Washington State
Department of Transportation

Royal Slope Railroad Inspection and Assessment
October 2009

Cover Photos:

Top Left: Example of broken joint rail joint taken at Mile Post 2000.5
Top Right: Rock slide covers the tracks at Mile Post 1999.55
Center: Taunton Power House and Royal Slope Railroad viewed from State Route 26
Lower Left: View of Bridge Over Lower Crab Creek
Lower Right: View of rail line at dusk, taken at Mile Post 1991.4

Summary of Findings

The four day inspection of the 26-mile long Royal Slope Railroad between Othello and Royal Slope revealed a rail line that is in need of basic maintenance, updating of the at-grade crossing signage, some rail repairs, a relatively small number of new ties, a washout repair and the clearing of a number of rock and mud slides. The line could be put back into safe, light volume operation with between $1.2 million in 2010 dollars and $1.3 million in 2012 dollars of capital funding.

In order to host sustained, moderately heavy rail car volumes, the line would need significantly more capital investment. In addition to bringing the line to a safe operating state, it would require the installation of at least 7,500 ties, the placement of over 30,000 tons of ballast tamped and regulated into place, and servicing of most of the rail joints. This additional work is estimated to cost between $7.7 million in 2010 dollars and $8.0 million in 2012 dollars.

Figure 1 - View of rail line as it passes Red Rock Lake, southeast of Royal City

Taken together, a capital investment of between $9.2 million and $9.3 million in 2012 dollars would bring the line to a state of safe and sustainable condition that could host three or more trains per week.

Introduction

Industrial property owned by the Port of Royal Slope as well as privately owned industrial property sit at the end of the state-owned rail line generally referred to as the Royal Slope Railroad. The rail line is the only rail route that serves this area, however the line is currently not in operation. The port has indicated that a number of potential industrial and commercial businesses have chosen not to locate in this area due to the lack of rail service and that some current businesses would use rail service if it were available.

The line, which was operated by the Chicago, Milwaukee, St. Paul and Pacific Railroad (aka Milwaukee Road) until 1980 and has not been actively operated since 1998, has fallen into disrepair. A number of rock slides have been reported to be blocking the line. Even with no rail traffic, timber ties can degrade over time and expansion and contraction of the rail can damage the rail joints.

The port secured a federal Strategic Infrastructure Project Program grant of $9,077 from Grant County to fund an inspection of the line to determine the capital costs to bring the line back into service. The Washington State DOT agreed to provide an experienced inspector and materials for the task of inspecting the line, creating a capital estimate and provide this report.

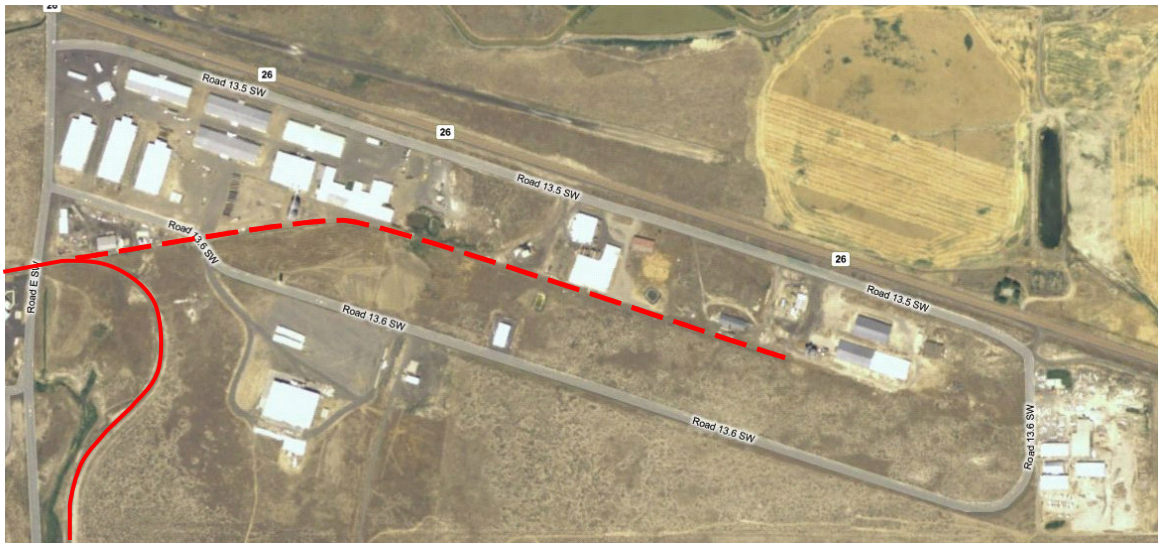

Figure 2 – Aerial view of the Port of Royal Slope and non-port properties at the end of the rail line with the rail line traced with solid red line and the port owned spur traced with dashed red line

History and Geography

The Chicago, Milwaukee, and St. Paul Railroad, later renamed Chicago, Milwaukee St. Paul and Pacific and marketed as the "Milwaukee Road", built their Pacific Extension to Seattle and Tacoma between 1906 and 1909. The eastern 20.5 miles of the Royal Slope Railroad from Othello to Royal City Jct. is part of the Pacific Extension. This line from Othello to Seattle was electrified in 1920. The power house at Taunton was built for that purpose. The electrification was removed in favor of diesel-electric locomotives in 1972.

Station / Location Name	Approx. Mile (Marker) Post
Othello - Property Line with CBRW	1989.06 +/- 0.01
Anson	1993
Taunton	1997
Corfu	2002.5
Royal City Jct.	2009.53/0.0
Royal City – End of Track	5.1

Figure 3 – Location Names & Approximate Mile Posts

Figure 4 – Typical track construction methods used by Milwaukee Road in 1906-1909; taken near Malden, Whitman County, Washington

From the time it was built until 1980, this section of the line was operated as main line. Traffic was controlled by track warrants issued at various stations along the line which directed train meets and other train movements. Originally, sidings were located at Anson, Taunton, Corfu, and Royal Slope Jct. At these sidings, a spur track was also built; however, there is no evidence of industries along the line.

Between 1966 and 1967, the Milwaukee Road built the Royal Slope Branch from the main line at the newly created Royal City Jct. north to Royal City to serve Royal City and the Port of Royal Slope. This branch makes up the western 5.4 miles of the Royal Slope Railroad. This branch line is the only rail connection for the industrial area southeast of Royal City. The branch line extends to the west of the industrial area, allowing a train to then back into the industrial area to serve customers in the port.

