Enbridge Pipelines Inc.

Line 9B Reversal and Line 9 Capacity Expansion Project

Line 9 Intelligent Valve Placement Methodology and Results

Filed pursuant to Condition 16 of NEB Order No. XO-E101-003-2014

June 9, 2014

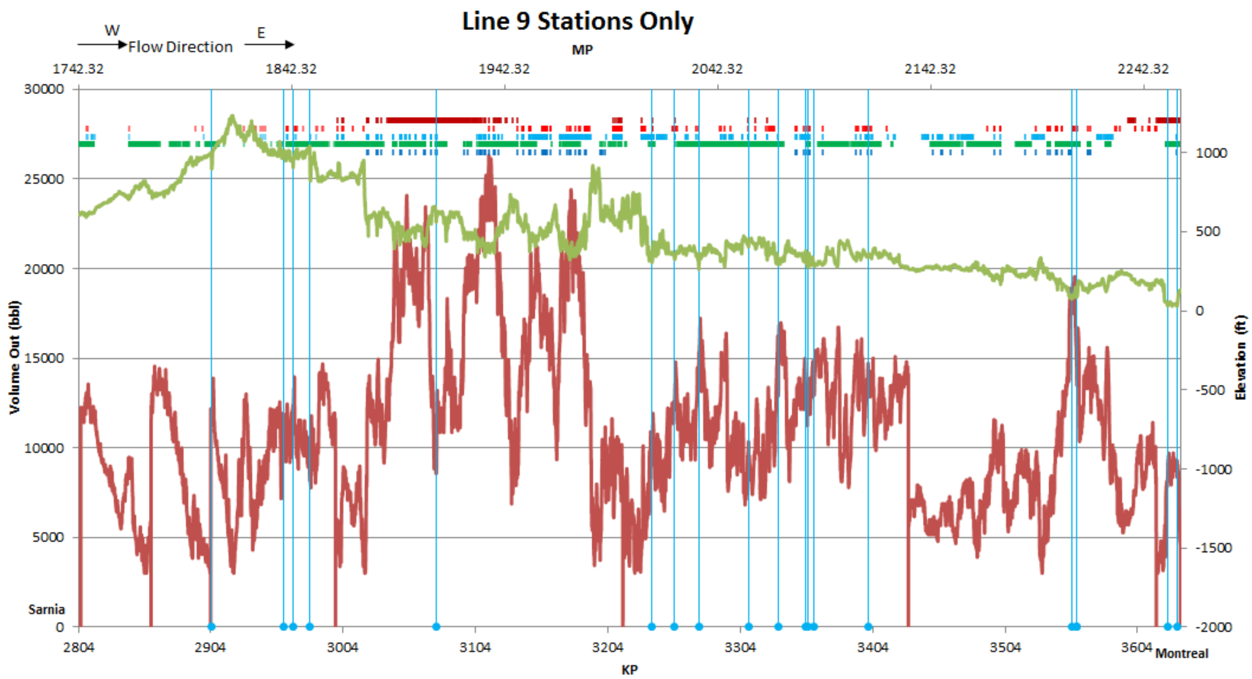
In conjunction with the Line 9B Reversal and Line 9 Capacity Expansion Project ("Project"), Enbridge has reviewed its existing pipeline valve placement configuration along Line 9, which includes remote controlled valves at its eight operating stations and 38 remote controlled valves at various locations, and has proposed the addition of 17 remote controlled valves. Remote controlled valves have been an effective layer of protection over the life of Line 9.

Remote controlled valves allow the pipeline operator to isolate sections of a pipeline that are at higher elevations from any release point. If a release were to occur at the bottom of a valley or at a low elevation then all sections of the pipeline not isolated would drain down to that location. However, if a release were to occur at the top of a hill, the oil in the pipeline would remain in place, and therefore valves at the hill top would provide no benefit. The primary driver for valve placement is reducing the potential drain down of oil at lower elevations with a focus on high consequence areas such as water bodies and populated areas.

The volume out calculation estimates the amount of oil that could be released from any location assuming a full bore rupture of the pipeline. Upon detection, pumps are shut down, valves are closed and the remaining oil at higher elevations drains to that location. For the purposes of analysis, it is assumed that the pumps will continue at design flow rate for 13 minutes: 10 minutes would be required for detection, analysis and confirmation of the release, and three minutes would be required to close the valves. The 13 minutes used for the purposes of analysis is a worst case scenario, and this number is used consistently for modelling across the entire Enbridge system. Enbridge is typically able to detect releases, shut down the pumps, and isolate the system in shorter timeframes. The volume out profile is highly dependent on the pipeline diameter and elevation.

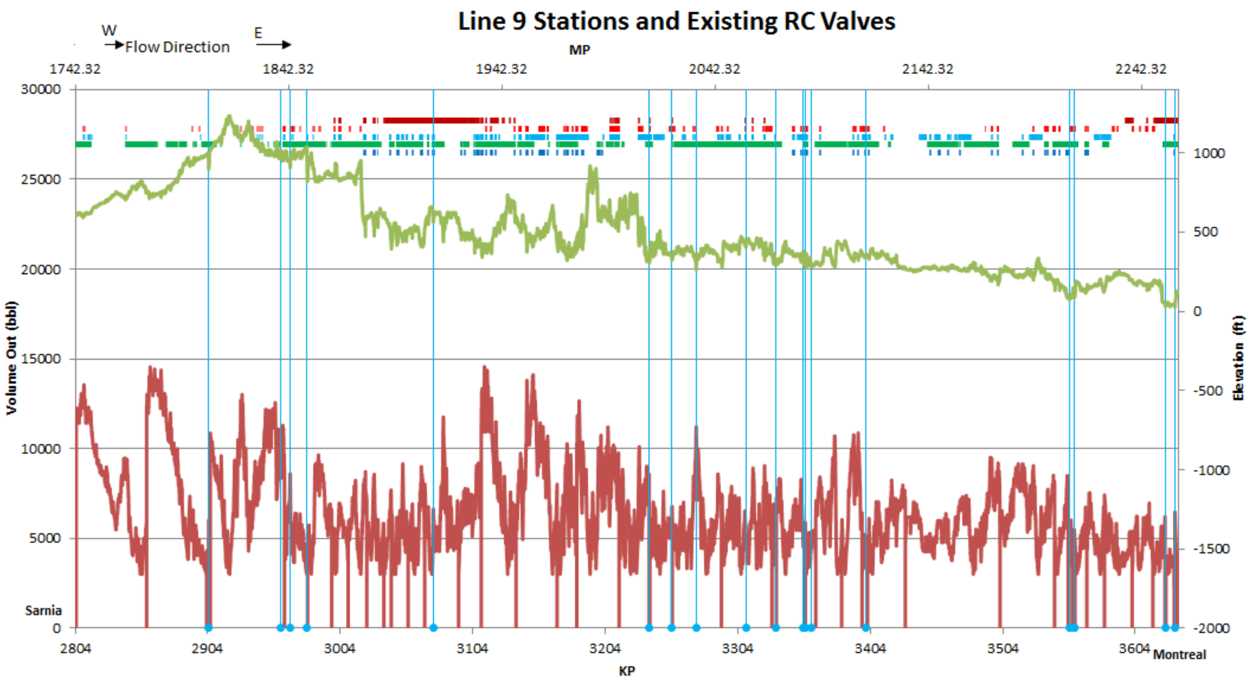
Graph 1 shows the hypothetical volume out profile that would exist if only the facility and station valves were in place on Line 9. As shown by the red line, the volume out profile is highly variable with the lowest volume out existing at the highest elevation and the highest volume out in the range of 4290 m^3 (27,000 barrels).

Also of note is the elevation profile. The highest elevation is just downstream of the Thames River and generally drops towards the east coast, with a small variation in the Creighton Heights area. As a result of this profile Enbridge would expect upstream valves to be of most use to limit drain down from the west.



Graph 1 – Volume out profile with station/facility valves only

When all the current existing remote controlled valves are included in the volume out analysis, the overall reduction of volume out across the entire line is evident in Graph 2. Volume out at the larger water crossings (blue vertical lines) is significantly reduced. Line 9 has been operating under this scenario since it commenced operation in 1976.



Graph 2 – Volume out profile with all current and existing valves – 2013

With the Project in mind, Enbridge took the opportunity to further enhance this layer of protection by proposing and installing an additional 17 valves to further reduce risk by limiting the potential volume out on Line 9. This decision was made by looking at the volume out range above and recognizing areas where volume out reductions could be further achieved through valve placement.

Condition 16:

Enbridge shall file with the Board for approval, at least 90 days prior to applying for LTO, the results of its project to update the Line 9 mainline valves system from Sarnia Terminal to Montreal Terminal using Enbridge Intelligent Valve Placement (IVP) methodology. Through these results Enbridge shall:

a) demonstrate that the new Line 9 valves system meets or exceeds the requirements of CSA Z662-11 clause 4.4 Valve location and spacing, with particular reference to clause 4.4.8, note (2);

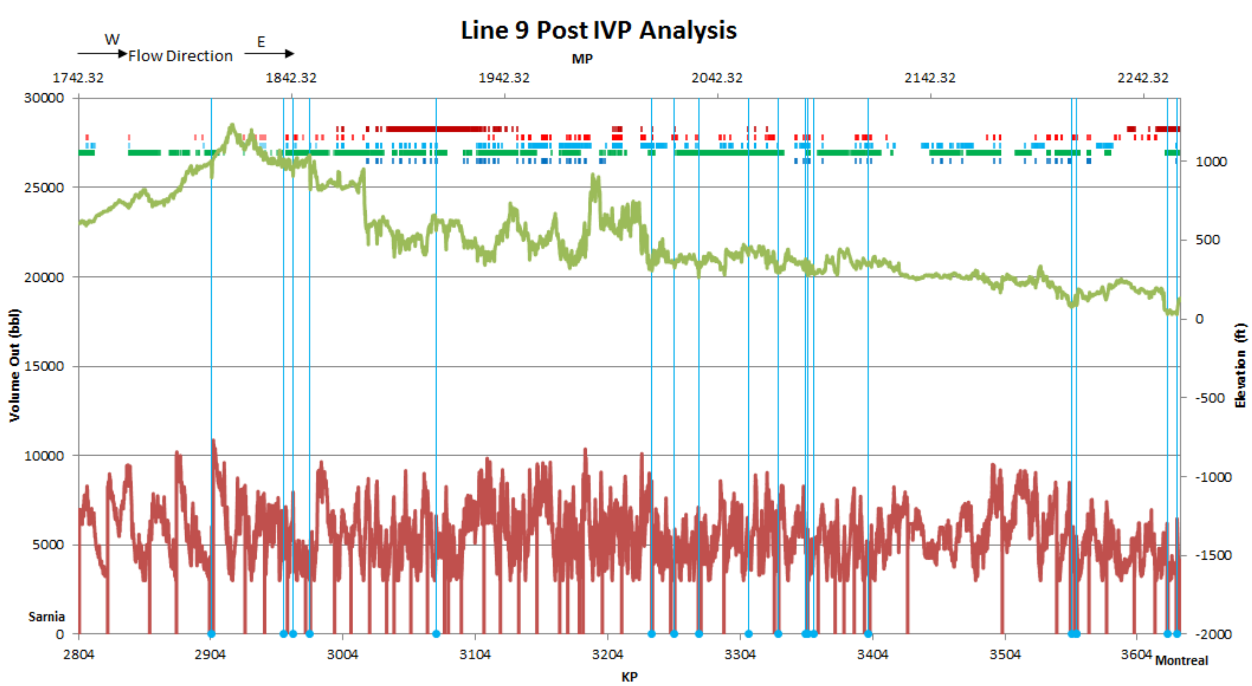
CSA Z662-11 clause 4.4.8: For HVP and LVP pipelines, valves shall be installed on both sides of major water crossings and at other locations appropriate for the terrain in order to limit damage from accidental discharge. Notes: (1) Consideration should be given to the installation of check valves to provide automatic blockage of the pipeline. (2) A major water crossing means a water crossing that in the event of an uncontrolled product release poses a significant risk to the public or the environment.

The Enbridge IVP method uses a consequence based approach for optimizing valve placement to reduce potential damage from accidental discharge to populated areas, water crossings, high consequence areas, and areas of high volume out. The placement of valves reduces both the impact of a pipeline release and its remediation requirement.

