Big Bend Tunnel Rehabilitation
Talcott, WV

CSX Transportation (CSXT) utilizes the historic 6,565-foot-long Big Bend railroad tunnel for mainline traffic on the Alleghany Subdivision. The tunnel was constructed in 1932 in Talcott, West Virginia. Traffic consists of heavy-tonnage coal and other freight. Soil and drainage issues combined with increased rail traffic, heavier trainloads, and concrete slab wear and tear have required maintenance over the years. In 2013, CSXT embarked on a full scale rehabilitation effort to reduce future maintenance and the potential of line outages.

Problem
The bedrock under the rail ballast underwent many years of dynamic cyclical loads from the passing heavily loaded rail traffic. This coupled with drainage problems resulted in a softening and erosion of the bedrock under the invert slab in specific sections of the track, as well as around the tunnel liner in one of those sections.

Design Solution
The Owner’s Consulting Engineer, AMEC Environment and Infrastructure, Inc., developed a compaction grouting solution to fill voids below the tunnel invert slab and improve the loosened subgrade. The compaction grouting was completed in 17 specific sections along 1,200 feet of the tunnel. Because of the minimal overburden, limited volumes of compaction grout could be injected in each hole. This necessitated a very tight spacing for the compaction grout locations. In many sections, this spacing was as tight as 2 feet on center. In one 200-foot long section, which had suffered the greatest bedrock degradation, backfill grouting of the voids behind the tunnel liner was necessary. In order to support the tunnel liner during these temporary fluid loads, rock bolts were installed prior to the grouting. Following the backfill grouting, the tunnel liner was permanently tied into the rock mass with rock dowels. Additionally, several fractures within the liner were located and these were structurally repaired with an epoxy grout.
Construction
Because this was an active rail line, the work took place predominately at night for minimal disruption to traffic. Depending on the Owner’s traffic demands, train schedules and grout crew schedules were sequenced and scheduled on a weekly, daily, and sometimes hourly basis.

Following each shift, all equipment and materials required removal from site. This required all drilling, grouting, and support equipment to be assembled on separate rail-mounted carts and conveyed in and out of the tunnels with Hy-rail trucks. These carts were purpose built in-house to effectively accommodate the proper staging of the crew, equipment, materials, and supplies.

The drilling was a unique cased-hole overburden system developed specifically for the highly variable conditions. The drilling for grout pipe placement extended a maximum of 10 feet below ground surface through open graded cobble sized ballast rock; a concrete invert slab; voids; and very soft, highly saturated silt-like decomposed rock and bedrock. The grouting operation required a small diameter casing, necessitating careful drilling procedures to ensure damage to the casing did not occur through the highly variable formations.

Given the nature of this work, the logistics were such that there was one way in and out of the tunnel. It was not possible for one crew to pass another in the single-track tunnel. Therefore, the sequencing of the drilling and grouting crews required planning in advance to ensure constant work. Contingency plans were required because on many instances the variable ground conditions would dictate a change in the schedule.

Conclusion
This project had intense demands from nearly all fronts: technical, schedule, resources (equipment and crew), and management. Hayward Baker’s experience and depth allowed the project to be completed safely, on time and meeting the Engineers technical requirements.