Figure 5 – Electric locomotive or motor typically used on the line before 1972

After the Milwaukee Road ceased operations in 1980, the main line from Othello to Warden was purchased by the Burlington Northern Railroad. That segment of line is now owned and operated by the Class III (aka short line) Columbia Basin Railroad. The 20.5 miles of main line from Othello to Royal City Jct. and the Royal Slope Branch were purchased by the Port of Royal Slope in 1983. These lines were subsequently operated under the name Royal Slope Railroad. In 1993 the Washington State Department of Transportation (WSDOT) purchased the line to keep it from being abandoned. The port continued to operate the line under lease from WSDOT between 1993 and 1998. No trains have operated over the line since 1998.

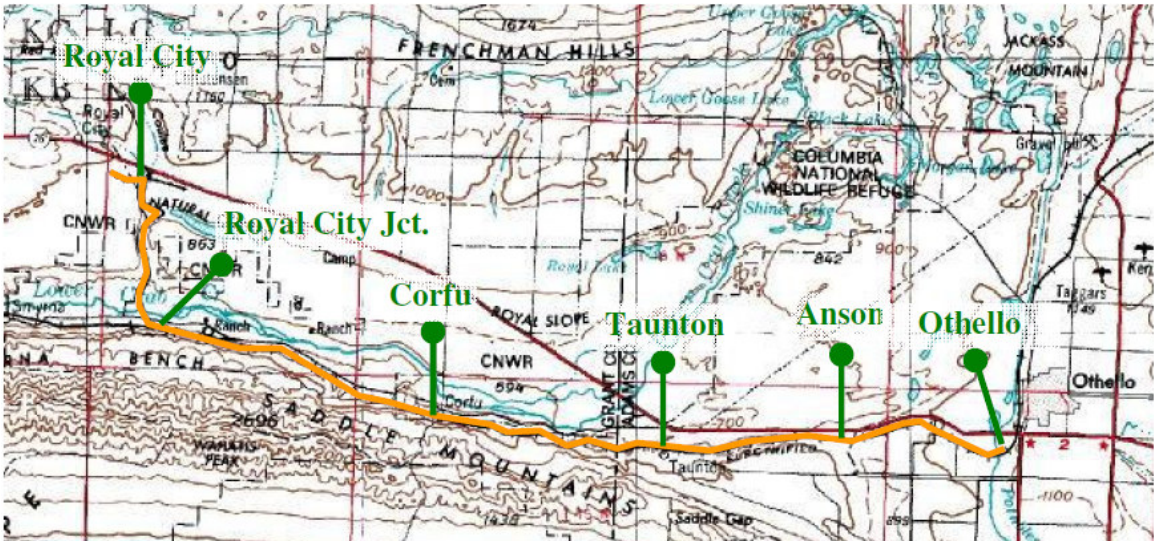

Figure 6 – Map of Royal Slope Railroad with rail line traced in orange

From Othello (Mile Post (MP) 1989) to Anson (MP 1993), the line travels through relatively flat farm land. As the line continues west, the ground slopes away to the northwest. The line is built along the north slope of the Saddle Mountains, necessitating the line to be built on large cut and fill sections as the line descends 400 feet vertically between Anson and Royal City Jct. (MP 2009.5). Some of the cut and fill sections are over 300 feet in height, with many of the cuts being nearly vertical into basalt bed rock. The fill sections have steep sides and are relatively narrow at the top. The grades average a gentle 0.4% with short segments as steep as 1.2% between Othello and Anson.

From Royal City Jct. to Royal City the line turns north and crosses the valley of Lower Crab Creek and then climbs up Red Rock Coulee. The climb is on a 2.5% grade and extensive basalt rock cuts and a tall fill. As the line reaches Red Rock Lake, the fill section is about 130 feet high. As the line reaches the industrial area southeast of Royal City, it becomes nearly flat.

The horizontal curves between Othello and Royal City Jct. are relatively gentle with most being 3 degrees or less per 100 feet with only a one mile segment that has tighter curves between 4 degrees and 7 degrees per 100 feet. Between Royal City Jct. and Royal City the branch line is laid out with much tighter curves. Typically the branch line has curves

between 3 degrees and 8 degrees per 100 feet with several tighter curves between 9 degrees and 12 degrees per 100 feet.

The Othello-Royal Slope area is naturally arid, but irrigation has lead to the development of many agricultural fields on both sides of the line. The line has two bridges. One is near Othello over the Potholes East Canal built in the 1930's or 1940's after the main line was constructed. The other is on the branch line near Royal City Jct. over Lower Crab Creek. There are also over 80 smaller drainage structures throughout the line, mostly concrete or galvanized steel pipes.

Inspection Procedure

Given the length of the Royal Slope Railroad, the reported slides blocking the tracks, and that the line is not currently in operation, the inspector used a medium-sized all-terrain vehicle (ATV) to travel along the line between inspection points. Where the ATV could not safety move around obstacles and where it was more time efficient, the inspector walked between inspection points.

The inspection points were intended to be at approximately 1/10th mile intervals. As the inspection began and measurements were taken, the "mile posts" on the line were discovered to vary as much as 300 feet from the true one mile interval from the previous mile post. Further, the use of an ATV to move from location to location did not allow for precise distances to be measured. Thus the inspector used the rail lengths, typically 39 feet each, which could vary from section to section, to estimate a 1/10th mile distance. The interval distances were "reset" when a "mile post" was encountered that could be verified as such. This insured that the distance between "mile posts" was divided into 10 intervals, but those intervals vary in distance.

The mile post labels on the Royal City Branch section are somewhat confusing. Originally, the beginning mile post for the Royal Slope Branch was at main line mile post (MP) 2009.52, the approximate rail miles from Chicago. The mile posts on the branch line were then labeled in ascending order starting from that point (MP 0.0) to Royal City (5.1). At some point after the main line west of Royal City Jct. was removed from service, the branch line mile posts were renumbered. Old MP 1.0 became new MP 2010.0 and so on. This resulted in the distance between MP 2009 and new MP 2010 being about 1.5 miles. For this inspection, the historic mile post labels for the branch line are used, ensuring that 15 track inspection intervals would be laid out and to help correlate the inspection information with the 1976 Milwaukee Road track charts.

Except where the mile post was labeled with a number, once an inspection interval was estimated and the track inspection location was determined, the inspector marked the location using permanent paint on the top of a ties or rail head with a decimal point and number equal to the interval distance from the last mile post (i.e. ".4" is about 0.4 miles from the previous mile post location). Thus most of the inspection locations should remain visible for at least a year into the future.