Enbridge has determined that a watercourse crossing of 30 m would, regardless of other factors such as flow, location or other environmental considerations, be considered to be a major watercourse crossing. 30 m has been used consistently by Enbridge and other pipeline companies as an appropriate limit. This aligns with the U.S. standard, U.S. Code of Federal Regulations 49.195.260 (e), which requires the placement of valves on either side of a water crossing more than 100 feet (30 m) wide. The width of the watercourse would be determined based on the ordinary high water mark. This means a line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

As discussed in Enbridge's Watercourse Crossing Management Plan ("WCMP") filed pursuant to condition 18, Enbridge also examines whether any uncontrolled release into any watercourse, of any size, could pose a significant risk to the public or environment. To be clear, a release of any volume is unacceptable to Enbridge. However, in the unlikely event of a release, the first consideration would be the management of the release through existing Enbridge programs. Valve placement is one of the many tools and programs Enbridge utilizes to minimize potential releases on its lines. As part of the valve placement program, Enbridge places valves on both sides of major watercourse crossings and additional valves at optimal locations near other watercourse crossings to reduce potential volumes released to as low as practicable to ensure that all potential releases are manageable. Taking into account Enbridge's extensive leak detection, valve placement, and emergency management programs and control centre procedures as discussed in the WCMP, Enbridge has determined that any release at any watercourse crossing along Line 9 could be sufficiently managed, and therefore would not pose a significant risk to the environment or public.

Graph 3 shows the volume out for Line 9 with the 17 new valves installed. With the installation of these 17 new valves, all major water crossings will have a valve on each side. Enbridge believes that with the installation of these 17 new valves and improvements in other mitigation layers of protection such as leak detection and emergency response plans that all major water crossings will have valves on both sides and that all other locations will be protected by valves in order to limit damage from accidental discharge. Upon completion of the new valve installations, the maximum volume out will be approximately 1,600 m^3 (10,000 barrels), with the average volume out being approximately 906 m^3 (5,700 barrels) over the entire Line 9 right of way.



Graph 3 – Volume out profile with 17 additional valves

Appendix A provides a description of the IVP process used to determine the placement of these additional 17 valves, and Appendix B provides details on the location of each new valve. The major water bodies are considered first, and then all remaining water bodies. There are approximately 154 direct watercourse crossings (rivers or lakes that the pipeline crosses as opposed to running parallel to) on Line 9 that are all protected from a valve either upstream or downstream of its location. As discussed in part b) of this report, Enbridge is of the view that placing additional valves on the banks directly adjacent to some of these streams and creeks would have limited or diminished benefit either because of the elevation profile or because an existing adjacent valve provides the desired volume out reduction.

In conclusion, as required by CSA Z662-11 clause 4.4.8**,** all major watercourse crossings along Line 9 are protected with a valve on both sides, and through Enbridge's extensive leak detection, valve placement and emergency response programs and control centre procedures, Enbridge has determined that any release at any watercourse crossing along Line 9 could be sufficiently managed, and therefore would not pose a significant risk to the environment or public.

b) demonstrate and explain why it believes that the maximum release volume between valves is as low as reasonably practicable, so as to prevent spill volumes that pose a significant risk to the public or the environment including, but not limited to, watercourses, water intakes, urban infrastructure, and ecologically sensitive areas. This assessment shall be based on the Watercourse Crossing Management Plan requested in Condition 18. It shall also address terrain profiles and flow conditions that could interact with the subject crossing in a manner that could present a risk to people or the environment at locations distant from the release;

The table of watercourse crossings included in the WCMP and information gathered at those water crossings were used in the IVP analysis.

Volume Out Reductions at Major Water Crossings

As a result of the valve placements the volume out reductions at major water crossings are:

Centerline (KP)	Water Body Name	Width (m, (ft))	Volume Out (m^3 (bbl)) Stations Only	Volume Out (m^3 (bbl)) Post Valve Placement
2904.68	Thames River	36, (117)	2,181 (13,719)	932 (5,864)
2958.67	Black Creek	116, (380)	1,879 (11,816)	1,083 (6,815)
2966.14	Nith River	37, (122)	2,171 (13,654)	1,217 (7,653)
2979.11	Grand River	76, (250)	1,798 (11,307)	675 (4,246)
3074.17	West Branch Don River	160, (526)	2,100 (13,209)	1,054 (6,632)
3237.26	Trent-Severn Waterway	146, (480)	1,896 (11,927)	647 (4,067)
3254.37	Moira River	101, (330)	2,350 (14,783)	760 (4,780)
3272.56	Salmon River	35, (116)	2,680 (16,858)	777 (4,887)
3310.08	Millhaven Creek	35, (116)	1,458 (9,172)	852 (5,359)
3332.55	Rideau Canal	69, (225)	2,684 (16,881)	916 (5,764)
3353.62	Unnamed Creek	60, (198)	1,977 (12,438)	822 (5,169)
3355.06	Gananoque River	55, (180)	2,181 (13,720)	580 (3,648)
3359.92	Unnamed Creek	91, (300)	2,453 (15,427)	857 (5,389)
3400.55	Buells Creek	104, (340)	2,248 (14,137)	737 (4,636)
3554.11	Ottawa River	475 (1,557)	3,049 (19,178)	898 (5,648)
3557.94	Riviere du Nord	148, (484)	2,653 (16,685)	874 (5,495)

3558.28	Ruisseau Fraser	77, (253)	2,576 (16,202)	797 (5,012)
3626.77	Riviere des Milles Isles	152, (500)	1,381 (8,686)	478 (3,009)
3633.61	Riviere Des Prairies	342, (1,122)	1,326 (8,341)	478 (3,009)

Volume Out Reductions at Water Crossings less than 30 metres:

The volume out reductions at water crossings less than 30 metres are:

Centerline (KP)	Water Body Name	Width (m, (ft))	Volume Out (m^3 (bbl)) Stations Only	Volume Out (m^3 (bbl)) Post Valve Placement
3160.45	Graham Creek	5 (15)	2,794 (17,575)	1,499 (9,426)
2841.89	Bear Creek	18 (60)	1,484 (9,333)	1,484 (9,333)
2987.96	Fairchild Creek Tributary	4 (12)	2,283 (14,360)	1,483 (9,329)
2880.73	Nairn Creek Tributary	7 (22)	1,482 (9,325)	1,483 (9,325)
3156.95	Graham Creek	10 (32)	2,887 (18,159)	1,468 (9,235)
3144.83	Soper Creek	8 (27)	3,320 (20,885)	1,466 (9,222)
3151.10	Hunter Creek	0 (1)	3,104 (19,526)	1,465 (9,214)
3500.50	Raisin River	24 (80)	1,791 (11,266)	1,462 (9,197)
3051.18	Little Etobicoke Creek	4 (12)	3,829 (24,084)	1,456 (9,159)
3515.65	Unnamed Ditch	3 (10)	1,573 (9,895)	1,456 (9,158)
3519.01	Riviere Beaudette	12 (40)	1,571 (9,879)	1,453 (9,142)
3124.42	Oshawa Creek	6 (20)	2,731 (17,177)	1,453 (9,140)
2914.12	Waubuno Creek	0 (1)	1,450 (9,121)	1,450 (9,121)
3324.26	Collins Creek	12 (39)	2,128 (13,382)	1,439 (9,053)
3108.62	Urfe Creek	0 (1)	3,788 (23,827)	1,432 (9,009)
3527.20	Delisle River	18 (60)	1,504 (9,462)	1,387 (8,725)
2989.98	Fairchild Creek	5 (16)	2,175 (13,680)	1,375 (8,649)
3111.13	Duffins Creek	18 (60)	4,008 (25,211)	1,373 (8,639)
3114.32	Unnamed Creek	3 (9)	3,990 (25,094)	1,371 (8,625)
3114.32	Unnamed Creek	3 (10)	3,990 (25,094)	1,371 (8,625)
3107.77	Ganatsekiagon Creek	0 (1)	3,724 (23,425)	1,368 (8,607)
3289.03	Sucker Creek	5 (18)	2,436 (15,325)	1,365 (8,588)
3029.59	Sixteen Mile Creek	16 (51)	2,377 (14,949)	1,363 (8,574)
3552.72	Ruisseau Charette	5 (16)	3,004 (18,898)	1,351 (8,495)
3158.33	Graham Creek	4 (12)	2,754 (17,320)	1,347 (8,470)

3115.55	Unnamed Creek	1 (4)	3,947 (24,824)	1,328 (8,355)
3066.25	Humber River	15 (50)	3,617 (22,750)	1,320 (8,300)
3081.78	East Branch Don River	11 (36)	2,914 (18,331)	1,314 (8,264)
3149.53	Orono Creek	0 (1)	3,369 (21,191)	1,311 (8,245)
2928.90	North Branch Creek	4 (13)	2,018 (12,692)	1,304 (8,202)
3543.00	Riviere a la Graisse	1 (3)	1,744 (10,969)	1,285 (8,081)
3064.79	West Humber River	16 (54)	3,581 (22,527)	1,284 (8,077)
3023.09	Bronte Creek	13 (44)	2,126 (13,369)	1,280 (8,051)
3128.04	Oshawa Creek	5 (18)	2,305 (14,495)	1,275 (8,019)
3118.24	Unnamed Creek	6 (20)	3,881 (24,414)	1,263 (7,944)
3149.15	Wilmot Creek	4 (13)	3,320 (20,883)	1,262 (7,936)
2943.70	Thames River	9 (30)	1,494 (9,398)	1,243 (7,818)
3153.02	Stalker Creek	1 (3)	2,656 (16,707)	1,237 (7,782)
3098.22	Little Rouge Creek	8 (27)	3,302 (20,768)	1,236 (7,773)
3155.77	Graham Creek Tributary	0 (1)	2,654 (16,694)	1,235 (7,770)
2810.86	Waddell Creek	0 (1)	2,066 (12,997)	1,229 (7,728)
2868.77	Unnamed Creek	3 (10)	2,283 (14,358)	1,220 (7,676)
2809.91	Perch Creek Tributary	8 (27)	2,057 (12,936)	1,219 (7,666)
3140.04	Bowmanville Creek	0 (1)	2,706 (17,020)	1,215 (7,643)
3247.95	Potter Creek	3 (9)	1,943 (12,221)	1,213 (7,627)
3542.78	Riviere a la Graisse	0 (1)	1,552 (9,764)	1,211 (7,614)
3377.10	Jones Creek	3 (9)	2,660 (16,730)	1,196 (7,523)
3569.35	Ruisseau Lalande	2 (8)	2,400 (15,096)	1,195 (7,514)
3537.85	Lacombe Drain	3 (10)	1,303 (8,196)	1,191 (7,492)
3097.16	Little Rouge Creek Tributary	2 (8)	3,252 (20,453)	1,186 (7,458)
2941.89	Phelan Creek	7 (22)	1,390 (8,746)	1,185 (7,455)
3172.18	Ganaraska River Tributary	1 (4)	3,427 (21,553)	1,179 (7,418)
3394.95	Golden Creek	5 (18)	2,508 (15,775)	1,179 (7,415)
3105.50	West Duffins Creek	10 (33)	3,525 (22,169)	1,179 (7,414)
3351.62	Sucker Brook	10 (32)	2,244 (14,115)	1,178 (7,411)
3292.22	Napanee River	21 (70)	2,607 (16,396)	1,174 (7,385)
3140.60	Bowmanville Creek Tributary	6 (21)	2,662 (16,741)	1,171 (7,364)
2808.39	Perch Creek	0 (1)	2,008 (12,629)	1,170 (7,359)
3209.23	Cold Creek	12 (38)	1,662 (10,453)	1,170 (7,357)
2890.50	Oxbow Creek	3 (9)	1,168 (7,346)	1,168 (7,346)

