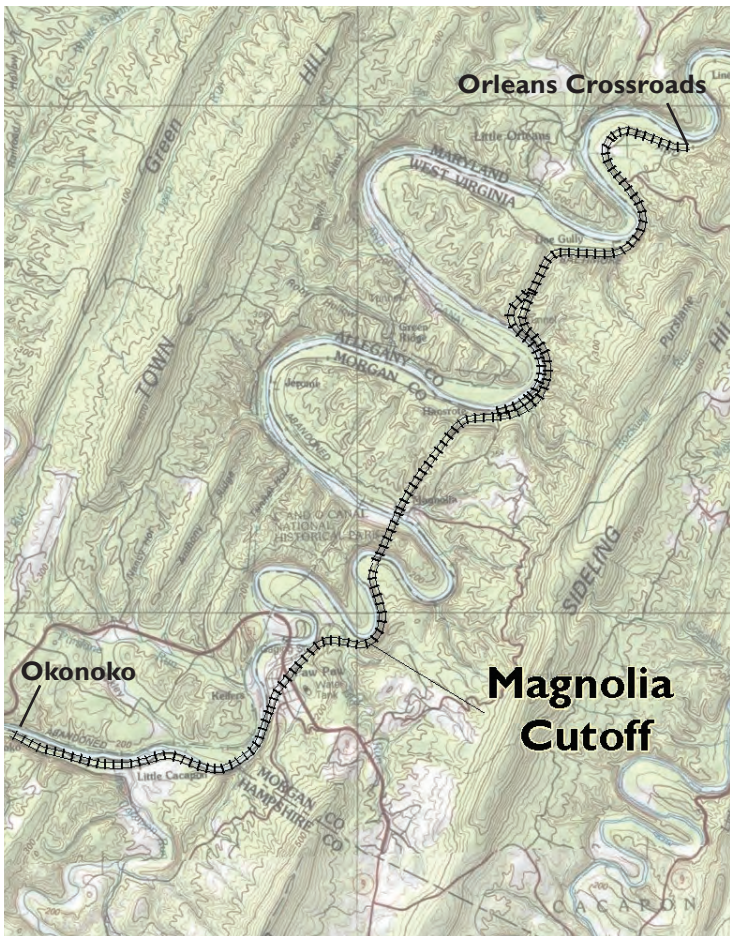
She'll Be Comin' 'Round the Mountain

The Baltimore & Ohio Railroad's Magnolia Cutoff, A Feat *of* Engineering Excellence




On December 6, 1914, the Baltimore & Ohio Railroad (B&O) officially opened its Magnolia Cutoff line through Morgan and Hampshire counties, said to be the most extensive railroad improvement program ever undertaken and arguably remains so to date. The line was designed to reduce, or "cutoff," distance on the existing B&O route by eliminating the winding path along the Potomac River. Constructed between 1913 and 1914 through unnamed ridges of the Allegheny Mountains, the 12-mile cutoff lessened grades and facilitated the laying of two tracks across peninsulas in the Paw Paw Bends of the Potomac River, reducing the length of the route by nearly six miles. Construction of the line also provided freight traffic with its own separate route and alleviated congestion on the main line, thereby also enabling increased levels of passenger traffic. The Magnolia Cutoff required the construction of four tunnels, a long cut at Doe Gully, two bridges over the Potomac River, and a concrete retaining wall necessary to hold the mountainside back where space was limited along the river. This meticulous planning and engineering feat cost an exceptional $500,000 per mile to construct and was completed in just 21 months. The successful execution of the design and cost effectiveness of construction was a testament to the planning and abilities of engineers under whose direction the cutoff was constructed. Remarkably, the B&O saw a return on investment in less than a decade as the Magnolia Cutoff ended up saving the railroad over $500,000 a year in operating costs. The cutoff, still in operation today, represents the epitome of railroad engineering and planning excellence of the early twentieth century.



The Magnolia Cutoff (as shown above) extended southwest from Orleans Crossroads in Morgan County to Okonoko in Hampshire County, passing through Allegany County, Maryland, along the way.