At each track inspection location, the size and condition of the rail, as well as the condition of the joints and joint bolts, were noted. The ties were then visually and audibly examined and the number of acceptable ties over a 39 feet length was noted. The number of acceptable ties within 24" of each joint was also noted. The gauge (the distance between rails) and the track alignment were not examined, but large deviations in the alignment were noted. At the four turnouts (aka switches) on the line, the frog, points and joints were visually examined, but the wear on the frog, the flangeway depth and guard rail gauges were not measured or noted.

One of the typical visual cues of track condition is evidence of movement between the rail and tie plates, tie plates and ties, and evidence of spikes pulling out of the ties. As the line has not been in service in about ten years, these visual cues were not available, making the inspection more challenging.

The inspection of the line was primarily designed to assess the track and adjacent ditch conditions, but the two bridges on the line were also briefly examined where a ladder or other special equipment was not required for access. Other inspection locations included 23 at-grade crossings, where obstructions, such as slides or trees, blocked the tracks, where a washout undermined the track, or where the track condition would be unsafe for any rail traffic.

Existing Conditions

The existing conditions will be detailed by element. The elements will be compared to the federal class of track requirements as well as the appropriate state safety and accepted industry standards.

Rail

All the rail on the line is jointed rail of a standard, inverted "T" section. The rail is secured to the ties using typical rail spikes and seated on tie plates. There are also rail anchors mounted to the rail base to minimize migration of the rail longitudinally. No gauge bars between the left and right rails were observed.

The rail size on the track between mile post (MP) 1989.06 (Othello) and MP 1997.02 (Taunton) is 112 lbs. per yard (#/yd.), with the exception of 2 sections of 115#/ yd. rail on the right side at MP 1990.10 where a past derailment may have occurred. The sections measured were generally 39 feet in length and each rail section had 3 joint bolt holes at either end. Few defects in the rail were observed, with only eight inspection locations where the rail head near the joint had been repaired or the gauge side of the head was chipped.

Figure 7 – Typical damaged rail head

The rail size on the track is generally 100 #/yd. between MP 1997.02 (Taunton) and MP 2007.96 (1.5 miles east of Royal City Jct.). The exception is near MP 2000 (2.5 miles east of Corfu) where 5 sections of 115#/yd. rail was used where a past derailment is known to have occurred. The 100 #/yd. sections measured were generally 39 feet in length and each had 2 joint bolt holes at either end. The 115#/yd. rail sections had 3 joint holes at either end. The 100#/yd. rail had many defects and repairs. At MP 1997.08 (Taunton) two sections of both rails have been bent laterally, likely by vandals. There were 11 inspection locations where the rail head near the joint was chipped or cracked. There were 45 inspection locations where the rail head had been repaired at the joint. The rail sections covered by gravel or dirt at grade crossings at MP 2004.66, 2006.31 and 2006.67 could not be inspected and may be damaged. At MP 2004.66, there are two sections of damaged rail lying to the side.

The rail size on the 1.5 miles of track between MP 2007.96 and 2009.52 (Royal City Jct.) is 112#/yd. The sections measured were 39 feet in length and each had 3 joint bolt holes at each end. No defects in the rail were observed.

The rail size on the track between MP 2009.52/0.0 (Royal City Jct.) and MP 5.16 (Royal City/End of Track) is 100#/yd, with the exception of a 1.03 mile segment between MP 2.87 and 3.90 where 131#/yd. rail is in place. The rail sections measured were between 35feet and 36 feet in length. The 100#/yd. rail sections had 2 joint bolt holes at each end; the 131#/yd. sections had 3 joint bolt holes at each end. There were 2 locations in the 131#/yd segment where the rail head had been repaired at the joint. No other defects in the rail were observed, however the rail sections at MP 0.12, where the Lower Crab Creek roadway gravel covers the 100#/yd. rail, could not be observed and as the rails do not appear to be guarded from lateral roadway loads, it is likely that the rail is damaged.

The rail in the siding at Taunton is 75#/yd. from the east switch through Danielson Road to about MP 1997.0; between about MP 1997.0 to the west switch, the rail is 85#/yd. The rail is worn and appears to have been re-laid from another location. Given the lack of timber rail protection at the Danielson Road crossing, it is likely the rail in the gravel portion of the crossing is damaged.

At Royal City Jct., the spur track that is the old Royal City Jct. main line siding is comprised of 34 sections (17 on each rail) of 100#/ yd. re-laid rail. Each section is about 36 feet long. No defects in the rail or joints were noted.

Switches

The line has only four track switches (aka turnouts). These were not measured for frog angle size and the 1970's era track charts did not record this data either. A right-of-way map drawn for the 1967-1968 branch line construction noted a proposed #10 turnout, which these appear to match.

Figure 8 – Left-hand diverging switch at Royal City Jct.

The east switch to Taunton Siding is built as a left-hand diverging switch with 112#/yd. rail and with the diverging route leading to the siding. The west switch to Taunton Siding is built as a right-hand diverging switch with 100#/yd. rail and with the diverging route leading to the siding. The switch at Royal City Jct. is built as a left-hand diverging switch with 100#/yd. rail and with the diverging route leading to the former main line siding which

now ends about 660 feet to the west. The switch at Royal City is built as a right-hand diverging switch with 100#/yd. rail. The switch is laid out such that the main route is on the diverging leg leading back toward Royal City Jct. The switch leads to the Port of Royal Slope spur line east of Road "E" SE.

No defects were observed in the points or frogs other than the points could not be moved in any of the four switches. The only bad switch ties were noted at Royal City Jct., where four scattered ties were bad.

Joints

The joints that connect the rails together are made of a bar on each side the rail, and up to three bolts through both bars and each rail (up to six bolts total). The gap and alignment of the two rails at the joint will also be assessed in the section of the report. For any rail line, the rail joints are an area of concern as this is the most likely location of a failure and severe derailment.

Figure 9 – Compound Joint; 100#/yd (left) and 131#/yd (right)

The bars are sized based on the size of the rail. Though this can vary by location, on this line the number of bolts used at each joint is also dependent on the rail size, with the joints between the 100#/yd rail sections having four bolts in total and the joints between 112, 115, or 131#/yd rail sections having six bolts total. The compound joints (joints where the rail size changes; see Figure 9), have four bolts when 100#/yd rail is being joined and six bolts if 112# of heavier rail is the smallest rail size being joined.