3473.76	Unnamed Ditch	1 (4)	1,305 (8,211)	1,163 (7,315)
3175.26	Ganaraska River	17 (55)	3,880 (24,407)	1,160 (7,299)
3366.01	Unnamed Ditch	10 (33)	2,558 (16,089)	1,156 (7,273)
3304.84	Wilton Creek	5 (18)	1,802 (11,334)	1,154 (7,260)
2949.53	Horner Creek	6 (20)	1,928 (12,128)	1,147 (7,214)
3478.31	Murray Drain	2 (7)	1,257 (7,908)	1,115 (7,011)
2865.93	Mud Creek	6 (19)	2,177 (13,692)	1,114 (7,009)
3472.19	Hoople Creek	9 (29)	1,253 (7,878)	1,110 (6,982)
3614.58	Ruisseau Noir	0 (1)	1,815 (11,416)	1,108 (6,972)
2954.36	Black Creek	2 (6)	1,888 (11,877)	1,107 (6,963)
3095.41	Rouge River	13 (44)	3,170 (19,938)	1,104 (6,942)
2859.72	Adelaide Creek	6 (19)	2,166 (13,622)	1,103 (6,940)
3101.26	Petticoat Creek	2 (8)	3,169 (19,933)	1,103 (6,937)
3221.06	Breakaway Creek	3 (11)	1,094 (6,882)	1,094 (6,882)
3212.01	Cold Creek	7 (23)	1,582 (9,953)	1,090 (6,856)
3205.08	Cold Creek Tributary	2 (7)	1,630 (10,252)	1,088 (6,844)
3213.99	Cold Creek	8 (26)	1,579 (9,933)	1,087 (6,837)
3121.59	Lynde Creek	5 (16)	3,317 (20,860)	1,079 (6,784)
3201.98	Shelter Valley Creek	2 (8)	1,615 (10,160)	1,073 (6,752)
3566.58	Riviere Rouge	9 (29)	2,480 (15,602)	1,073 (6,746)
3580.27	Riviere du Chene	9 (28)	2,474 (15,559)	1,070 (6,733)
3366.88	Black Creek	1 (4)	2,471 (15,540)	1,069 (6,725)
3058.46	Mimico Creek	9 (28)	3,323 (20,904)	1,063 (6,687)
3080.04	Newtonbrook Creek	0 (1)	2,292 (14,415)	1,059 (6,659)
3042.60	Credit River	24 (78)	3,479 (21,885)	1,055 (6,633)
3042.60	Credit River	15 (50)	3,479 (21,885)	1,055 (6,633)
3263.00	Blessington Creek	4 (12)	2,057 (12,936)	1,052 (6,620)
3271.93	Fisher Creek	0 (1)	2,416 (15,195)	1,052 (6,619)
3135.91	Farewell Creek	0 (1)	2,046 (12,866)	1,046 (6,579)
3503.25	Lefebure Branch	6 (20)	1,281 (8,057)	1,040 (6,541)
3053.97	Etobicoke Creek	14 (47)	3,437 (21,621)	1,034 (6,502)
3179.79	Gage Creek	0 (1)	3,497 (21,998)	1,028 (6,463)
3070.48	Black Creek	4 (14)	2,174 (13,672)	1,024 (6,439)
3584.33	Ruisseau des Anges	0 (1)	1,616 (10,164)	1,014 (6,377)
3533.12	Robertson Coulee	2 (6)	1,013 (6,373)	1,013 (6,373)

3208.04	Cold Creek Tributary	2 (7)	1,505 (9,466)	1,013 (6,369)
3536.39	Lacombe Drain	0 (1)	1,104 (6,941)	1,006 (6,329)
3116.94	Unnamed Creek	2 (6)	3,616 (22,743)	997 (6,274)
3094.76	Rouge River Tributary	3 (10)	3,022 (19,009)	991 (6,231)
3605.40	Ruisseau Rivard-Lawson	2 (6)	1,697 (10,672)	990 (6,227)
2893.00	Medway Creek	9 (30)	990 (6,224)	990 (6,224)
3612.94	Riviere Mascouche	17 (55)	1,691 (10,634)	984 (6,189)
3432.55	Black Creek	7 (24)	1,126 (7,085)	984 (6,189)
3416.19	South Nation River Tributary	3 (11)	2,069 (13,016)	982 (6,175)
2871.38	Unnamed Creek	0 (1)	2,043 (12,852)	981 (6,170)
3460.21	Gogo Drain	2 (5)	1,114 (7,006)	971 (6,109)
3403.13	Butlers Creek	3 (9)	2,385 (15,004)	971 (6,105)
3391.55	Lyn Creek	2 (8)	2,540 (15,974)	966 (6,073)
3382.64	Jones Creek Tributary	4 (13)	2,061 (12,964)	962 (6,048)
3032.48	East Sixteen Mile Creek	14 (45)	1,966 (12,367)	953 (5,992)
3456.02	Mattice Drain	3 (9)	1,094 (6,882)	952 (5,986)
3456.58	Hoasic Creek	5 (18)	1,094 (6,882)	952 (5,986)
3507.66	Williamson Drain	0 (1)	1,039 (6,538)	922 (5,801)
3168.35	Unnamed Creek	0 (1)	3,322 (20,897)	922 (5,798)
2936.73	Mud Creek (2)	3 (9)	1,109 (6,975)	904 (5,685)
3462.76	Moffat-Fetterly Drain	4 (14)	1,044 (6,569)	902 (5,673)
2999.64	Spencer Creek	10 (34)	938 (5,899)	879 (5,530)
2894.92	Medway Creek Tributary	4 (12)	876 (5,509)	876 (5,509)
3361.27	Unnamed Creek	3 (11)	2,455 (15,441)	859 (5,403)
3546.91	Rigaud River	24 (78)	2,066 (12,998)	859 (5,402)
3603.26	Ruisseau Hogue-Therrien	4 (13)	1,564 (9,840)	858 (5,395)
2875.84	Unnamed Creek	3 (9)	1,897 (11,934)	835 (5,252)
3543.47	Rigaud River East	6 (20)	1,910 (12,014)	819 (5,150)
3599.57	Ruisseau Lapointe	2 (7)	1,168 (7,344)	809 (5,090)
3131.59	Tributary to Oshawa Creek	1 (3)	1,430 (8,996)	788 (4,958)
3131.60	Unnamed Creek	1 (3)	1,430 (8,996)	788 (4,958)
3047.72	Mississauga Creek	Culvert	2,974 (18,706)	788 (4,954)
3602.28	Riviere Saint-Pierre	5 (17)	1,450 (9,118)	743 (4,674)
3182.84	Unnamed Creek	2 (5)	2,874 (18,077)	739 (4,650)
3279.27	Marysville Creek	3 (9)	1,770 (11,131)	730 (4,594)

3137.07	Black Creek	2 (7)	2,313 (14,548)	728 (4,582)
3587.50	Ruisseau des Anges	2 (7)	1,306 (8,217)	719 (4,520)
3594.45	Riviere Mascouche Tributary	4 (14)	1,030 (6,480)	672 (4,225)
3182.24	Unnamed Creek	2 (7)	3,112 (19,572)	641 (4,029)
2901.40	Unnamed Ditch	0 (1)	575 (3,614)	575 (3,614)

In summary, Enbridge will not have any major crossings with a volume out over 1,225 m^3 (7,700 barrels) or any water crossing less than 30 m with a volume out greater than 1,510 m^3 (9,500 barrels) following the installation of planned valves on Line 9. Enbridge is of the view that these volume out numbers to be as low as reasonably practicable.

Release volumes are primarily determined by the pipe diameter, flow rate, elevation and remote controlled valve placement. The placement of the additional 17 valves was prioritized based on the significance of water bodies, from large to small in terms of width, followed by the direct and indirect impact on high consequence areas. The term "High Consequence Area" ("HCA") is derived from the U.S. Code of Federal Regulations ("CFR") 195.450; further details are contained in Appendix A. Terrain profiles were then used to estimate not only the direct impact but the overland flow into a water body that could directly or indirectly impact an HCA. In addition, average annual flow velocities were used to estimate the extent of impacts to HCAs downstream of a release.

Enbridge performed an analysis of the potential benefit of placing additional valves beyond the 17 selected, which confirmed that any additional valves would have minimal impact on reducing volume out in the event of a release and therefore, considering the risks associated with valves, as discussed below, would not be reasonably practicable.

After placing the additional 17 valves, Enbridge believes it has reduced the volume out for Line 9 to a manageable level and the lowest level reasonably practicable. To reiterate, a release of any volume anywhere, not just at water crossings, is unacceptable to Enbridge. However, given Enbridge's extensive leak detection program, control room management, and emergency response program, as discussed in the WCMP filed pursuant to condition 18, Enbridge has determined that after the placement of the 17 additional valves, any release along Line 9 could be sufficiently managed, and therefore would not pose a significant risk to the environment or public.

Enbridge takes the following additional factors into consideration when determining the optimal number and placement of valves:

1. The estimated volume out is considered to be a very conservative number as it assumes:
    - a full bore rupture;
    - it will take the full 13 minutes to shut down the line;
    - full flow during valve closure;
    - flow rate at design maximum; and
    - complete drain down of level pipe.

   These assumptions are the worst case scenario, and the likelihood that a significant release that meets all these assumptions would occur is highly remote .Therefore, in the unlikely event of a significant release the expected volume out would be considerably lower than the calculation used to determine valve placement.

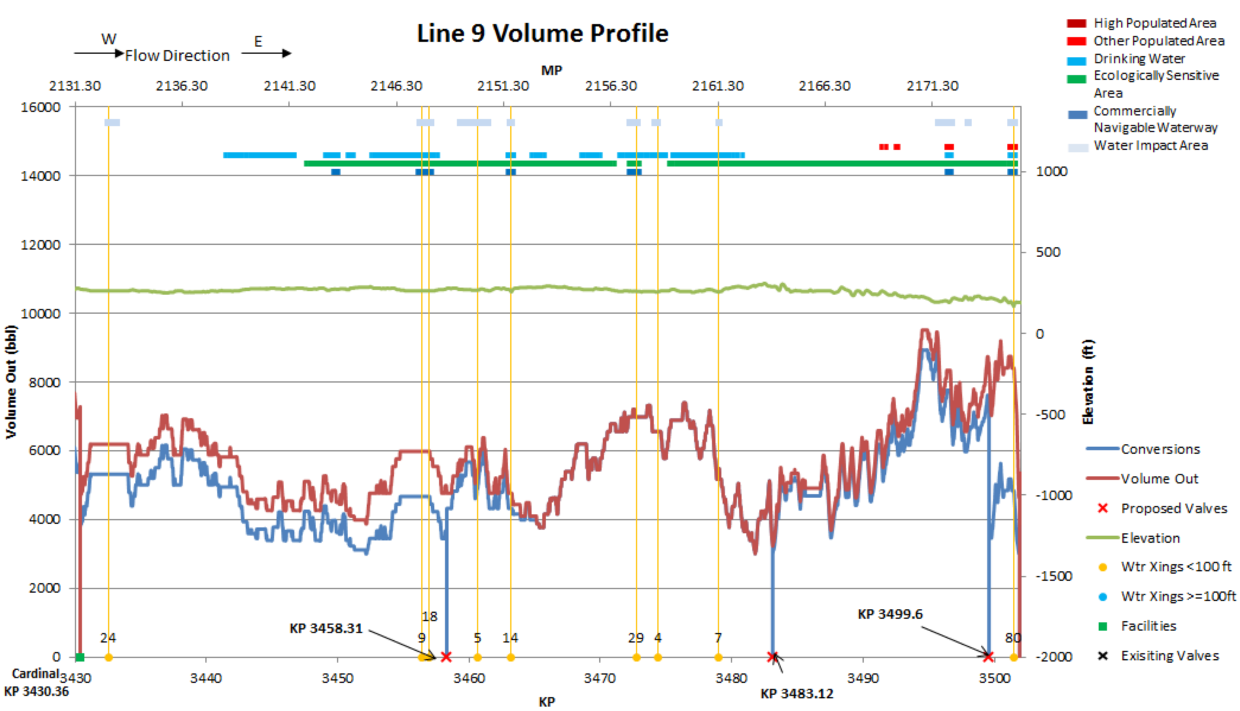
2. The addition of valves presents an increased risk for the release of product as valves themselves are considered to be higher risk leak sources. Valves contain moving parts and require above-ground facilities that make them susceptible to damage, and vandalism, which contribute to this increased risk.

Therefore, keeping the number of valves to an optimum level and balancing benefit and risk is critical.

c) provide explicit criteria and rationale for using 8 manually operated valves (MOV) on the pipeline, instead of remotely controlled valves, and describe how these MOVs are to be maintained, how access to them is to be assured (including during snowing periods), and for each valve provide an estimate of the maximum time to close the valve once an alarm is sounded;

The manual valves that exist on Line 9 were installed during the original construction and have been useful for planned maintenance such as planned purging of the line, hydrotesting and general maintenance which requires removal of product from sections of the line. These manual valves are not considered as a layer of protection during an emergency response and are not relied upon in such cases. An analysis was performed on the eight remaining manual valves on Line 9 and it was found that these valves would not reduce the volume out in the event of a release by a significant quantity.