West Virginia's Natural Resources and the Railroads

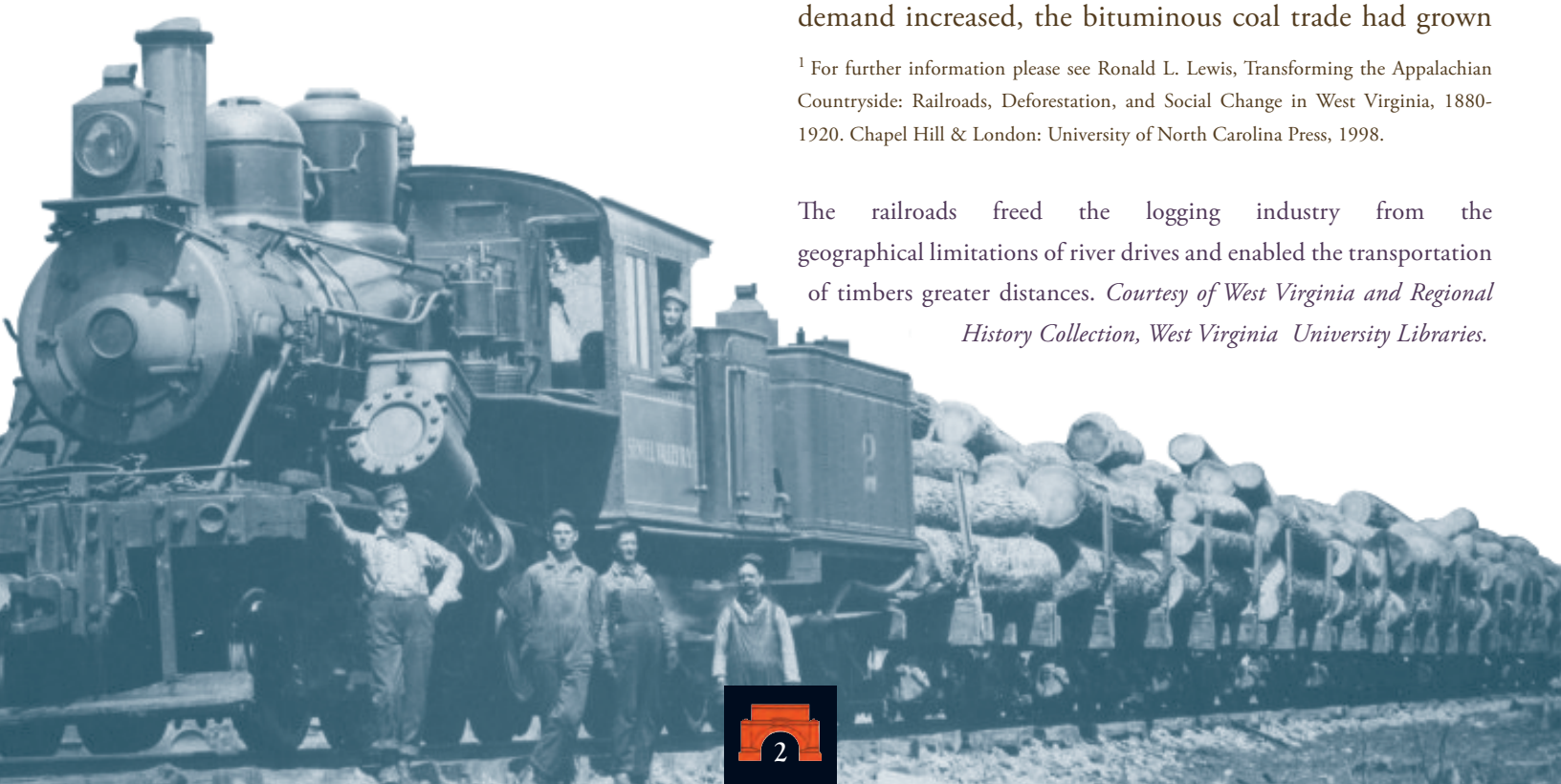
At the time of settlement, the area that would become West Virginia was blanketed with rich forests that offered an extraordinary variety of timber of various size and eventual commercial value. The Allegheny Mountains and upland section, through which the Magnolia Cutoff would travel, was populated with northern hardwoods, such as sugar maples, yellow birch, basswood, and red spruce, on the higher elevations; hemlock on its northern exposures; and white pine and central hardwoods on the lower elevations. Initially, these forests were timbered by farmers for local consumption and to clear land for farmsteads and fields. By the early 19th century, regional and national settlement drove the demand for lumber and expansion of the lumber industry. Without access to a connected transportation network, however, early loggers cleared forests and floated their timbers downstream to lumber mills, resulting in little more than small clearings of timber.

Until the coming of railroads to the mountains of West Virginia, logs harvested by local timber crews were moved to lumber mills via waterways. *Courtesy of West Virginia and Regional History Collection, West Virginia University Libraries.*

Deforestation of any magnitude required technology, heavy equipment, and the connected transportation network that was created by railroads. By the 1850s, the B&O completed its trunk line through northern West Virginia (still part of Virginia at this time), followed in the 1870s by the Chesapeake & Ohio Railroad (C&O) in southern West Virginia. More than 600 logging railroads and small independent railroads sprouted from the main lines, linking the swaths of timber to the processing mills and eventually onward to the national markets in Chicago and New York. The railroads along with advanced capitalist development of the 1880s unlocked West Virginia's rich storehouse of natural resources that had previously been largely untouched to distant investors. [1]

The railroads also fueled the growth of bituminous coal mining in West Virginia. Early on most of the coal extracted out of West Virginia mines was for local and regional consumption. Like the lumber industry, only mines located along navigable rivers were able to supply coal for far away markets as waterways provided the only means for distant transport. The coming of the railroads to the coal fields in the mid-19th century fueled the growth of the commercial coal industry. By 1883, the major rail lines were completed throughout West Virginia, and coal production totaled nearly three million tons a year. Less than two decades later, as the railroad network improved and demand increased, the bituminous coal trade had grown

[1] For further information please see Ronald L. Lewis, Transforming the Appalachian Countryside: Railroads, Deforestation, and Social Change in West Virginia, 1880-1920. Chapel Hill & London: University of North Carolina Press, 1998.