In the areas where a four bolt joint is used, there are at least 27 locations where the joint bolts have failed and the rail has appeared to have separated, creating a gap at the rail head of between ¾ inches to 6 inches. This is likely from the combination of repetitive heating and cooling and action of gravity moving the "down-hill" rail segments, much like an

Figure 10 – Joint Bolts and Gap Requiring Repairs

inchworm. Many of these locations were previously marked with paint on the bar and rail, but several others have not. To meet even the federal definition of "Excepted" track condition, at least one functioning joint bar must be secured by at least one functioning bolt through each rail.

In a few other four-bolt joint locations the gap is tight, suggesting that the rail is in compression in these locations and that at least some of the bolts may be cracked.

At about 60 locations (about 0.8% of the joints inspected) the bolts are loose, rattling in the hole. Most, but not all, of the loose joint bolts were in six-bolt joints. This method of detection is somewhat dependent on rail temperature and excess tension or compression in the rail joint.

No broken joint bars were observed, but at one location, a corner of a joint bar is chipped. This is not a defect. No cracks near the bolt holes in rails and bars were observed. No rail mismatches at the joint greater than 1/8th of an inch at the gauge faces or the tread faces were observed.

The vegetation throughout the Taunton siding prevented a thorough inspection of the joints, but given the small rail size, it is likely that between 10% and 30% of the joints have either broken bars or bolts.

Ties

The line has treated timber ties throughout. The line generally has between 22 and 23 ties per 39 feet rail section which equates to the ties being on 21 inch centers, or, stated another way, about 3000 ties to the mile, typical for track with treated timber ties.

Typically, treated timber ties decay from the inside out, as the treatment penetrates only an inch or two beyond the surface. The typical inspection technique used to determine the tie condition is to sound the ties with a hammer or boot heal, and to visually inspected their condition; however, as the line has been dormant, a ties ability to hold the spikes is difficult to judge. Further, the ties could sound solid from above, but have deteriorated from below, rather than from the center out. Thus, while the technique of sounding the ties was used, it may not result in detecting all the defective ties.

Figure 11 – Tie exposed showing deterioration from below

On average the line has over 6 "good" ties per 39 feet section, which would meet the FRA Class of track requirements for Class 1. Five serviceable or "good" ties per 39 feet section are required for straight track or track on a broader than 2 degrees per 100 feet curve. Six good ties per 39 feet section are required for track on curves tighter than 2 degrees per 100 feet A "good" tie is one that adequately holds the fastener, in this case the spike, and can support the weight of train traffic, thus be able to hold the rail in gauge and in alignment.

However, there are several locations where the five or six "good" ties requirement is not met. Further, the good ties requirement is a minimum and it is not considered economical to operate a line in such marginal conditions for a long period of time.

In addition to the FRA Class of track requirements for "good" ties per 39 feet section, there is a requirement for good ties at each rail joint. For Class 1 and Class 2, the requirement is for 1 good tie within 24 inches. The inspector noted 111 inspection locations where this requirement was not met. Prorating this over the line, this would suggest that there are likely over 1500 joint locations where this requirement is not met.

The vegetation throughout the Taunton siding prevented a thorough inspection of the ties, but it is likely that the number of good ties in the 39 feet is likely between 3 and 5 and the good ties within 24 inches of any joint averages less than 1.

Ballast

The purpose of the ballast is to support the ties and resist lateral forces from moving the track out of horizontal alignment. The optimal main line ballast is from crushed, angular, durable stone that is graded such that 90% of the stones are ¾ inch or larger, thus not "evenly" graded. In addition, ballast should be tamped tightly around each tie. The ballast depth should be regulated such that it reaches to within 1 inch of the top of the ties, but not cover top of the ties. Taken together, these practices support the ties and resist lateral forces, but also allow water to drain away from the timber ties, prolonging their life.

Figure 12 – Typical poor "pit run" ballast between Othello and Royal City Jct.

The ballast on the line between Othello and Royal City Jct. is only fair, and is comprised of "pit run" material with very few angular stones and is evenly graded with a high

amount of fine sand or silt. This is evident from the amount of vegetation growing within the ballast area. There are also several locations where ballast has been placed and not tamped and regulated. In many other locations between Othello and Royal City Jct., particularly where the line is on a fill section, the ballast is not deep enough to come to within 1 inch of the top of the ties, leaving the ties without adequate lateral support. In a few locations, the ballast is fouled from mud or silt from storm or irrigation run off.

The ballast on the line between Royal City Jct. and Royal City varies between adequate and poor, and is comprised of 1/2" or smaller crushed stone, likely intended for use in yards. The ballast is properly tamped and regulated. In this segment there are several locations where that ballast is fouled with silt. Over the entire line, there is about 0.8 miles of fouled ballast.

Vegetation Control

Vegetation should be controlled to allow train crews to see the track ahead for obstacles and for a track inspector to view the condition of the line. Vegetation should also be kept clear so as not to damage train equipment, harm train crews or cause a derailment. Dry vegetation is a fire hazard that could lead to damage of the rail and ties. Finally, the decaying vegetation holds in moisture on the timber ties, promoting decay of the ties.

Figure 13 – Trees obstructing track at Royal City

The vegetation control on the line between Othello and Royal City Jct. is considered poor. The sage brush grows both between and just outside the rails in most places. In some locations the sage brush is too thick to walk through without stepping off the tracks. At two locations west of Taunton, where water is being impounded in ditches next to the tracks, trees with limbs as large as 2 inches in diameter extend over the line, making the line impassible except by foot.

Between Royal City Jct. and Royal City, there are several locations where the sage brush grows both between and just outside the rails in most places. At locations between MP 1.28 and MP 1.72, where the where water is being impounded in ditches next to the tracks, trees with limbs as large as 2 inches in diameter extend over the line, making the line impassible. At Royal City, west of Road "E" SE, the line is in a natural drainage way and the wet areas adjacent to the ballast section have resulted in trees as large as 4 inches at the base to grow within the ballast section, making this end of the line impassible.

Ditches

Ditches allow storm water to flow way from the ballast section, keeping the subgrade from becoming saturated and failing and keeping the fine material in the subgrade from "pumping" up into the ballast section and fouling the ballast with fines.

Over 14 miles of the 26-mile line has at least one ditch which is silted in and overgrown with sage brush. Fortunately, the arid climate makes many of the ditches unused except during extreme rainfall, as is typical during a thunderstorm, or in sudden snow melts. At about MP 1995.7 east of Taunton, however, irrigation runoff from above the line on the south side has resulted in water being present most of the year and the silted ditch causes water to flow through and over the ballast. At three other locations between Corfu and Royal City Jct. (MP 2007.33, 2008.4 and MP 2009.4) storm or irrigation water has caused silt and small rocks to fill the southern ditch and cover the rail. At MP 2007.33, this resulted in the culvert being filled and the ballast and subgrade being undermined.