The following Graph 4 illustrates a flat area of the pipeline where if a release were to occur, once the pumps were stopped and the pressure dropped, there would be minimal drainage. Three of the eight remaining manual valves on the line are within this section of pipeline. The graph illustrates these three valves would have minimal benefit in reducing the volume out if they were converted to remote controlled operation. The graph also shows little to no impact to water bodies.



Graph 4 – Volume out profile showing three manual valves that are not planned for conversion

The analysis of the other five manually operated valves yielded similar results showing minimal reductions to the volume out.

All remote controlled valves require additional equipment in order for the Enbridge Control Centre to operate them. The main components include an electric actuator that turns the valve, a power source, communications equipment with redundancies that often include a satellite tower and all associated data acquisition equipment. The sites require access, environmental and construction permits, landowner permission and access to power. New valves can take up to one year to source and a valve project can take from one to two years to complete.

Access (including winter) – All of the manually operated valves are close to municipally maintained roads. In heavy snow events contractors or Enbridge crew members would be dispatched, when safe to do so, to operate a manual valve. The valves would be accessed by walking to the site or, in an emergency, by use of an all-terrain vehicle.

Maintenance – Manually operated valve sites are inspected monthly. Testing includes semi-annual lubrication and partial operation, semi-annual check for water or oil in gear box – drain and re-lube as required, painting as required, security checks monthly to ensure fencing is in good order, and vegetation management as required during the growing season.

Maximum Time to close – Enbridge personnel could take between 1.5 to 4 hours in poor weather to arrive on scene. Once on scene, and following the performance of some initial safety procedures, the manually operated valves can be closed within 10-15 minutes. Two examples of past response times include: Belleville to MLV 32 = 3 hours; and Montreal to MLV 33 = between 3 and 3.5 hours depending on roads, conditions and traffic.

d) describe the procedure to be used to verify the alarm before personnel are dispatched to manually close valves, including a description of any other measures that will be taken with respect to MOVs to reduce spill volumes in the event of a release, and the effect of these measures on the size of spill anticipated;

When the Enbridge Control Centre verifies that the cause of the alarm requires shut down, or if the Control Centre cannot identify the cause of the alarm within 10 minutes, the system is shut down and remote controlled valves are closed within the area of concern. Field personnel are then dispatched to the area to verify the alarm.

As mentioned previously, manual valves are not relied on to reduce release volumes in the event of a release; however, if a manual valve were situated between the release site and the nearest remote controlled valve it would be closed as a precautionary measure once the release had been verified. This closure would be communicated by regional personnel to the Control Centre.

e) explain if the use of these MOVs may negatively affect Enbridge's leak control evaluation for the Project (i.e., Initial Volume out of 95.2 m^3**, total volume out, assessed incremental Project risk of 2.2%, etc.).**

The use of manually operated valves does not negatively impact the initial volume out, the total volume out, or the assessed incremental Project risk of 2.2%, as the manually operated valves are not considered as a mitigation measure for a release.

Initial Volume Out

The design flow rate for the pipeline in its current state is 42,444 m^3/day (266,965 bpd) or 29.5 m^3 per minute. Using 13 minutes, the initial volume out is 383.2 m^3. The design flow rate for the pipeline after capacity expansion is 52,944 m^3/day (333,000 bpd). Using 13 minutes as the maximum length of time that the pumps would continue at design flow rate, the initial volume out is 478.4 m^3. The difference in initial volume out is 478.4 – 383.2 = 95.2 m^3.

Appendix A – Explanation of IVP process

The following flow diagram illustrates the high level stages of analysis.

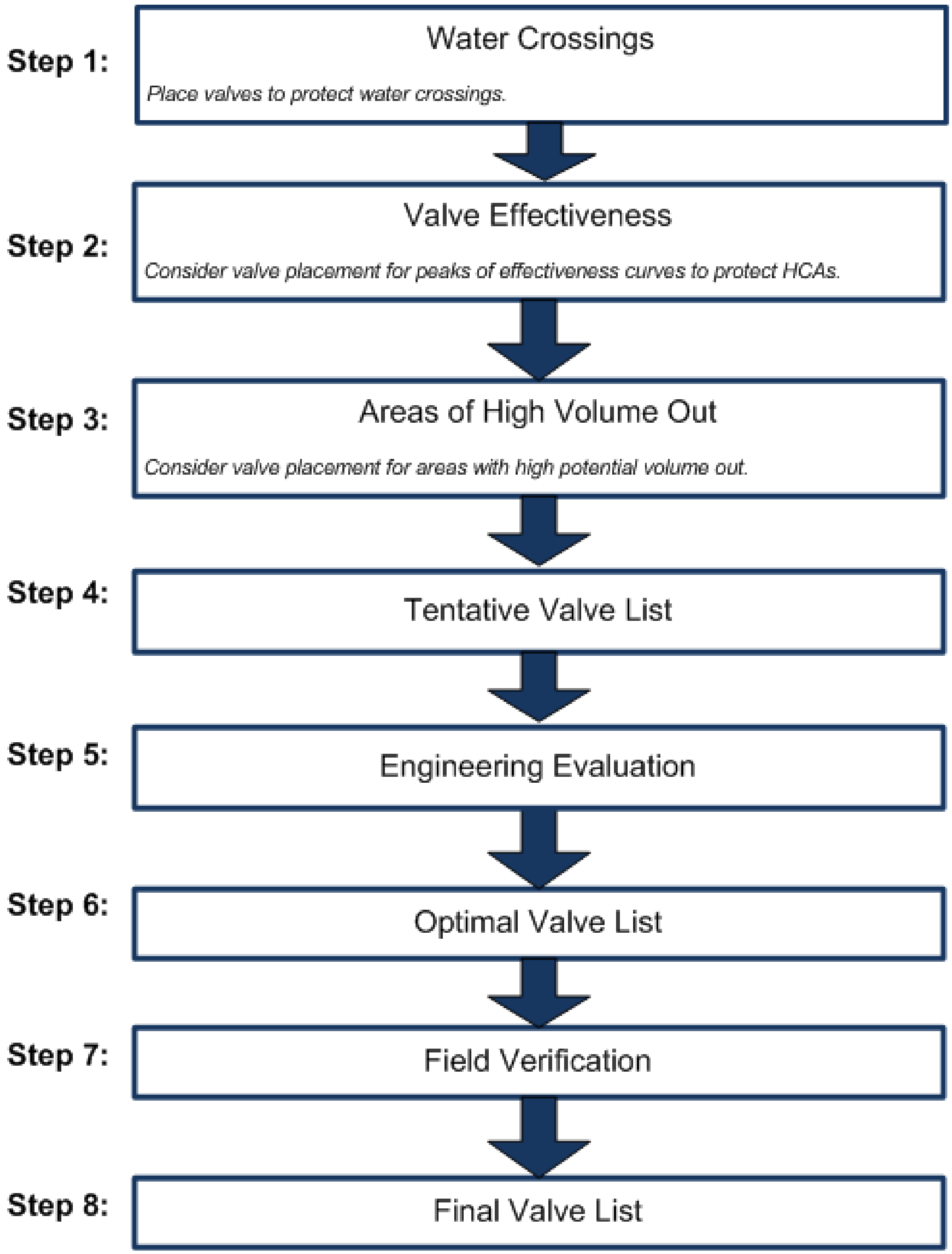


Table 1: IVP process flow chart

Water Crossing Valve Placement

Water bodies greater than 30 metres (100 ft.) wide are automatically considered a major water crossing and therefore a remote controlled sectionalizing valve shall be installed on each side.

A bay, lake, river or stream that is less than 30 m wide is to be considered for valve placement if it meets one or more of the following criteria:

- Direct or downstream impact to a High Populated Area ("HPA") or Other Populated Area ("OPA")
- Direct or downstream impact to a reservoir holding water intended for human consumption ("DW")
- Direct or downstream impact to a Commercially Navigable Waterway ("CNW")
- Direct or downstream impact to an Environmentally Sensitive Area ("ESA")
- Year round or annual mean flow velocity of ≥ 6 km/hr with very poor access
- Tributary path

When evaluating tributary path data as justification for valve placement, the following is taken into consideration:

- Distance to a water crossing greater than 30 m wide
- Distance to standing water body
- Distance to HCAs such as drinking water or populated areas
- Distance to power plants or other significant industrial facilities that require water

Water crossing valves are placed within a reasonable distance of the crossing, taking into account elements such as distance to existing facilities, potential volume out, presence of HCAs, and location within a flood plain.

Evaluation of a 'reasonable distance' is based on factors such as elevation profile, next nearest valve location, and overland flow conditions. For example, a valve will not be placed at the highest elevation on the line since this eliminates its effectiveness.

Valve Effectiveness

Valve effectiveness is a relative score that measures the effectiveness of a given valve placement in reducing volume out to HCAs. The highest points of the effectiveness curve for pipe sections are examined and valves are considered for placement around this peak location. Valve placement is based on the amount of volume out reduction to HCAs taking into consideration the types of HCAs being protected and the additional tributaries that are protected.

Areas of High Volume Out

After placing valves for steps 1 and 2, areas that have a high calculated volume out are considered for additional valve placement. Valves are placed in order to reduce the volume out profile to a practical level, which will vary from pipeline to pipeline, based on pipeline diameter and design flow rate.

Field Verification

The intent of field verification is to perform an on-site review of the proposed valve placement locations to examine valve site access, constructability, power availability, availability of land, etc. Typically the field verification process requires adjustments to the valve placement locations.

If field verification determines that a valve location is undesirable, an alternate location will be suggested and additional analysis will be performed to compare the original identified location with the new proposed location to determine whether moving the valve location is acceptable.

Canadian High Consequence Area Definitions and Data Collection

Since Canadian codes do not currently have a definition for HCAs, Enbridge has developed a definition that is used for the IVP process.

This section defines HCAs, discusses the methodology applied to Canadian HCA identification, and identifies HCA data sources.

The term "High Consequence Areas" is derived from the U.S. Department of Transport ("DOT") Code of Federal Regulations ("CFR") 195.450. High consequence areas are in turn applied to CFR 195.452; Pipeline Integrity Management in High Consequence Areas. CRF 195.450 defines four types of high consequence area as follows:

1. High Population Area
2. Other Populated Area
3. An Unusually Sensitive Area (that is, a drinking water or ecological resource area)
4. A Commercially Navigable Waterway

Enbridge has expanded this definition to include five high consequence area types as follows:

1. High Population Area
2. Other Populated Area
3. Drinking Water Resource
4. Environmentally Sensitive Area
5. A Commercially Navigable Waterway

Canadian High and Other Population High Consequence Areas

For populated areas within 200 m of the pipeline, the Enbridge Population Class Survey data (where available) was used to determine the appropriate population HCA. The Population Class Survey performed by Enbridge is based on the CSA Z662-11 class location assessment requirements. In this method, the measured population is classified as Class 1, 2, 3 or 4. For the purposes of the Canadian HCA identification, areas cited as being Class 4 were designated as a High Population HCA and those as a Class 3 were considered an Other Populated Area. For areas outside 200 m or instances where population survey data is not available, the populated areas were determined to be an OPA or HPA on the basis of population and municipal designation. A population greater than 50,000 resulted in a classification as an HPA. If the populated area has a municipal designation of village, town, or city, and a population less than or equal to 50,000, it was designated as an OPA. For those OPAs lacking a defined spatial extent on the 1:50,000 Natural Resources Canada digital topographic maps, Google Earth and/or other available aerial photographs were used to confirm the boundaries of the OPA.

Drinking Water Resources

The U.S. DOT definitions for drinking water resources, CFR 49 Section 195.6 (see above), are used as the basis for determining drinking water resources. In summary, a drinking water resource is defined as:

1. The water intake for a community water system ("CWS") or Non-transient Non-community water system ("NTNCWS") that obtains its water supply from a surface water source and does not have an adequate alternative drinking water source;
2. The Source Water Protection Area ("SWPA") for a CWS or a NTNCWS that obtains its water supply from a Class I or a Class II aquifer and does not have an adequate alternative drinking water source. Where the SWPA is not identified, the Wellhead Protection Area will be used until the state has identified the SWPA; or
3. The sole source aquifer recharge area where the sole source aquifer is karst in nature.

Due to the difficulties in obtaining data on drinking water areas, few were originally identified for Line 9. Enbridge is working with municipalities and the Minister of Environment, Ontario to obtain additional information where available.

Groundwater well locations are supplied by each province as a point and are buffered to a 400 m radius. Surface water intakes are supplied in the same manner; however a simple one-quarter mile buffer is insufficient in providing an accurate picture of this type of HCA. First, all surface water sources are extracted within an eight km radius of the intake location. Then, only the surface water sources hydrologically connected to the intake location are buffered to one-quarter mile for use as a drinking water high consequence area.