The railroads freed the logging industry from the geographical limitations of river drives and enabled the transportation of timbers greater distances. *Courtesy of West Virginia and Regional History Collection, West Virginia University Libraries.*

The railroads facilitated the transport of coal to distant markets and directly contributed to the exponential growth of the coal mining industry in the late 1800s. *Courtesy of West Virginia and Regional History Collection, West Virginia University Libraries.*

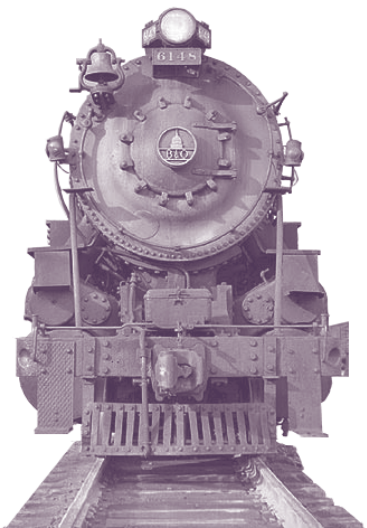
to over 30 million tons a year. Specifically, at the time of the construction of the Magnolia Cutoff in 1913, the B&O cataloged approximately 72 million tons of freight for the year, of which 47.5 million tons were "products of mines." The next highest transport classification was "manufactures," which totaled 12.1 million tons, whereas "products of forests" were cataloged at three million tons.[2]

The development of the railroads coupled with the growth of extraction industries represented a major increase in the state's economic development and profoundly altered life for most West Virginians. Financial power along with political power became concentrated in those towns easily accessed by the railroad. The burgeoning businesses and associated professional services required electricity and telephone service, previously unknown in the regions through which the railroads traversed. In addition, the coming of railroads spawned small towns along the lines where previously only scattered farmsteads had existed. Mass-produced products from distant markets, such as New York and Philadelphia, were made conveniently accessible via the railroad, thereby lessening the need for self sufficiency.

[2] For further information, please see A.W. Thompson, "Magnolia Cut-off Improvement on the Baltimore and Ohio Railroad," Proceedings of the Engineers Society of Western Pennsylvania 1914.

[3] For exact details on the construction equipment used in the Magnolia Cutoff construction, see A.W. Thompson, 1914, 929-932.