Rock Slides

As the line is built on cut slopes, the line has had a number of slides historically, most notably at MP 2000 east of Corfu where the line was realigned around the slide area. Since operations on the line ceased over ten years ago, rocks in the form of slides and in some cases large boulders have fallen and now either obscure clearances or completely cover the line. These locations are between Taunton and Royal City Jct.

Figure 14 – One of the large rocks slides near MP 1999.55

East of Taunton between MP 1999.4 and MP 1999.7 has two major rock slides along with two smaller slides. In total, over 170 cubic yards of rock debris will need to be removed to make the line passable.

East of Corfu between MP 2001.7 and MP 2001.8 the slide fence has failed and up to 10 cubic yards of rock has covered the ties and filed the area between the rails. The rock debris closest to the track would need to be removed to make the line passable.

West of Royal City Jct. between MP 2006.75 and MP 2007.65, the line is on a ledge with a near vertical cut on the south side. Rock slides with smaller rock as well as some boulders have fallen from the cut slope. The slides and boulders will need to be removed to make the line passable. The volume of this rock debris is estimated to be over 60 cubic yards.

Bridges and Drainage Structures

The line has two medium-sized bridges. One is near Othello over the Potholes East Canal built in the 1930's or 1940's after the main line was constructed. The other is on the branch line near Royal City Jct. over Lower Crab Creek.

Bridge Number EE-226½ is over the East Potholes Canal at MP 1989.34 near Othello. This bridge is 120 feet long with three 38 feet long steel beam spans on four concrete piers. Each span has four 36¼-inch deep by17-inch wide steel I-shaped rolled beams on sliding bearings. It has a ballasted timber deck and a walkway without railing on south side of the bridge.

Bridge Number EE-244½ is over Lower Crab Creek at MP 0.47 near Royal City Jct. This bridge is 218 feet long with 14 feet to 15.5 feet long treated timber beam spans on 15 treated timber trestle bents. Each span has two groups of three 17-inch deep by 10-inch wide treated timber stringers. The stringers are supported by 14-inch by 14-inch (nominal) treated timber caps that are subsequently supported by 14-inch diameter treated timber piles.

There are over 80 smaller drainage structures, mostly concrete or galvanized pipes throughout the line. Generally, the culverts on the line were not inspected with one exception.

Figure 15 – Washout and plugged culvert EE-1233 at MP 2007.33

The exception is the culvert at MP 2007.33. This is identified as Bridge Number EE-1233, a 30 inch diameter, 32 foot long, corrugated metal pipe in the January 1976 track charts. This culvert is only a few feet below the ties and is located on a ledge with near vertical slopes above and below the line. As discussed in the Ditches section of this report, storm or irrigation water carried mud and rock debris down a narrow gap in the rock slope which plugged the culvert, filled the ditch and coving the tracks. The water continued over the tracks which washed away the subgrade and undermined the track. It is estimated that over 100 yards of fill material could be required to repair the undermined area.

Highway-Rail At Grade Crossings

At locations where public roadways and the rail line cross, The Washington Utilities and Transportation Commission (WUTC) enforces specific state safety regulations that must be met. Further, at public and private crossings, the roadway surfaces and the track through the crossing must be maintained. The line has 23 locations where roadways or trails cross the tracks. None of the crossings are listed in the Federal Railroad Administration data base of highway-rail crossings. Five crossings are confirmed to be public crossings by the presence of older at least one cross-buck sign at each crossing, but mapping suggests that another four crossings could be for unnamed county roads. The remaining crossings are most likely private crossings. The table that follows lists the nine confirmed or likely public crossings.

Roadway	RR MP	Warning Devises	Surface Type	Roadway Owner
Thacker Road	1991.08	2 Cross Bucks	Asphalt	Adams County
Anson Road	1993.02	1 Cross Buck	Timber	Adams County
Danielson Road	1997.68	1 Cross Buck	Asphalt/Gravel	Adams County
Unnamed	2001.35	None	Timber	Grant County
Unnamed (Corfu Rd or Road "B" SE)	2002.56	None	Timber	Grant County
Unnamed	2004.66	None	Gravel over timber	Grant County
Lower Crab Creek Road	0.11	1 Cross Buck	Gravel over rails	Grant County
Unnamed	1.56	None	Dirt	Grant County
Road "E" SE	4.64	1 Cross Buck	Asphalt	Grant County

Figure 16 – List of confirmed and suspected public at-grade crossings

The warning devices at these roads do not meet the current requirements for signage at a public at-grade crossing as laid out by the Manual for Uniform Traffic Control Devices (MUTCD). At least two cross buck-type signs which meet visibility/reflectivity specifications is required, as are yellow advance warning signs. In addition, a recent change to the MUTCD now requires that a standard yield or stop sign be mounted below each cross buck. Thacker Rd. just west of Othello is the closest to meeting the MUTCD standards, but does not meet the modern reflective/visibility requirements or the yield/stop sign requirement.

At private crossings, the signage is usually a standard stop sign and a "no trespassing" sign on either side the crossing. None of the suspected public crossings or the likely private crossings has any warning signs.

The crossing surfaces for each of the public and private crossings vary in type and condition. The three asphalt surfaces are adequate, with some cracking. The flangeways at these three crossings are packed full of sand and gravel. The nine exposed timber crossing surfaces are generally decayed and loose from the spikes into the ties, with spike heads sometimes exposed. At the five crossings where the surface is gravel or dirt but

use timber to protect the rail and flangeway, the timbers are in a similar condition as the all timber surfaced crossings, with the flangeways packed with sand and gravel. The remaining six crossings are either dirt or gravel surfaces that have been graded to completely cover the ties and rails. Two of the six appear to have been "pioneered" since operations ended, covering the rails with up to 6 inches of dirt.

The rail and tie condition at each crossing appeared adequate. However the ties are difficult to inspects are crossings due to their inaccessibility. At the six crossings where gravel or dirt covers the rail, the rail condition could not be inspected. It is likely the 100#/yd. rail in the crossing of Lower Crab Creek Road has been damaged by the loaded farm trucks and equipment used in the area.

Similarly, at the heavily curved Danielson Road where asphalt surface has been installed, shoulder gravel has been placed on the inside of curve to allow semi-trucks to easily negotiate the turn. While the rail did not appear damaged, the lack of rail protection in the gravel area could lead to damage.

