segment-by-segment basis to specific track locations. These segments are defined based on "homogenous" track and traffic characteristics and as such can be as short as a tenth of a mile or an individual curve. For each such segment, a "base" risk factor is established based on the site's temperature range and the rail's force free or neutral temperature.

Additional risk factors are then developed for the segment based on track, traffic, and related data, which is readily available in railroad databases. These risk factors are then be added to (or subtracted from) the base risk factor to calculate a total risk value for each track segment or site being analyzed. The resulting calculated risk factor is compared against pre-defined risk thresholds for follow up action. The overall result is an easy to

implement methodology for identifying potential buckling risk sites on the railway.

The **BuckleRisk** model utilizes track, traffic, and environmental data from several sources within various railroad and external databases. The general data requirements include location information, temperature data (such as US NOAA data), installation or target installation temperatures, track

data such as rail size and type, tie type and spacing, fastener type, ballast type, curvature and grades, speeds and speed changes, tonnage, bridge locations and type, turnout and signal locations, gang and track work records, Track Geometry Data, previous thermal incident records, rail adjustment reports, etc.



Sub	Seg	Track	Start MP	End MP	Curv	Grade	Tie/Fast	Last Distress	State	TINT	Ambient	Risk
GALVESTON	7500	1	24.24	24.57	0	0.03	FS	> 5 years	TX	1100	1116	B5
ARKANSAS	7400	0	261.05	261.21	2.58	-0.48	FS	> 5 years	KS	95	111	B5
VALLEY	5	0	0	0.15	5.47	-0.8	FS	3/27/2002	NE	95	111	B4
LAMPASAS	7508	0	218.72	218.89	3.53	0.21	FS	5/18/2001	TX	1100	1116	B3
SLATON	7107	0	38.65	38.83	1.04	-0.3	FS	> 5 years	TX	1100	1116	B3
PANHANDLE	7100	2	489.8	490.02	1.93	0.48	FS	> 5 years	TX	1100	1116	B3
PANHANDLE	7100	1	497.34	497.39	1.31	0.6	FS	> 5 years	TX	1100	1116	B3
RED RIVER	485	0	147.39	147.54	0	1.1	FS	> 5 years	TX	1100	1116	B3
RED RIVER	485	0	236.3	236.55	1.75	-0.43	FS	> 5 years	TX	1100	1116	B3
CHICKASHA	11003	0	721.69	721.95	0	0.97	FS	> 5 years	TX	95	108	B2
SIoux CITY	144	0	108.09	108.11	5	-0.06	FS	> 5 years	NE	95	111	B2
AURORA	3	0	98.23	98.38	2.25	0.41	FS	4/22/1998	IL	95	106	B2
MARSHALL	197	0	144.53	144.67	0	-0.3	FS	> 5 years	SD	95	111	B1
RED RIVER	485	0	1139.74	1140.07	0	1.01	FS	> 5 years	TX	1100	1116	B1
RED RIVER	485	0	1144.55	1144.83	0	1.27	FS	> 5 years	TX	1100	1116	B1
CHICKASHA	11003	0	720.87	721.22	0	0.63	FS	> 5 years	OK	95	111	B1
LAMPASAS	7508	0	394.25	394.41	0.5	0.57	FS	> 5 years	TX	1100	1116	B1
RED ROCK	7400	0	416.58	416.74	0	-0.24	FS	10/31/1999	OK	95	111	B1
LAMPASAS	7508	0	272.2	272.34	0.02	0.42	FS	2/26/2002	TX	1100	1116	B1
ST JOSEPH	3000	1	205.91	206.1	5.03	-0.35	CE	> 5 years	NE	95	111	B0

Application on US Class 1 railroad has shown **BuckleRisk** able to successfully identify sites with high potential for track buckling, as verified by inspection by local railway forces or by actual buckling incidents. **BuckleRisk** has been shown to generate a manageable number of high risk segments and as such does not place an excessive maintenance burden on local forces. Field applications have determined that reasonable correlation exists between the calculated high buckling risk values and actual experience or field observation.