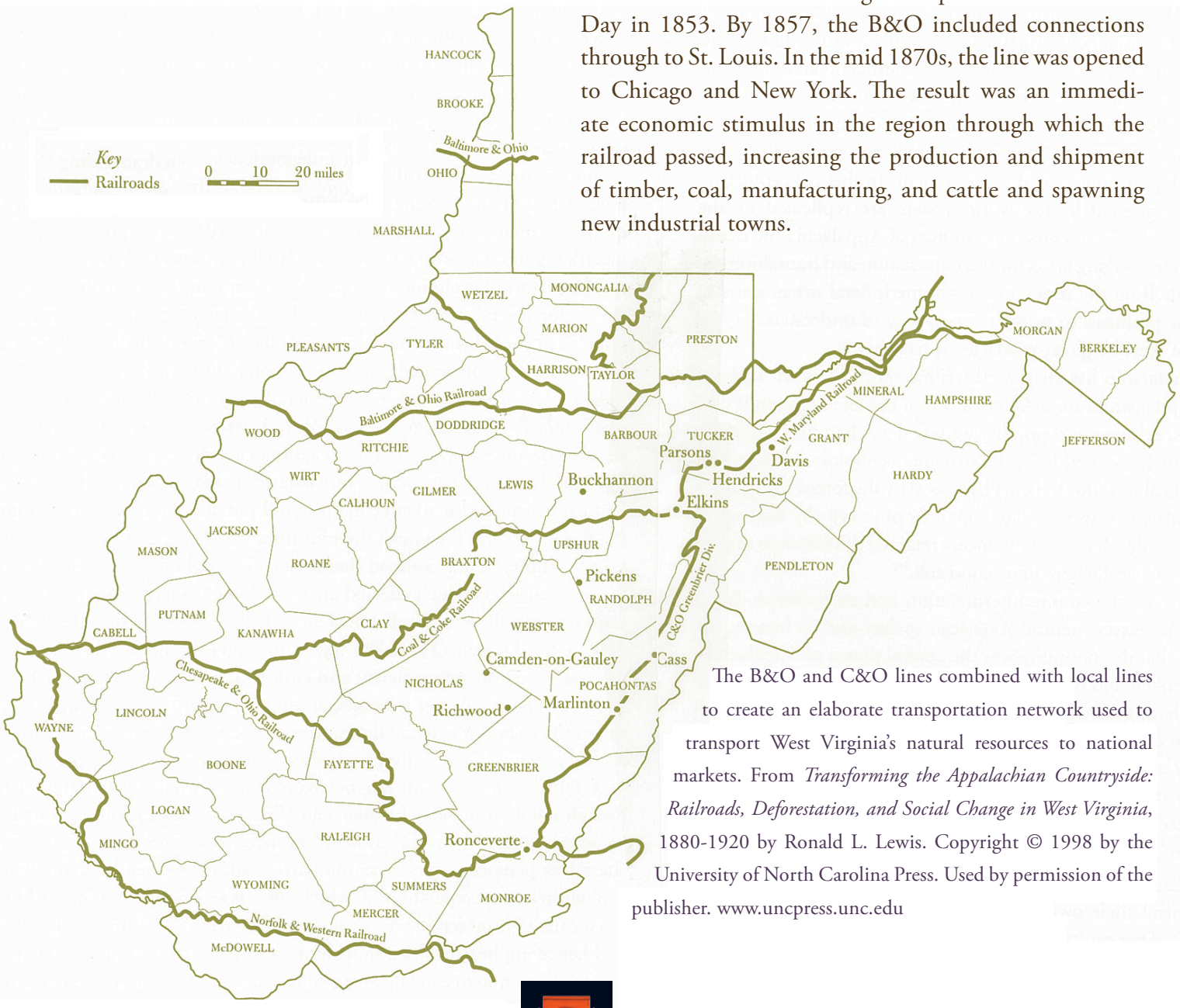
While many welcomed railroad development and the exploitation of natural resources as a means for economic prosperity, some resisted railroad construction. Many farmers opposed expansion of the rail system, including the small logging lines, due to fear of economic loss from the destruction of their livestock and property by the locomotives, which often sparked fires along their paths. They also worried that the railroads would depress the price of livestock and feed in the local markets by bringing in cheaper products from outside markets. Others feared the railroads and timber operations would lure their sons away, thus leaving the family farm to fall into neglect and disrepair. Yet, railroads provided a link to bring the nation together after the Civil War and served as the engine of modernization for not only West Virginia but the entire nation well into the 20th century.[3]



The B&O Through West Virginia

The B&O was incorporated in 1827, predating the state formation of West Virginia by 36 years. The railroad was chartered by Baltimore businessmen who feared the diversion of trans-Allegheny trade resulting from completion of the National Turnpike (1818) and the Erie Canal (1825).Therefore, shortly after incorporation, the B&O undertook a truly massive investment in industrial expansion through northern West Virginia that included overcoming major engineering and political roadblocks. The line entered West Virginia at Harpers Ferry in December 1834, and crossed back into Maryland at Cumberland in November 1842. In 1852, the line to Grafton and Wheeling was completed via the Allegheny Mountains with grades of up to 2.2 percent. The B&O became the first common carrier railroad in the nation and the first to offer scheduled freight and passenger service.

Completion of the railroad facilitated the transport of natural resources from the Allegheny region to major cities, where they were processed into final products and/or distributed to the masses. The first trip of the B&O from Baltimore to Wheeling took place on New Year's Day in 1853. By 1857, the B&O included connections through to St. Louis. In the mid 1870s, the line was opened to Chicago and New York. The result was an immediate economic stimulus in the region through which the railroad passed, increasing the production and shipment of timber, coal, manufacturing, and cattle and spawning new industrial towns.



The B&O and C&O lines combined with local lines to create an elaborate transportation network used to transport West Virginia's natural resources to national markets. From *Transforming the Appalachian Countryside: Railroads, Deforestation, and Social Change in West Virginia*, 1880-1920 by Ronald L. Lewis. Copyright © 1998 by the University of North Carolina Press. Used by permission of the publisher. www.uncpress.unc.edu

The B&O and other railroads throughout the nation assisted in combining separate local economies into a single national marketplace.

The Magnolia Cutoff

Following construction of the B&O's Metropolitan Branch in the 1870s, the portion of the original line between Baltimore and Point of Rocks, Maryland, became known as the Old Main Line. The section west of Weverton, Maryland to Cumberland, Maryland was known as the East End of the Cumberland Division. The terrain through which the East End passed presented engineering and financial challenges to the B&O, including the winding Potomac River path laid astride steep mountainsides between Doe Gully and Paw Paw. The eastbound track between Orleans Road and Okonoko (Little Cacapon) was especially problematic as it included two single-track tunnels (Paw Paw and Doe Gully) and the steepest grade remaining between Martinsburg and Cumberland at Hansrote. Here, at Hansrote, the steep grade necessitated a helper grade on which additional locomotives were stationed solely to assist trains up the incline.