Material on Hand

In addition to the rail, ties, other track material, and bridge structure material that is in place on the line, there is additional material not installed but stored on the line. At the unnamed grade crossing at MP 2004.66, there are about three segments of 100#/yd. rail laying just NE of the crossing.

At Royal City Jct. there is a switch frog and other switch-related track parts, several stacks of tie plates and three "kegs" of track spikes. The frog and other switch material were not closely inspected.

Figure 17 – Switch frog and other track material stored at Royal City Jct.

At Royal City beyond the official end of track at about MP 5.15, there is 1300 feet of track in place. The rail is 90#/yd. relay rail and the ties have little or no ballast. It appears that the track was not heavily used when the line was in operation. Some of the rail sections appear to have defects and to have been repaired with joint bars and bolts.

At Corfu just southwest of the unnamed at-grade crossing, there is what appears to be between nine and twelve bridge timbers. Measurements of these timbers were not taken.

While not closely inspected, these materials could be used to make repairs on the line or could be sold as scrap to fund repairs.

Recommended Actions

The current condition of the line would not allow safe or economical rail operations between Othello and Royal City. The condition assessment that follows will first outline the repairs required to allow for safe operations at relatively low traffic volumes of less than 2,500 rail cars per year. This will be followed by an outline of the repairs required to allow for economical rail operations at higher traffic volumes of over 2,500 rail cars per year.

The assumed threshold of 2500 cars is based upon the generalized financial break-even point of "Rule of 100", that is 100 cars per year per mile. In order to relate this to trains per week, 2500 cars per year would equal an average of about 50 cars per week. At 50 cars per week, one to three trains per week over the line could be expected, depending on a number of economic factors, including car hire costs, customer commitments, and the type and number of locomotives used. The assumed 2500 cars per year threshold is for discussion purposes and is not to be taken as an absolute or based on specific operational or maintenance requirements of the line. An assessment of the economic potential of rail operations over the line is outside the scope of this report.

Repairs for Safe Operations at Low Traffic Levels

In order to operate safely, the line's condition should at least meet the federal Condition Class 1 standards for track conditions. The following actions are required and are listed in order of the discussion in the Existing Conditions section of this report:

1. Replace up to 200 ft. of 100#/yd. rail at the Lower Crab Creek Road grade crossing likely damaged by road work and two sections of 100#/yd. rail near Taunton where the rails have been bent laterally by vandals.
2. Adjust the four switches to allow them to operate properly.
3. Close and repair the 27 joints where the rail has pulled apart and the bolts have broken (See following discussion).
4. Install approximately 2000 ties at locations throughout the line, including 1560 ties within 24 inches of rail joints.
5. Place, tamp and regulate approximately 220 tons of ¾ inch or larger crushed ballast around the newly placed ties.
6. Control vegetation by spraying or otherwise removing vegetation at least three feet from outside each rail.
7. Clear trees to at least eight and half feet from the centerline of tracks.
8. Clear the rock slides estimated to be about 240 cubic yards from the track between Taunton and Royal City Jct.
9. Repair the embankment and replace the function of the Culvert Structure EE-1233 at MP 2007.33 (See following discussion).
10. Install new cross buck signs with yield or stop signs below at each of the five to nine public at-grade crossings; also install warning signs at the 13 to 17 private crossings (See following discussion).
11. Clear the flangeways of nine at grade crossings, estimated to be a total of 328 linear foot of flangeway.

12. Clear the gravel from the tracks, replace as many as half the ties within the crossing areas and install a 100 ft long timber crossing surface at Lower Crab Creek Road and 16 ft. long timber or asphalt crossing surface at Danielson Road.
13. Clear the dirt from the two "pioneered" crossings at MP 2006.31 and MP 2006.67 and install at least timber rail protection.
14. If necessary for operations, repair Taunton Siding to FRA "Excepted" condition by inserting one new tie within 24 inches of each rail joint (Estimated to require 90 ties); At each rail joint, ensure at least 1 functioning joint bar and that each rail is connected to the functioning joint bar with at least 1 bolt (estimated to require the servicing of about 90 joints); clear vegetation for 1.16 miles.

There are two possible ways to repair the 27 pulled-apart joints in Item 3. One is to heat the rails for some distance on each side of the joint and mechanically pull the rails together and install the joint bars and bolts. The other is to simply cut 13 feet sections out of each rail and then insert a new section of rail and install two new joints, thus creating a segment with three – 26 feet rail sections. While the "heating/mechanical" repair is preferred from a long-term perspective, the "cut-out" repair is more expedient.

At least part of the work described in Item 8 has been arranged to be completed by port-directed volunteer labor and equipment. For estimating purposes the entire rock clearing volume is assumed to remain, as it is not yet completed and reviewed by the rail line owner, WSDOT.

All but one repair can be done from the tracks or roadways and are not technically complex. Item 9, the repair of Culvert Structure EE-1233, will required some engineering design to complete. The location on a ledge 80 feet above and about 250 feet south of Crab Creek Road will made it difficult to secure the toe of slope of the replacement subgrade or to secure some sort of pre-cast concrete blocks (i.e. ecology blocks) to support the subgrade. An alternate repair could be to construct a short, open deck, timber or steel bridge structure and to remove the subgrade from the area, avoiding future debris flows from overtopping the track.

As stated earlier, public at-grade crossings are regulated by the Washington Utilities and Transportation Commission (UTC). Though unlikely, it may be possible to get permission from the UTC to allow very limited movements over the public at-grade crossings without the installation of new cross bucks and other warning signs at the public crossings in a flagger where present when a train approaches. Regardless, modifications of public at grade crossings, including warning signs and surfaces, requires the proponent to petition the UTC to allow the change. Such a petition for each public crossing will need to be prepared and submitted and a site visit by WUTC staff, the rail operator, and the rail line owner or lessee will be required.

Repairs for Rail Operations at Higher Car Volumes

In order to allow for economical rail operations at a higher car volume, track conditions will need to be improved beyond the federal Condition Class 1 standards for track

conditions. The following actions are listed in the order required as traffic levels increase.