Canadian Environmentally Sensitive Areas

Canadian environmentally sensitive areas were identified within a five-km buffer on either side of the pipelines. The U.S. DOT definitions for Unusually Sensitive Areas, CFR 195.6 were used as the basis for determining the ESA high consequence areas. These areas include:

- an area containing a critically imperiled species or ecological community;
- a multi-species assemblage area;

- a migratory water bird concentration area;
- an area containing an imperiled species, threatened or endangered species, depleted marine mammal species, or imperiled ecological community where the species or community is aquatic, aquatic dependent, or terrestrial with a limited range; or
- an area containing an imperiled species, threatened or endangered species, depleted marine mammal species, or imperiled ecological community where the species or community occurrence is considered to be one of the most viable, highest quality, or in the best condition, as identified by the element occurrence ranking (EORANK) of A (excellent quality) or B (good quality).

The Enbridge Safety and Environment Species at Risk and provincial and national database are used to identify ESAs. These databases identify sensitive wildlife habitat at specific locations. Locations identified by the Species at Risk or Environment Canada database as a point are buffered by a 1.6 km radius around these locations to mark the extent of the ESA. When an ESA has a large area such as a migratory bird sanctuary, the shape of the area is used to allow for accurate representation.

Commercially Navigable Waterway

A commercially navigable waterway is defined as a waterway on which commercial navigation is likely. Large watercraft such as barges, commercial fishing boats, and ferries are considered as commercial navigation.

Enbridge Defined High Consequence Areas

Enbridge staff may identify High Consequence Areas in addition to those identified by application of the definitions noted above. These high consequence areas are called Enbridge defined HCAs.

Existing System Annual Review

The receipt of new information or information updates, plus configuration changes in the pipeline (for example, increased throughput) are addressed as an annual update of the existing system high consequence areas. This occurs in the fourth quarter – first quarter timeframe.
Starting in 2007-2008, an annual review in each Region has been undertaken to revise and/or identify Enbridge defined high consequence areas. This effort is being completed through an

annual data collection and validation process that is applied to the mainline and facility risk assessment models, and the valve placement analyses.

Exclusions

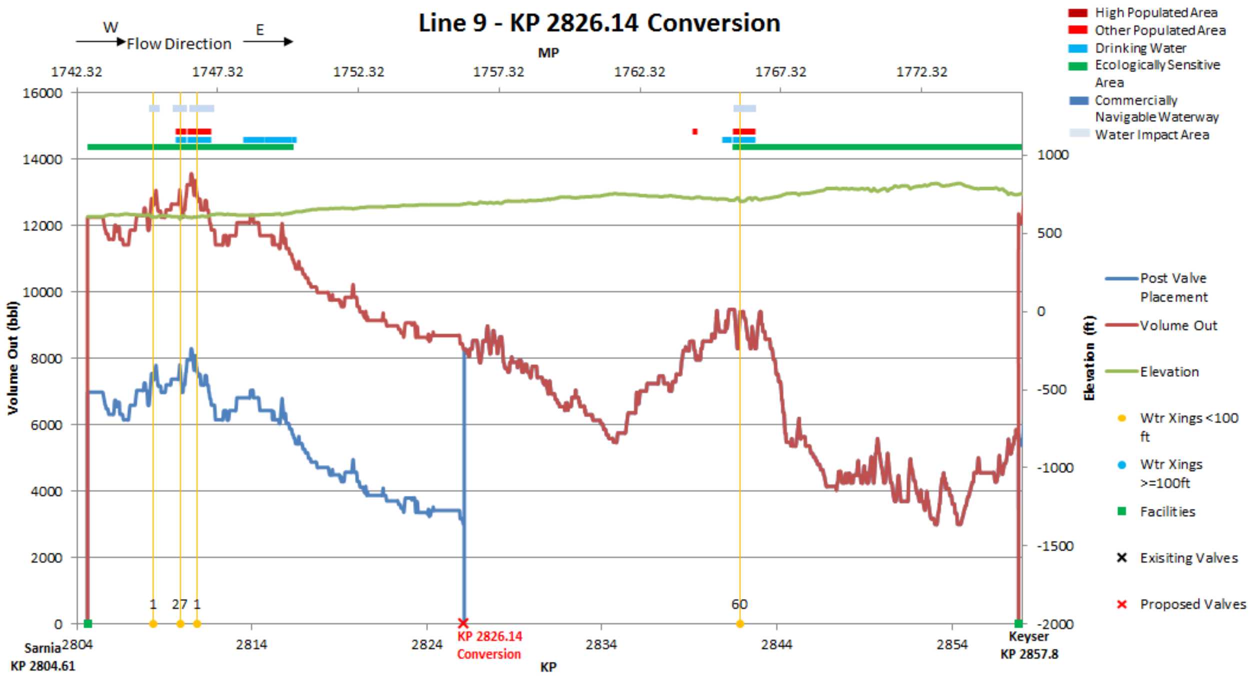
Sensitive areas or areas of concern do not in themselves, automatically obtain a designation of a high consequence area by Enbridge. This only occurs when the area of concern meets the requirements of the definition of HCA as provided earlier in this section.

Appendix B – Detailed analysis of the 17 new valves

Reference	KP	MP	Type	Valve Description
	2804.61	1742.71	Facility	Sarnia
1	2826.14	1756.08	Conversion	
	2857.80	1775.76	Facility	Keyser
2	2878.09	1788.36	Conversion	
	2903.12	1803.91	Facility	Bryanston
3	2929.94	1820.58	Conversion	
4	2944.70	1829.75	Cut-in	
5	2975.68	1849.00	Cut-in (2013)	
	2997.50	1862.56	Facility	North Westover
6	3080.61	1914.20	Cut-in	
7	3083.50	1916.00	Cut-in	
8	3122.75	1940.39	Cut-in	
9	3150.35	1957.54	Cut-in	
10	3173.70	1972.05	Cut-in	
11	3185.25	1979.22	Cut-in	
12	3199.75	1988.23	Cut-in	
	3214.48	1997.39	Facility	Hilton
13	3251.40	2020.33	Cut-in	
14	3272.31	2033.32	Conversion	
15	3274.34	2034.58	Cut-in	
16	3375.65	2097.53	Cut-in	
17	3390.08	2106.50	Cut-in	
	3430.36	2131.55	Facility	Cardinal
	3617.41	2247.70	Facility	Terrebonne
	3636.46	2259.58	Facility	Montreal

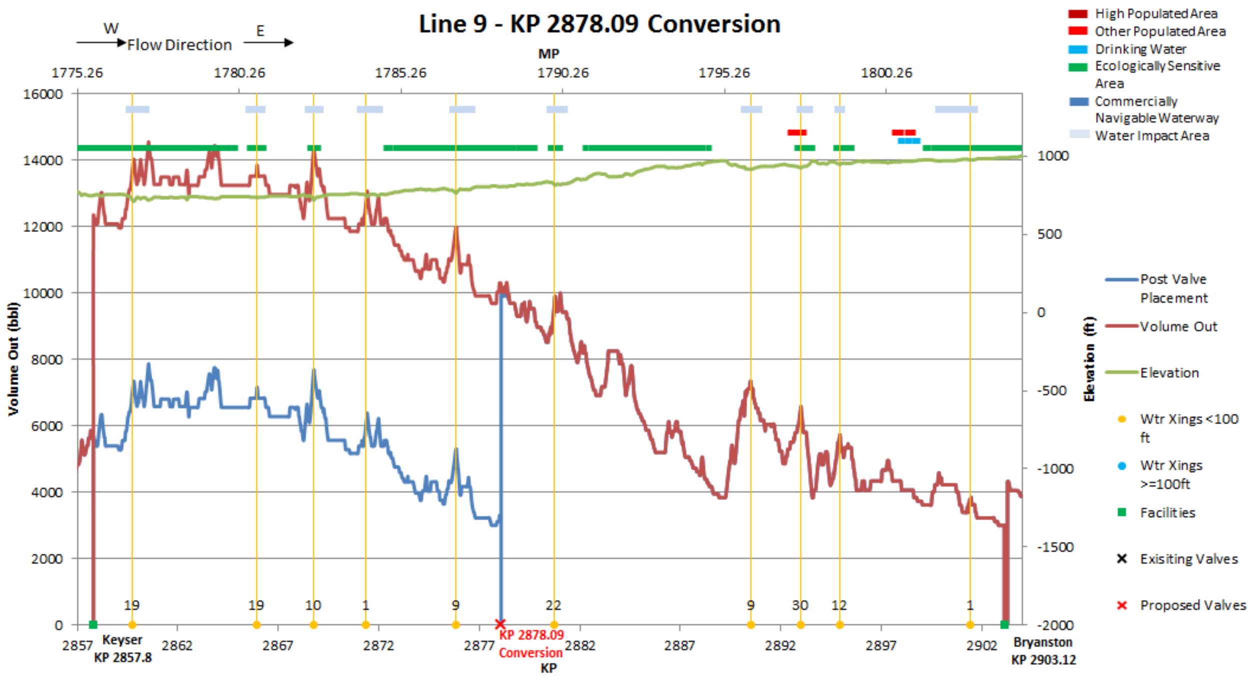
Table 1: List of new valves to be installed

Valve #1: KP 2826.14 Conversion



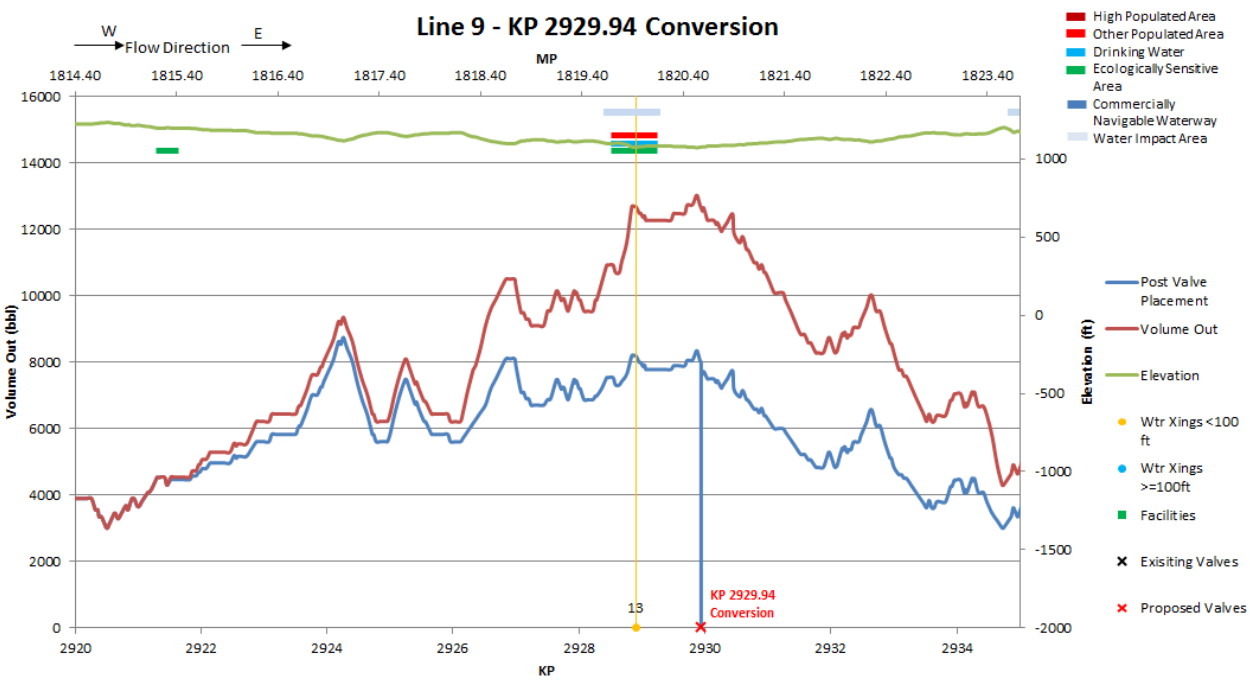
KP 2826.14 was placed as a water crossing and volume reduction valve. It provides an average volume reduction of 838 m^3 (5,269 bbl) over a 21.53 km footprint. It protects three water crossings that all flow into Lake Huron in less than 13 km. It provides volume reduction to surrounding OPAs, DW and ESAs. This location is a conversion valve so it takes advantage of an existing valve site.