By 1900, the need for improved facilities east of Cumberland were apparent as the increase of bituminous coal shipped from the coal fields of Maryland, West Virginia, and Pennsylvania, coupled with the movement of passenger and fast freight, taxed the facilities along the East End. A corporate plan to eliminate congestion was afoot by 1900. Between 1910 and 1913, the amount of tonnage traveling over the line increased by 25%, justifying the necessary economical expenditure to carry out improvements to the East End Subdivision.

In 1911, the B&O purchased the peninsulas of the Paw Paw Bends, including one in Maryland, in order to shorten the route through the area. The route was named the Magnolia Cutoff after one of the small West Virginia towns that it passed through. The new line would serve freight traffic, while passenger traffic would continue to travel along the more picturesque route of the main line.

Railroad engineers considered four possible lines for the new Magnolia Cutoff, keeping in mind the cost of initial construction as well as annual operating expenses:[4]

Lines	Cost of New Construction	Annual Operating Cost
1. Temporary third track along the present line retaining the eastbound helper grade.	$2,235,000	$615,087
2. Additional tracks, providing four tracks along present and retaining the helper grade.	$3,375,000	$615,087
3. Four track low grade cutoff abandoning the present line.	$15,575,000	$258,724
4. Two track eastbound low grade cutoff, using present line for westbound movement.	$6,000,000	$284,580

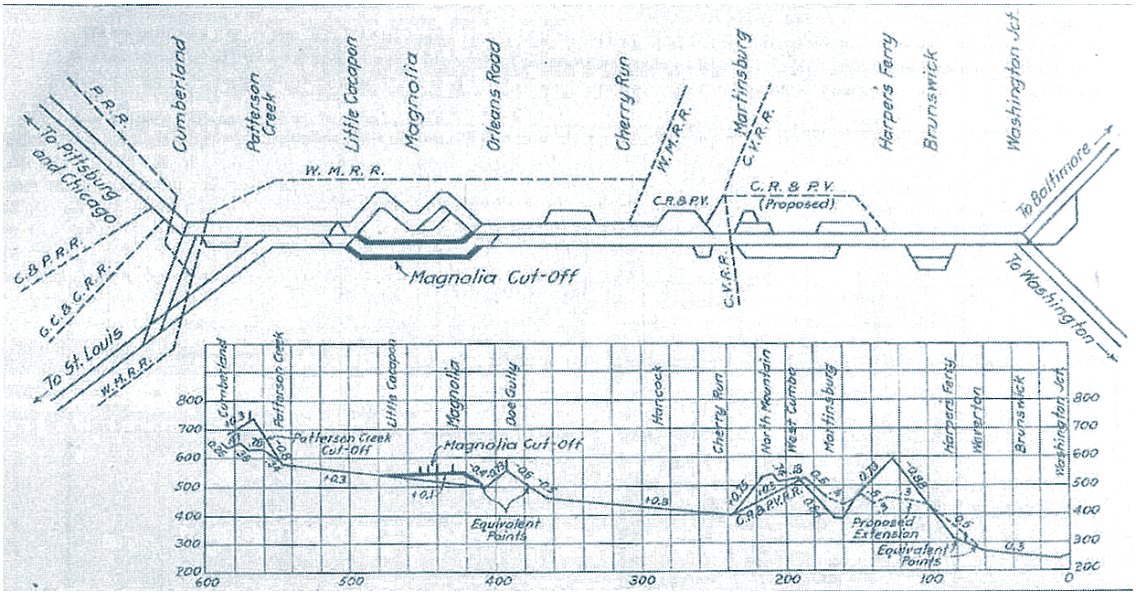
[4] Chart from A.W. Thompson, 1914, 892.

In addition to cost, there were two prominent considerations: 1) the need to maintain westbound traffic during the course of construction and 2) the requirement that the new line would have sufficient height to cross above the existing main line tracks at Magnolia and again at Walnut Grove Cemetery. The recommended line No. 4 was adopted by the B&O's President and Board of Directors, who authorized construction on March 13, 1913, at a staggering estimated cost of $6,000,000. The two new tracks would be used for eastbound traffic, while the existing double-track line would be used for westbound traffic, thus creating a four-track line between Orleans Road and Little Cacapon.

While the line chosen for the new Magnolia Cutoff was neither the cheapest nor the easiest to construct, it was the most effective long-term solution to alleviate congestion. Even though it was riskier when compared to the other options, and more costly than two of the options, the long-term payout was considered to be worth the cost and effort. As B&O Engineer A.W. Thompson noted in his 1914 address to the Engineers' Society of Western Pennsylvania, the Magnolia Cutoff "was absolutely needed… and was more essential to the development of the Baltimore & Ohio as a system than for the advantages to be gained from economies in operation."

In order to construct the line, the B&O had to overcome geographic constraints. The topography through which the cutoff would travel consisted of ridges running in a northeasterly and southwesterly direction. These constraints were compounded by the Potomac River, which cut across the ridges, creating a narrow gorge-like valley. In addition, the route was to parallel portions of the old right-of-way, with the two lines separated by only a few feet in several locations.