1. Service all existing joints, including replacing broken bars (none detected in this inspection), adjust tight and wide gaps between rail ends, replace all broken joint bolts and tighten all joint bolts.
2. Install catchment wall below the two major rock slide locations at MP 1999.55 using about 20 ecology blocks.
3. Install approximately 7,500 ties (about 300 ties per mile) at locations throughout the line, including ensuring two good ties within 24 inches of rail joints.
4. Replace or repair the rail sections that have chipped heads or other damaged rails, estimated to be about 30 locations (6% rail sections).
5. Replace timber or gravel crossing surfaces at all at-grade crossings with new timber planks or engineered, plastic composite railroad crossing panels (not rubber), replacing ties and any damaged rail at each of the 19 locations.
6. Place, tamp and regulate approximately 20,500 tons (about 1000 tons per mile) of ¾ inch crushed ballast in the 20.5 miles between Othello and Royal City Jct.
7. Place, tamp and regulate approximately 10,100 tons (about 200 tons per mile) of ¾ inch crushed ballast in the 5.5 miles between Royal City Jct. and the end of the track at Royal City
8. Rehabilitate Taunton Siding (1.16 miles long) by replacing an estimated 1,000 ft. of defective rail, installing about 600 new ties, placing 220 tons of ¾ inch ballast and servicing about 340 joints (all joints in the siding) (See following discussion)
9. Replace the 100#/yd. switches at the west end of Taunton siding and at Royal City with 115#/yd. or heavier switch rail, points and frogs and either remove the 100#/yd. switch at Royal City Jct. if the spur track is not being used, or replace it with 115#/yd. components as with the previously noted switches.
10. Inspect the 14-span treated timber trestle, Bridge Number EE-244½ at MP 0.47 near Royal City Jct., and treat any internal voids with the appropriate combination of fumigates and preservative compounds to reduce further decay.
11. Replace the asphalt crossing surfaces at Thacker Road, Danielson Road, and Road "E" SE with concrete surfaces; including reconstruction of the ballast, ties and rails through the crossings.

The rehabilitation of Taunton siding would be required to allow for the operator to sort cars for more than a few customers, if a customer where located on other than the Port of Royal Slope spur at Royal City, or if it is required for interchange with the Columbia Basin Railroad. To replace rail in a siding, it is common to use re-laid rail from the main track. Another source could be the 34 sections of 100# rail that might be available from the old Royal City Jct. siding, the spur referred to in Item 9.

Further, it may be necessary to rebuild some or all of the 1,300 feet of originally constructed track beyond the current end of track at MP 5.16 in Royal City to allow for the switching of longer strings of cars. The amount of rebuilt track needed will depend on the length of trains delivered to Royal City and the rail infrastructure inside the Port of Royal Slope property. With the only double ended siding on the line is at Taunton, it

may also be necessary to construct another double-ended siding at Royal City to allow a locomotive to switch cars into "trailing point" switches on the port property or elsewhere on the line.

Other Considerations

It should be noted that this work would be exempt under the State Environmental Protection Act and would be "categorically Excluded" under the Nation Environmental Protection Act, as long as there is not water present when repairing Culvert Structure EE-1233 at MP 2007.33. The only regulatory clearances would be to begin operations.

First, a new operator of the line would need permission to begin operations from the federal Surface Transportation Board (STB). Petitions to the Washington UTC, as previously discussed, would be required to modify the at-grade crossing. They would also likely inspect the crossings are the repairs are completed. Finally, the Federal Railroad Administration should be notified after the repair are completed to inspect the track condition.

While not required by regulations, it would be advisable to notify people living near the line and the public in general, that the line will be put back into operations. This will avoid complaints and to ensure people are more vigilant when crossing the line.

Estimating Procedure

The estimates are based on 2008 and 2009 bids on WSDOT advertised rail rehabilitation projects and, where appropriate, 2009 highway projects. Where more than one bid item was available, the mean or average of the unit costs was calculated and then a single standard deviation added to the mean to determine the unit cost to be used in this estimate. In the case of items that were bid as lump sum, the unit costs were determined based on an engineer's estimate of the components where costs were determined from research from non-WSDOT sources such as material-providers.

The total base cost is used to calculate the design, construction management, sales tax, and contingency. As no funding source for the work has been identified at this time, the costs have been inflated to 2010 and 2012 dollars to aid in determining a future budget.

As previously noted, the inspection of the tie condition has the potential to be in error due to the possibility of deterioration from below. Further, when the line is used for material and equipment movements during the repair work, other joint defects will either be revealed or will occur. These include broken joint bars and cracks in the rail flange at the joins. To account for these unknowns, the estimate for the repairs for safe operations includes a 40 percent contingency, which is higher than it would be other wise.

Estimate of Costs

Cost of Repairs for Safe Operations at Low Traffic Levels

Item No.	Work Item Discription	Quantity	Unit Cost	Unit Price	Item Total
Base Scope					
	Mobalization	1	LS	13,000	13,000
1	Install rail - remove damaged	260	LF	46.82	12,172
2	Track switch - Adjustment	4	EA	1,155	4,620
3	Joint Repair - Major (100# and 100#/115# Comp)	27	EA	542.62	14,651
4	New Ties - Installed - Main line	2000	EA	149.59	299,186
5	3/4 inch or larger crushed ballast - Place, tamp & regulate	220	TONS	47.37	10,421
6	Vegitation Control	26.3	MI	630.00	16,569
7	Tree Removal	1	LS	3,400	3,400
8	Clear Rock Debris	240	CY	75.00	18,000
9	Replace Culvert - MP 2007.33	1	LS	131,200	131,200
10	New Warning Signs - Installed, 2 signs per location	44	EA	110.00	4,840
11	Flangeways at road crossings - Clearing	328	LF	90.00	29,520
12	New Grade Crossings - Timber - Davidson, and Lower Crab Cr. Roads	116	TF	678.99	78,762
13.1	Gravel Debris Removal	32	TF	3.91	125
13.2	New Grade Crossing Surface - Timber	32	TF	678.99	21,728
	Subtotal				658,194
	Design/PE&E Preperation	8%	PCT	658,194	52,656
	Construction Management	10%	PCT	658,194	65,819
	Subtotal				776,669
	Taxes	7.90%	PCT	776,669	61,357
	Project Contingenies	40%	PCT	776,669	310,668
	Base Total				1,148,694
Option 1 - Add rehabilitation of Taunton Siding					
14.1	New Ties - Installed - Taunton Siding	90	EA	150	13,463
14.2	Joint Repair - Bar and bolt replacement (75# and 85#) - Taunton Siding	30	EA	54	1,628
	Subtotal				15,091
	Design/PE&E Preperation	8%	PCT	15,091	1,207
	Construction Management	10%	PCT	15,091	1,509
	Subtotal				17,808
	Taxes	7.90%	PCT	17,808	1,407
	Project Contingenies	25%	PCT	17,808	4,452
	Option 1 Total				23,666
	Base + Option 1				1,172,361
Option 2 - Major Slides previously remove by others					
A8.1	Delete Port ion of Item 8 - Clear Rock Debris	-177	CY	75	(13,275)
A8.2	Delete Portion of Design/PS&E Prep	8%	PCT	(13,275)	(1,062)
A8.3	Delete Portion of Construction Manamgent	10%	PCT	(13,275)	(1,328)
A8.4	Delete Portion of Taxes	7.90%	PCT	(15,665)	(1,237)
A8.5	Delete Portion of Project Contingencies	40%	PCT	(15,665)	(6,266)
	Option 2 Total				(23,168)
	Base + Option 2				1,125,526
	Base + Options 1 and 2				1,149,193
Option 3 - Use a bridge to span washout at MP 2007.33 instead of rebuiling culvert					
A9.1	Construct Bridge - MP 2007.33	20	TF	12,000	240,000
A9.2	Remove Subgrade	20	CY	75	1,500
A9.3	Delete Item 9 - Replace Culvert - MP 2007.33	1	LS	(131,200)	(131,200)
A9.4	Delete Portion of Design/PS&E Prep	8%	PCT	(131,200)	(10,496)
A9.5	Delete Portion of Construction Manamgent	10%	PCT	(131,200)	(13,120)
A9.6	Delete Portion of Taxes	7.90%	PCT	(154,816)	(12,230)
A9.7	Delete Portion of Project Contingencies	40%	PCT	(154,816)	(61,926)
	Subtotal				12,527
	Design/PE&E Preperation	8%	PCT	12,527	1,002
	Construction Management	10%	PCT	12,527	1,253
	Subtotal				14,782
	Taxes	7.90%	PCT	14,782	1,168
	Project Contingenies	25%	PCT	14,782	3,696
	Option 3 Total				19,645
	Base + Option 3				1,168,339
	Base + Options 1, and 3				1,192,006
	Base + Options 1, 2, and 3				1,168,838