Valve #2: KP 2879.09 Conversion



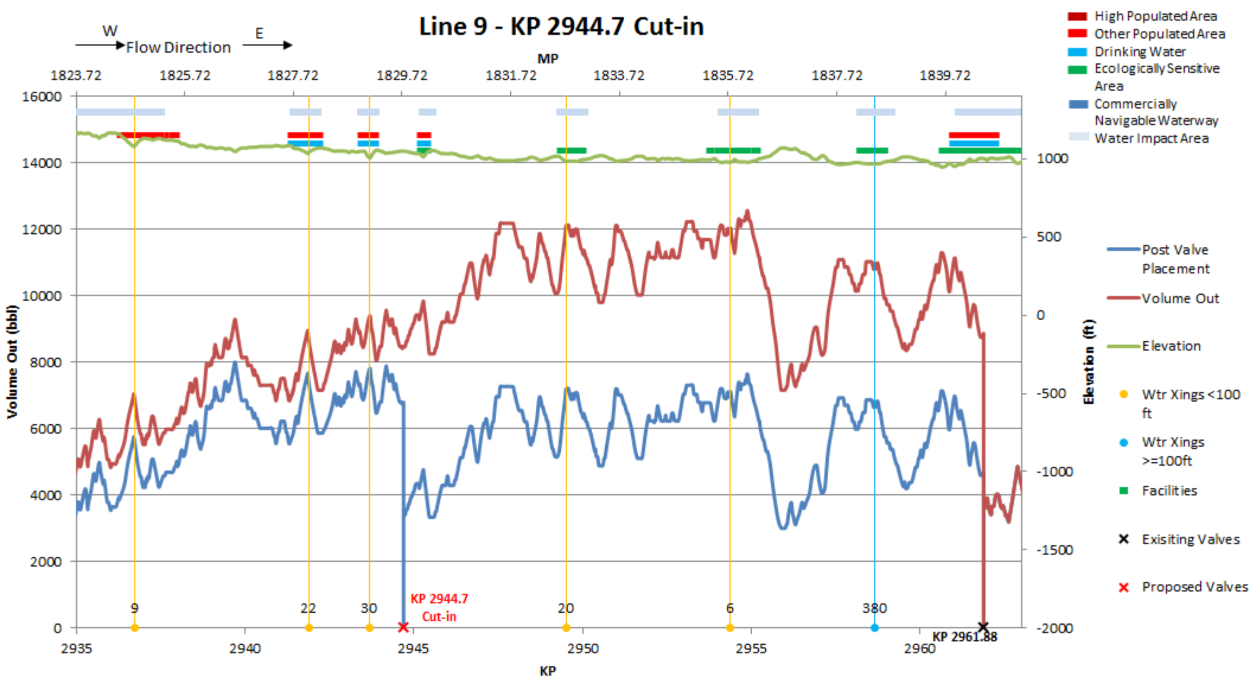
KP 2879.09 was placed as a water crossing and volume reduction valve. It provides an average volume reduction of 1,043 m^3 (6,566 bbl) over a 20.29 km footprint. It protects five water crossings that all flow into the Ausable River in less than 10 km (eventually into Lake Huron in 74 km). It provides volume reduction to surrounding ESAs. This location is a conversion valve so it takes advantage of an existing valve site.

Valve #3: KP 2929.94 Conversion



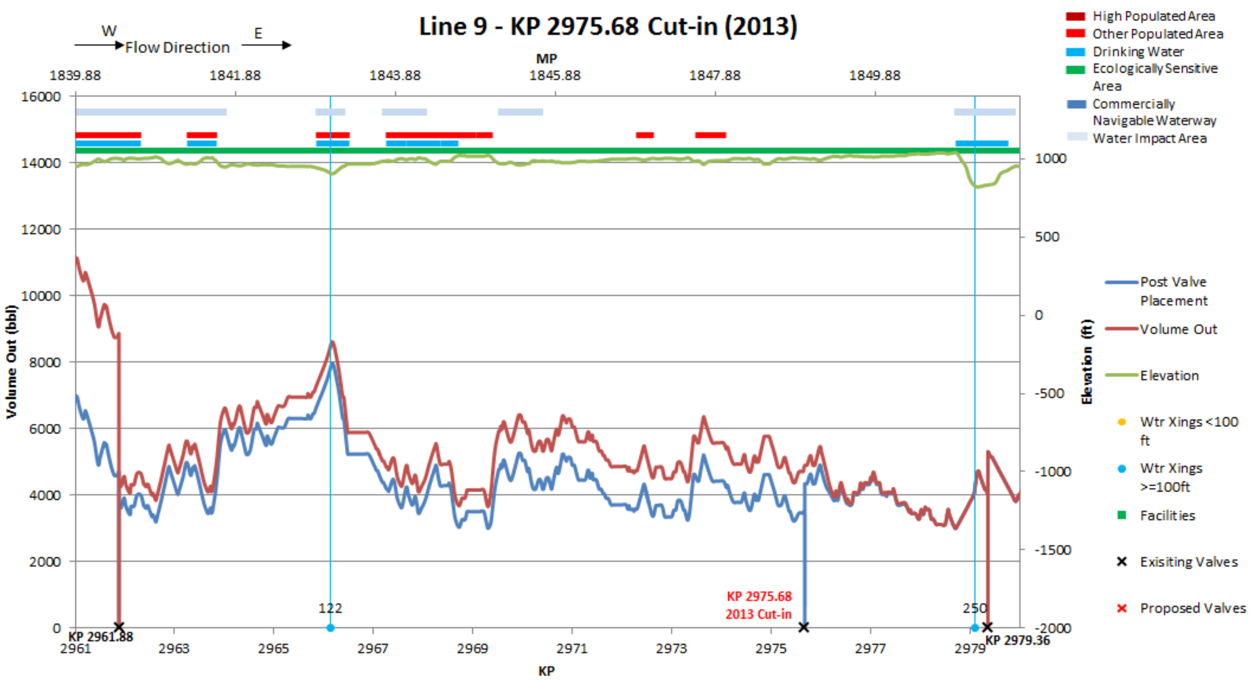
KP 2929.94 was placed as a water crossing and volume reduction valve. It provides a volume reduction of 714 m^3 (4,490 bbl) to the 4 m water crossing which flows into the Thames River in 35.4 km. It provides volume reduction to surrounding OPAs, DW and ESAs. This location is a conversion valve so it takes advantage of an existing valve site.

Valve #4: KP 2944.7 Cut-in



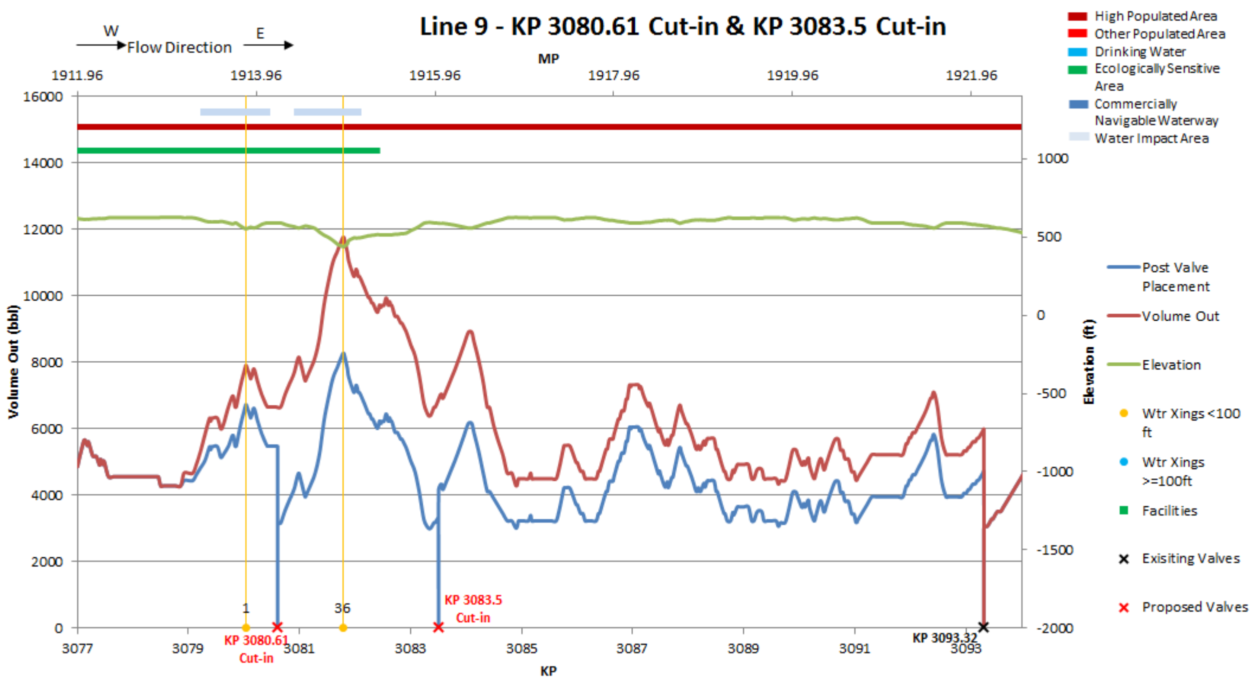
KP 2944.7 was placed as a major water crossing valve to protect the Black Creek. It provides a volume reduction of 661 m^3 (4,156 bbl) to the Black Creek. It has a 17.18 km footprint that protects five other water crossings and provides volume reduction to surrounding OPAs, DW and ESAs.

Valve #5: KP 2975.68 Cut-in (2013)



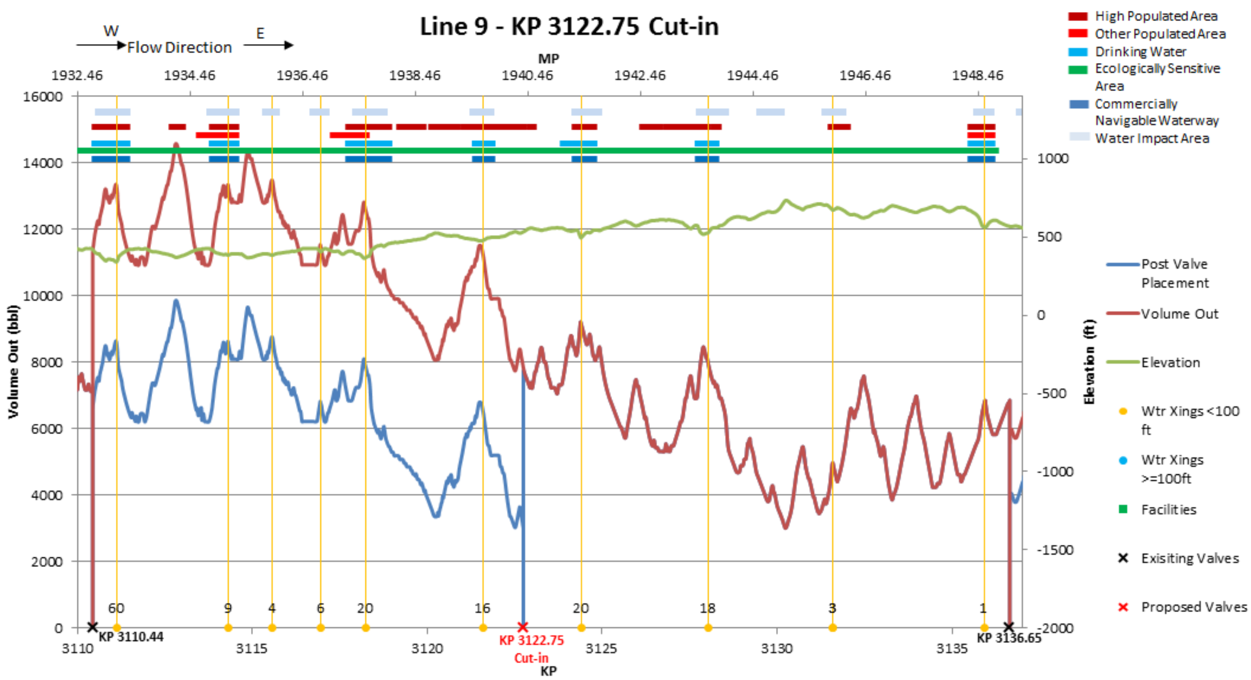
KP 2975.68 was placed as a major water crossing valve. It is the upstream valve for the Grand River and the downstream valve for the Nith River. It provides an average volume reduction of 203 m^3 (1,278 bbl) over a 13.8 km footprint. It provides volume reduction to surrounding OPAs, DW and ESAs. This valve was placed in 2013 after numerous field verifications.