Construction of the new Magnolia Cutoff commenced after March 1913. The cutoff involved the drilling of four double-track tunnels (Randolph, Stuart, Graham [in Maryland], and Carothers, from northeast to southwest), extensive earth removal at Doe Gulley Tunnel to accommodate two additional tracks, and the erection of two bridges over the Potomac River on either side of Graham Tunnel. In addition, at a point near Paw Paw Ridge, just west of Graham Tunnel where there was not sufficient room for both lines, the new tracks were elevated above the old line and separated by a massive concrete wall, earning the routes the respective designations of High Line [Magnolia Cutoff] and Low Line [existing main line].[5]



The east end of the cutoff began at the station at Orleans Cross Roads in Morgan County and extended over 12 miles to the west to Little Cacapon in Hampshire County. This diagram shows the steep grades the cutoff was designed to overcome.

[5] For more general information on the construction of the Magnolia Cutoff, please see Jeffrey R. Hollis and Charles S. Roberts, *East End: Harpers Ferry to Cumberland, 1842-1992.* Baltimore: Barnard, Roberts, & Co., Inc., 1993.

Just west of Graham Tunnel, the new tracks of the Magnolia Cut-off, separated by a massive concrete wall, were elevated above the old line. This separation earned the routes their respective designations of High Line and Low Line. *Courtesy of B&O Railroad Historical Society.*

The work on the Magnolia Cutoff was divided among seven different contractors under the direction of Francis Lee Stuart, Chief Engineer and head of the B&O's Engineering Department. The extensive construction effort required 22 shovels, 57 locomotives, 550 dump cars, six concrete plants, 126 drills, and two power plants at the town of Magnolia and Doe Gully. Two sawmills as well as a forging and blacksmith shop also located at Magnolia provided assistance in the cutoff's construction.[5]

The total work force for the Magnolia Cutoff numbered close to 2,500 men. Work camps for the cutoff were established in the towns of Doe Gully, Hansrote, Magnolia, Kesslers, and Paw Paw. Particular attention was paid to sanitation and supplying high-quality drinking water at the camps. Electric lights and modern fixtures were also provided in the camps and at the work sites wherever possible with the goals of increasing efficiency and providing services to the laborers.

The meticulous planning for the cutoff also included careful safety measures for the railroad construction laborers that contributed to a remarkably low accident rate during the course of the project's construction. *Courtesy of B&O Railroad Historical Society.*

[5] For exact details on the construction equipment used in the Magnolia Cutoff construction, see A.W. Thompson, "Magnolia Cut-off Improvement on the Baltimore and Ohio Railroad," 1914, 929-932.

Although large portions of the cutoff were constructed adjacent to the existing line, remarkably the Low Line remained in operation entirely throughout the Magnolia Cutoff's 21-month construction period. Various safety measures were employed during the course of construction since a large portion of the work occurred directly beside the active tracks of the Low Line. Footpaths were constructed adjacent to the existing tracks in order to prevent laborers from walking on the active tracks. All employees had to read and sign special instructions regarding safety and work practices, which were enforced by both uniformed and plain-clothes railroad security staff who performed daily patrols. As the construction of the line required extensive earth removal and fill, the soil strata figured closely into how the excavation work was planned and carried out. The sidehill cuts were benched in order to prevent landslides and to reduce the amount of falling stone that served as a barrier to the continuing operations along the existing line.

Footpaths were built along the existing tracks in order to deter workers from walking directly on the active line. Note the footpath above, to the right of the tracks, at the west end of the Doe Gully cut. *Courtesy of B&O Railroad Historical Society.*

Refuge niches were placed approximately 100 feet apart in the walls of each tunnel to provide cover for workers in the tunnel.

With the goal of increasing freight traffic along the line, the existing double-track Doe Gully Tunnel was replaced with a four-track open cut. To maintain operations through the tunnel, the trackside portion of the cut was excavated by steam shovels to within a short distance of the top of the tunnel, while the new grade was excavated alongside. Tracks were laid on the new grade, and traffic was diverted while a small steam shovel was used to excavate the remaining soil covering the tunnel