Inflation from 2009 to 2010			
Minimum (Base + Option 2)	1.30%	1,125,526	1,140,158
Maximum (Base + Options 1, and 3)	1.30%	1,192,006	1,207,502
Inflation from 2009 to 2012			
Minimum (Base + Option 2)	5.09%	1,125,526	1,182,872
Maximum (Base + Options 1, and 3)	5.09%	1,192,006	1,252,738

Repairs for Rail Operations at Higher Car Volumes

Item No.	Work Item Discription	Quantity	Unit Cost	Unit Price	Item Total
Base Scope					
	Mobalization	1	LS	81,000	81,000
1	Service Rail Joints	7,055	EA	54.26	382,821
2	Install catchment wall	250	SF	67.00	16,750
3	New Ties - Installed - Main line	7,500	EA	149.59	1,121,949
4	Install rail - remove damaged	1,170	LF	46.82	54,774
5	New Grade Crossing Surface - Timber	304	TF	678.99	206,412
6.1	3/4 inch crushed ballast - Place (Othello-RC Jct.)	20,500	TONS	39.47	809,218
6.1	Surface, Line and Dress (Othello-RC Jct)	102,980	TF	2.46	253,668
7.1	3/4 inch crushed ballast - Place (RC Jct. - Royal City)	10,100	TONS	39.47	398,688
7.2	Surface, Line and Dress (RC Jct-Royal City)	30,855	TF	2.46	76,004
8.1	Install rail - remove damaged (Taunton Siding)	1,000	LF	46.82	12,172
8.1	New Ties - Installed - (Taunton Siding)	600	EA	149.59	89,756
8.1	3/4 inch crushed ballast - Place (Taunton Siding)	220	TONS	39.47	8,684
8.1	Surface, Line and Dress (Taunton Siding)	6,127	TF	2.46	15,093
8.1	Service Rail Joints (Taunton Siding)	311	EA	54.26	16,876
9	Replace Switches - 115#/yd or Heavier	3	EA	216,400	649,200
10	Inspect and Treat Timber Bridge - MP 0.47	318	LF	406.45	129,252
11	New Grade Crossing Surface - Concrete	110	TF	1,845	202,950
	Subtotal				4,525,267
	Design/PE&E Preperation	8%	PCT	4,525,267	362,021
	Construction Management	10%	PCT	4,525,267	452,527
	Subtotal				5,339,815
	Taxes	7.90%	PCT	5,339,815	421,845
	Project Contingenies	35%	PCT	5,339,815	1,868,935
	Base Total				7,630,595
Inflation from 2009 to 2010					
	Base Total	1.30%		7,630,595	7,729,793
Inflation from 2009 to 2012					
	Base Total	5.09%		7,630,595	8,019,374

Total Rehabilitation Costs for Safety and Higher Volumes

Safe Operations at Low Traffic Levels	**2010 $**	**2012 $**
Minimum (Base + Option 2)	1,140,158	1,182,872
Maximum (Base + Options 1, and 3)	1,207,502	1,252,738
Operations at Higher Car Volumes		
Base	7,729,793	8,019,374
Minimum Total	**8,869,951**	**9,202,245**
Maximum Total	**8,937,295**	**9,272,112**

Appendices

Appendix 1 – Research Sources

WSDOT Sources
Chicago, Milwaukee & St. Paul Ry. Co. Right-of-way and Track Maps (6 sheets) from Othello to east of Smyrna, updated through 1977
Chicago, Milwaukee & St. Paul Ry. Co. Station Maps (3 sheets) for Anson, Taunton and Corfu, updated through 1948
Untitled Right-of-way Maps (3 sheets) from Royal City Jct. to Royal City, undated; later titled as Royal Slope RR.
C.M.ST.P. & P.R.R. Condensed Profiles, Washington Division, Dated January 1976 (aka Track Charts)
Washington State DOT – State Rail and Marine Office file of the Royal Slope Railroad Correspondence

On-Line Data Sources
- http://www.othello-wa.us/index.php?option=com_content&task=view&id=29&Itemid=101
- http://en.wikipedia.org/wiki/Chicago,_Milwaukee,_St._Paul_and_Pacific_Railroad
- http://www.rblanchard.com/resources/rule100.htm
- http://dor.wa.gov/Docs/forms/ExcsTx/LocSalUseTx/LocalSlsUseFlyer_09_Q4_alpha.pdf
- http://rti-railroad-tie.com/
- http://www.osmoserailroad.com/pdf/bridge_insp_trtmnt.pdf

Appendix 2 – Inspection Photos
Appendix 3 – Annotated Aerial Photos
Appendix 4 – Inspection Notes
Appendix 5 – Bridge Inspection Notes