Valve #6 & #7: KP 3080.61 Cut-in & KP 3083.5 Cut-in



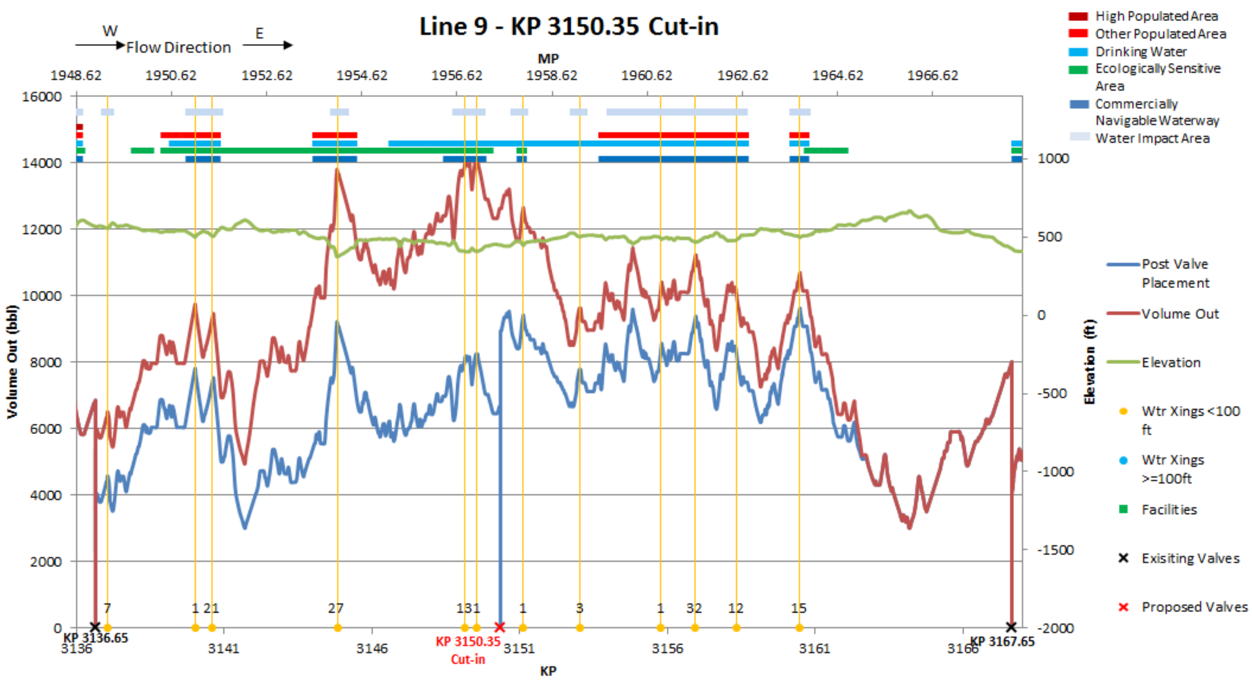
KP 3080.61 and KP 3083.5 are both cut-in valves placed to protect the Don River. Combined they provide a volume reduction of 555 m^3 (3,491 bbl) to the Don River and have a 14.46 km footprint. They provide volume reduction to surrounding HPAs and ESAs.

Valve #8: KP 3122.75 Cut-in



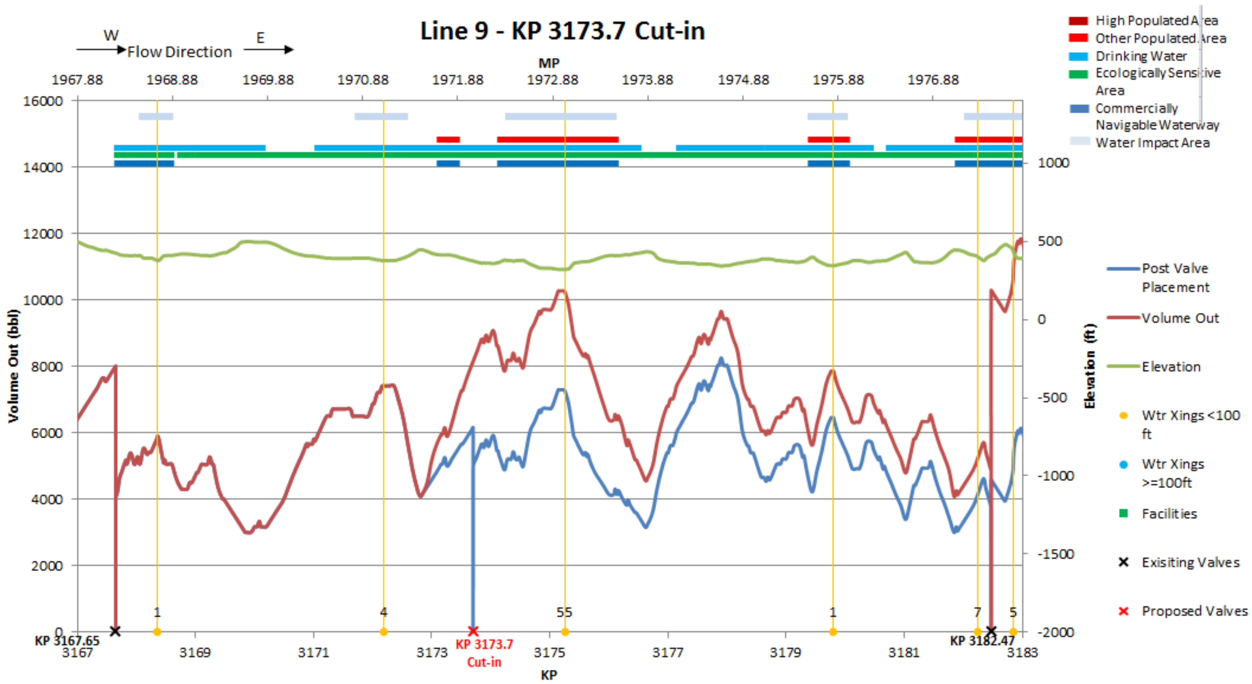
KP 3122.75 was placed as a water crossing and volume reduction valve. It provides an average volume reduction of 754 m^3 (4,741 bbl) over a 12.31 km footprint. It protects six water crossings that all flow into Lake Ontario in less than 14.5 km. It provides volume reduction to surrounding HPAs, OPA, DW, ESAs and CNWs.

Valve #9: KP 3150.35 Cut-in



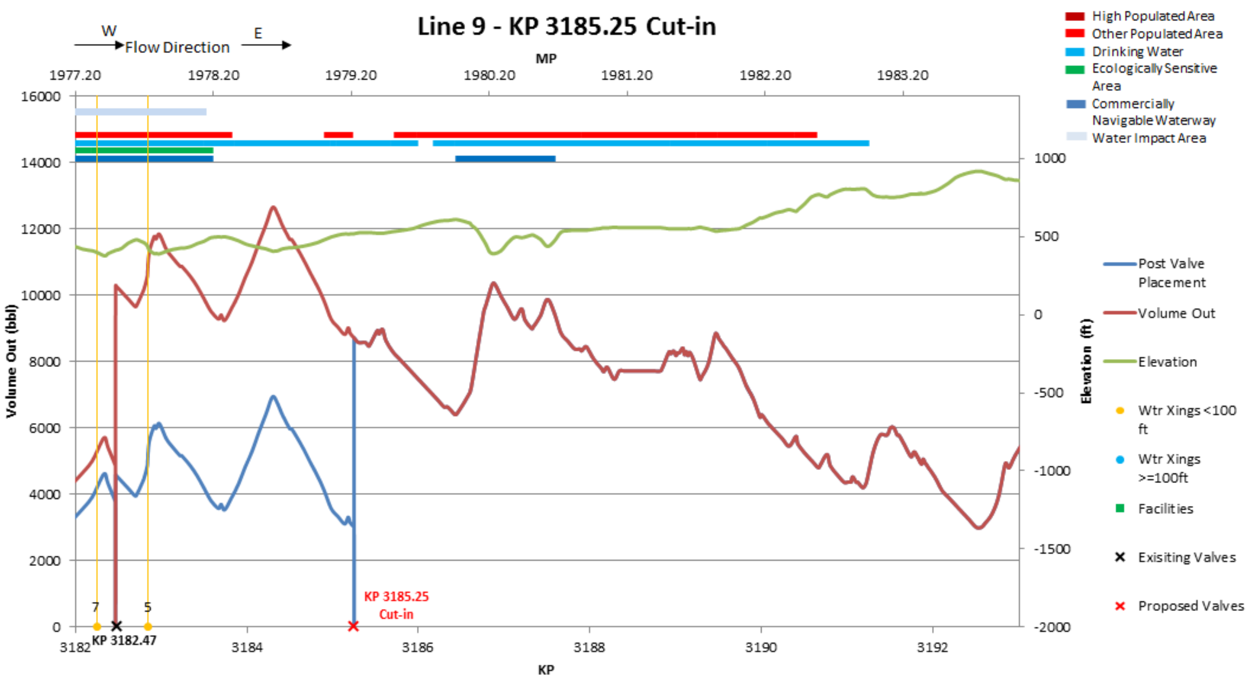
KP 3150.35 was placed as a water crossing and volume reduction valve. It provides a maximum volume reduction of 961 m^3 (6,045 bbl) and has a 26.07 km footprint. It protects twelve water crossings that all flow into Lake Ontario in less than 20.5 km. It provides volume reduction to surrounding OPAs, DW and ESAs.

Valve #10: KP 3173.7 Cut-in



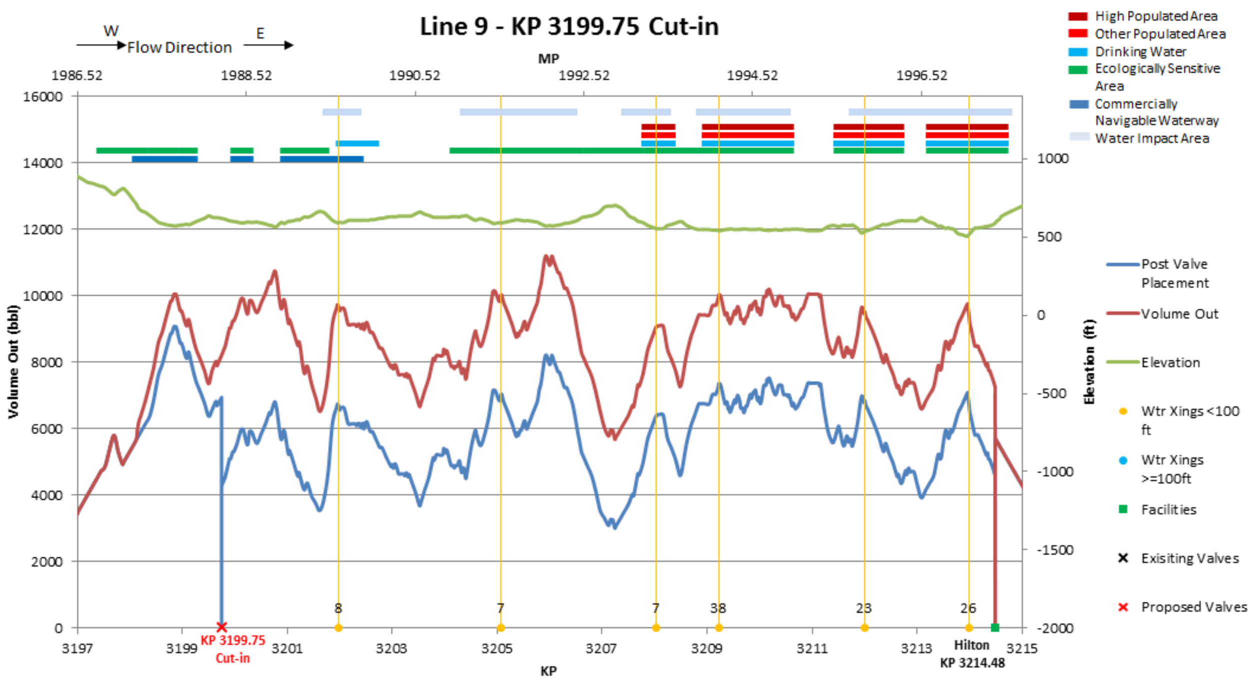
KP 3173.7 was placed as a water crossing and volume reduction valve. It provides a maximum volume reduction of 505 m^3 (3,175 bbl) and has a 9.63 km footprint. It protects three water crossings which flow into Lake Ontario in less than 9 km. It provides volume reduction to surrounding OPAs, DW, ESAs and CNWs.