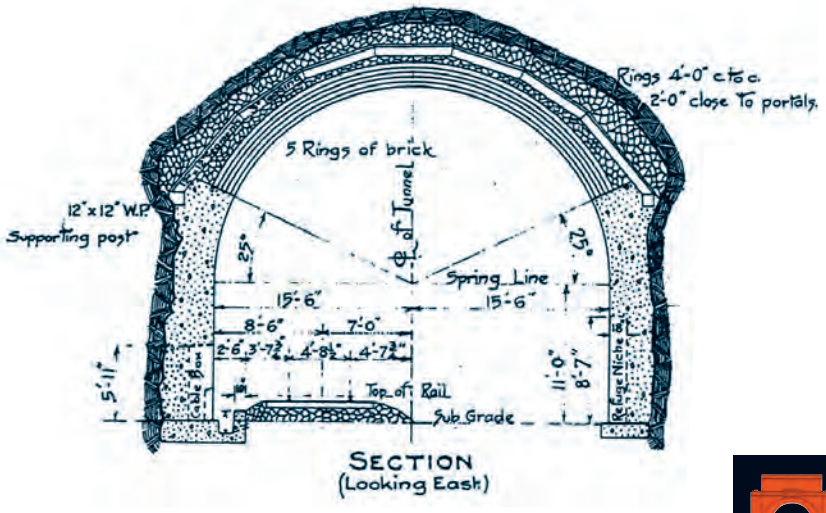
Steam shovels like this were used to open up and excavate the new tunnels associated with the Magnolia Cutoff. *Courtesy of B&O Railroad Historical Society.*

Construction of the four new tunnels necessary to complete the Magnolia Cutoff was begun by creating an opening approximately 16-feet wide at a height of nine feet using drills driven by compressed air and dynamite. The passageway was then dug out using a mechanical shovel. Graham Tunnel was the only one of the four tunnels to be driven through a solid rock core; the remaining tunnels were driven through loose rock. Timber cribbing supported the excavation until a permanent concrete lining was added. Refuse was removed from the site via dump cars. As soon as the tunneling was complete, a concrete and brick tunnel lining measuring not less than two feet in depth was added. The concrete mixture of the lining was one-part cement, three-parts sand, and five-parts stone and utilized broken stone as an aggregate.

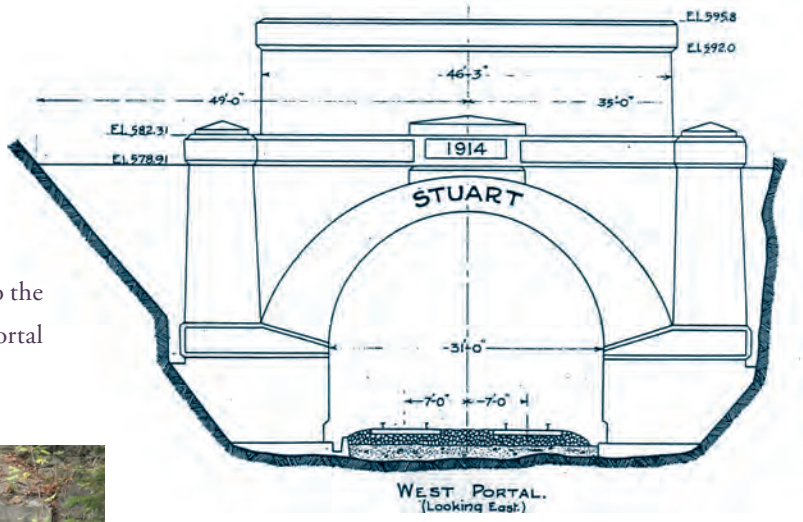
Each of the four tunnels—Randolph, Graham, Stuart, and Carothers—was named after a B&O engineer. The names of the tunnels and dates of completion were incised above the openings in the concrete portal faces. The designs of the portals were not peculiar to the Magnolia Cutoff but were typical of other B&O tunnels erected in the early 20th century. The Magnolia Cutoff, however, was the largest of B&O's contemporary improvement campaigns meant to increase the level and speed of rail traffic along its lines.

Stuart Tunnel was aptly named after the project's Chief Engineer, as the tunnel was the longest of the four, the

Since the B&O engineers had learned that exhaust gases from steam locomotives caused rapid deterioration of concrete, vitrified shale bricks were used to line the top of the tunnels, as shown in this section of Carothers Tunnel. *Courtesy of CSX Archives.*



Tunnel interior showing brick lining.



The construction of Stuart Tunnel necessitated the addition of steel to the timber cribbing as well as a concrete retaining wall above the west portal in order to reinforce the unstable terrain *Courtesy of CSX Archives.*

The name and completion date were incised into the portals of the tunnel.

most challenging to construct, and the last to be completed. Originally designed to be 3,355-feet long, when the approach cuts collapsed during construction, the tunnel length was shortened to 3,350 feet. The east approach cut was not completed prior to the tunnel construction, so the tunnel was drilled from the west portal. Stuart was the only one of the four tunnels to use steel in addition to timber cribbing, since the slate, shale, and sandstone strata encountered during drilling proved to be highly unstable. Steel forms supported by I beams were used to strengthen the arch, and the concrete liner was placed directly over the steel. Since the materials above the tunnel proved highly unstable, the construction of a retaining wall above the west portal also proved necessary in order to reinforce the terrain.

In addition to the tunnels, there were a number of other notable engineering feats along the cutoff. The framing of the bridges over the Potomac River on either side of Graham Tunnel required nearly 3,000 tons of steel that were placed from the banks of the river using a crane. The only other bridge to be erected as part of the cutoff project was a steel bridge that carried the line over Paw Paw Cut, near the town. A huge fill at Rockwell Run, which included heavy hillside cutting, was also necessary in the construction of the cutoff. The cutoff also employed a very deep cut near Paw Paw as well as a massive river wall between Paw Paw and Okonoko to achieve more room for two more tracks.

As well as being one of the largest improvement projects ever undertaken by the B&O, the Magnolia Cutoff was deemed by the engineering community and the railroad company to be a significant feat for both its construction schedule and its cost. The cutoff was in use by December 6, 1914, less than 21 months after approval of the project and almost three weeks ahead of schedule. The cutoff shortened the distance between Orleans Road and Paw Paw by 5.8 miles; eliminated 887 degrees of curvature; and resulted in a line of practically no grade particularly at Hansrote, West Virginia, where the old line

Graham was the only tunnel along the cutoff to be constructed adjacent to a bridge. The tunnel and the two adjacent bridges are the only portion of the cutoff to pass through Maryland.

had required the use of helper locomotives. On top of the impressive engineering and planning, all of this construction was done without any significant interruption to operations on the Low Line, where traffic was continuously operating.

The Magnolia Cutoff was built to relieve congestion and related operating savings were originally estimated at approximately $17,000 per month; however, with a few months the savings amounted to over $25,000 a month so that the project quickly paid for itself, saving the railroad over $500,000 a year in total costs. In addition, the ease of and speed of transport via the cutoff contributed to an increase in freight tonnage over the line, providing further economic compensation to the railroad.

The cutoff was also the last major improvement project of the B&O, as the railroad had overcome all of the significant natural obstacles along its lines by this time. The cutoff provided the B&O with four tracks through the highly trafficked area between Orleans Road and Little Cacapon. Eastbound freight traffic moved over the High Line, while the Low Line moved east- and westbound passenger traffic and westbound freight traffic. Passenger traffic was routed over the Low Line in part to avoid any accidents in the tunnel areas with freight trains running on parallel tracks. In addition, heavy eastbound freights were routed over the High Line to avoid the steeper grades along the Low Line. Thus, although it was assigned to carry the growing levels of freight, the cutoff also facilitated passenger traffic movement along the East End of the Cumberland Division.

Traffic along the B&O reached its peak in 1929, and dropped off significantly during the Great Depression. Between 1929 and 1932, total freight tonnage was cut in half and coal tonnage declined by 41%. Increased truck use and a declining need for coal and lumber resources contributed to this decline. Local passenger traffic also dwindled throughout the 1920s, reflecting a national trend of increased automobile use. During World War II, however, increased coal use along with the movement of merchandise, military supplies, and troops through Atlantic port cities breathed life back into the B&O for a short period. The return to peacetime traffic levels in the late 1940s concurrent with the ever-increasing use of the automobile coupled with highway construction ushered in another serious decline in railroad traffic system-wide. Changes in transport, storage, and handling of freight commodities in the next four decades resulted in diminished traditional rail movements and obsolete facilities. The B&O hit its all-time financial low point in 1961, and the C&O took control of the railroad shortly thereafter in 1963. The Magnolia Cutoff, or the High Line, continued to operate simultaneously with the Low Line, until the

latter was removed from operation in the early 1960s and the associated tracks were removed. Consequently, the Magnolia Cutoff was left as the only operating railroad through this area and continued to serve as the B&O's primary route through the West Virginia and Maryland mountain ranges.

The B&O, including the Magnolia Cutoff, was operated under the C&O's new corporate structure, the Chessie System, from 1972 until 1987. Both companies formally merged into CSX Transportation, Inc. in 1987, marking the official end of the B&O's corporate existence. In 2011, CSX Transportation, Inc., maintains ownership and operation of the railroad, including the Magnolia Cutoff. As a result of population growth and development, the United States is increasingly reliant on rail and highway infrastructure to transport people and freight. In 2011, freight traffic nationwide amounts to over 15 billion tons per year and is estimated to double by 2050. CSX Transportation, Inc., therefore, plans to double-stack intermodal containers in order to accommodate this ever-increasing demand upon the nation's railroad infrastructure. This improvement will enable the Magnolia Cutoff to continue to facilitate the transport of freight.

Courtesy of B&O Railroad Historical Society.

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For Further Information/Reading

A.W. Thompson, "Magnolia Cut-off Improvement on the Baltimore and Ohio Railroad." Proceedings of the Engineers' Society of Western Pennsylvania. Volume 30, February 1914-January 1915. Engineers' Society of Western Pennsylvania, Pittsburgh, Pennsylvania.

Jeffrey R. Hollis and Charles S. Roberts, *East End: Harpers Ferry to Cumberland, 1842-1992*. Baltimore: Barnard, Roberts, & Co., Inc., 1993.

Ronald L. Lewis, *Transforming the Appalachian Countryside: Railroads, Deforestation, and Social Change in West Virginia, 1880-1920.* Chapel Hill & London: University of North Carolina Press, 1998.