Valve #11: KP 3185.25 Cut-in



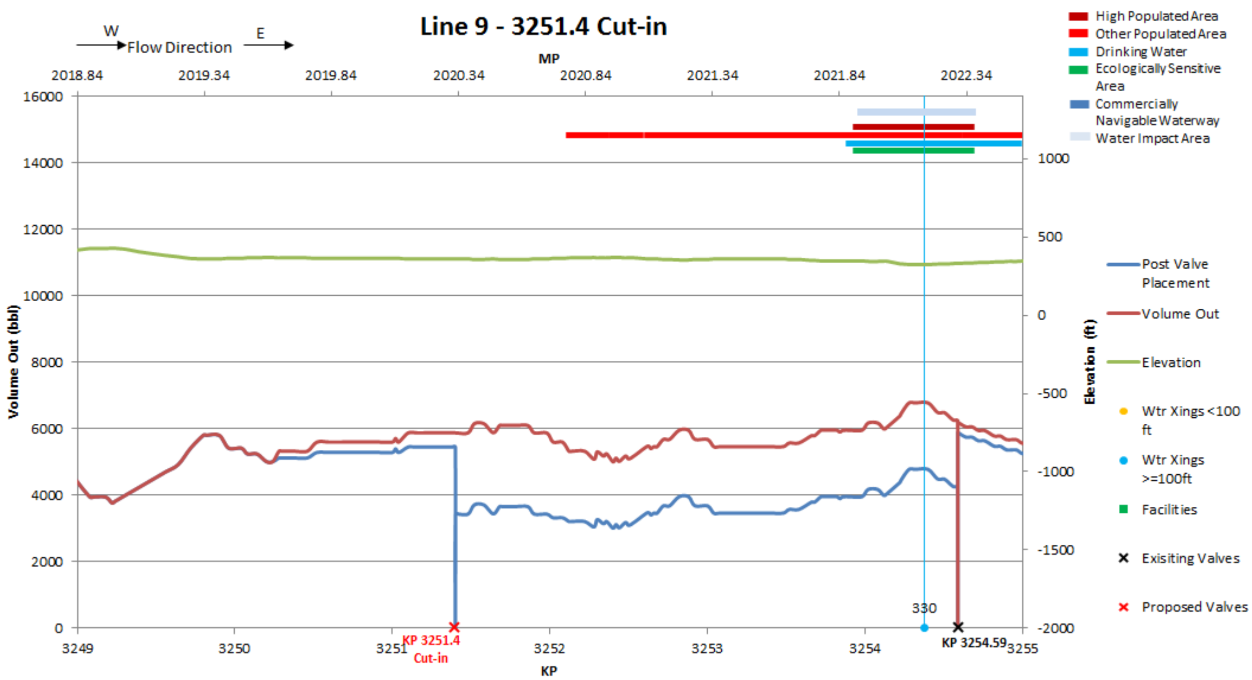
KP 3185.25 was placed as a water crossing and volume reduction valve. It provides an average volume reduction of 907 m^3 (5,705 bbl) over a 2.78 km footprint. It protects one water crossing that flows into Lake Ontario in 7.08 km. It provides volume reduction to surrounding OPAs, DW, ESAs and CNWs.

Valve #12: KP 3199.75 Cut-in



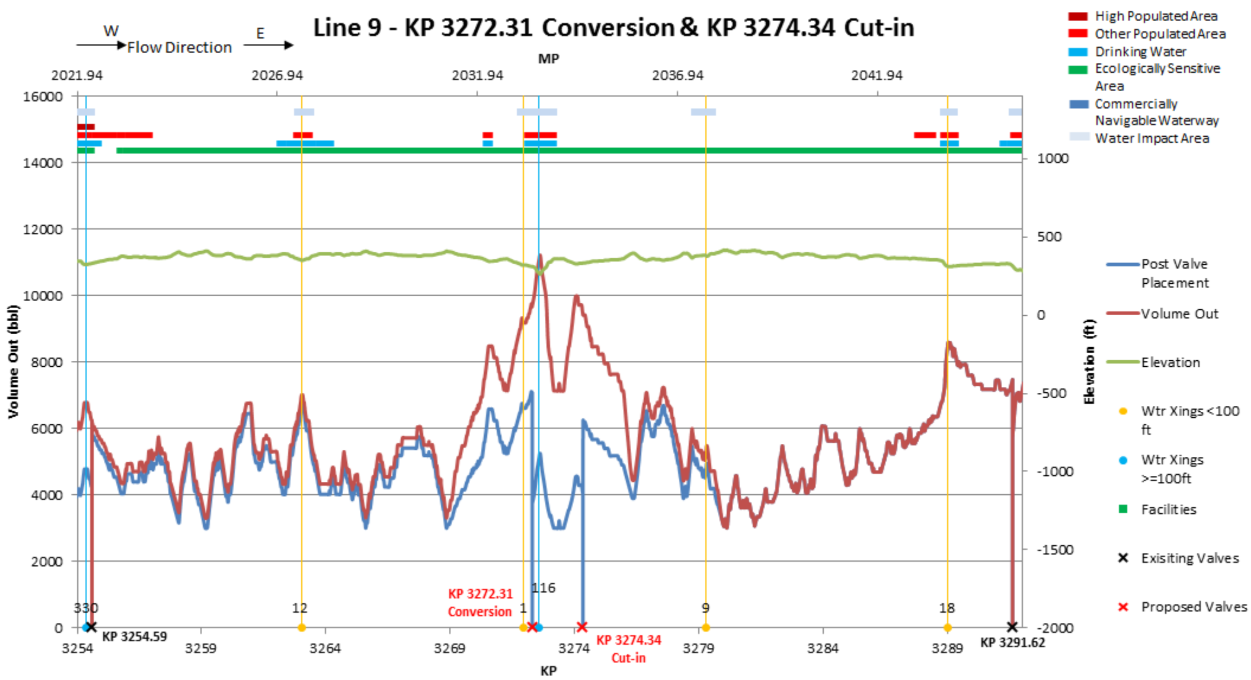
KP 3199.75 was placed as a water crossing and volume reduction valve. It provides an average volume reduction of 435 m^3 (2,739 bbl) over a 16.35 km footprint. It protects six water crossings, five that flow into the Bay of Quinte in less than 55 km and one that flows into Lake Ontario in 13 km. It provides volume reduction to surrounding HPAs, OPAs, DW, ESAs, and CNW.

Valve #13: KP 3251.40 Cut-in



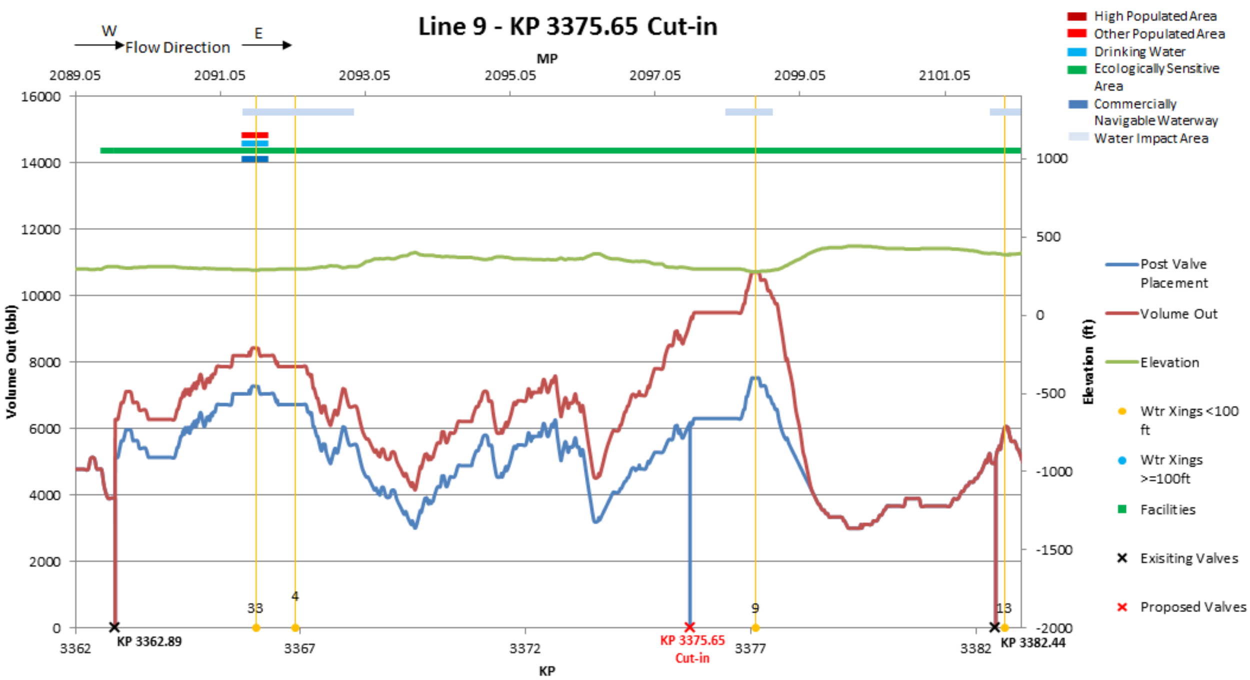
KP 3251.40 was placed as a major water crossing valve to protect the Moira River. It provides a volume reduction of 318 m^3 (2,000 bbl) to the Moira River. It has a 3.19 km footprint that provides volume reduction to surrounding HPAs, OPAs, DW and ESAs.

Valve #14 & #15: KP 3272.31 Conversion & KP 3274.34 Cut-in



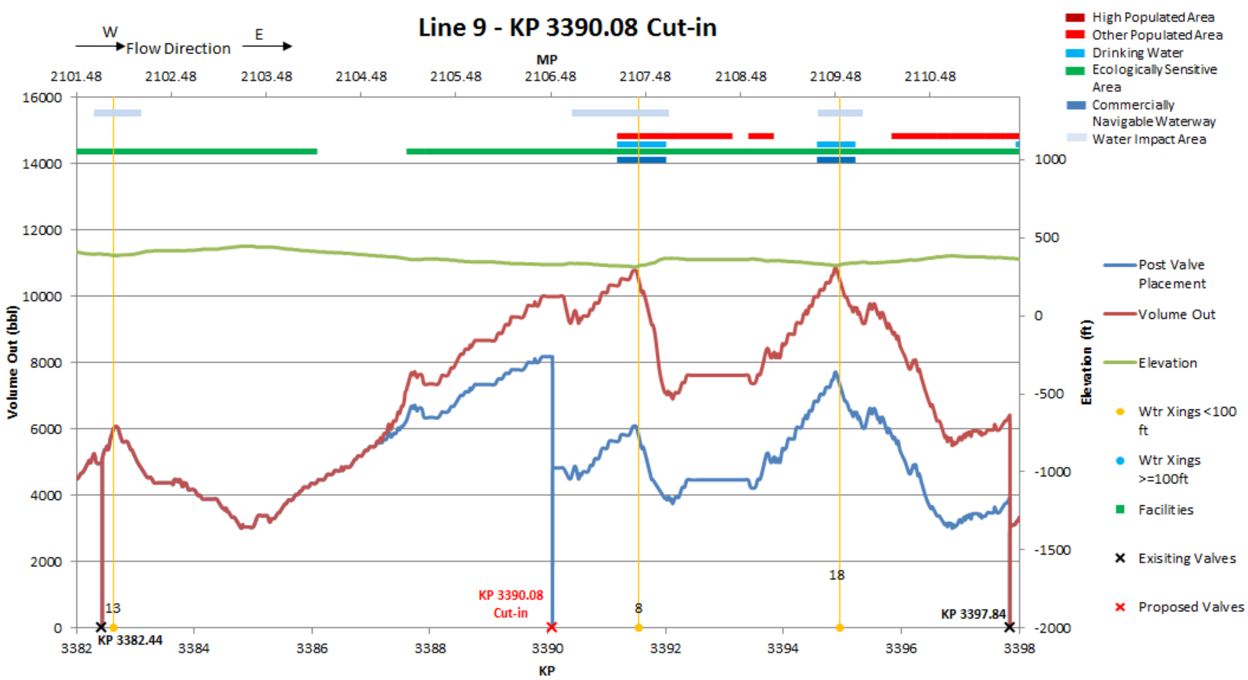
KP 3272.31 and KP 3274.34 were placed as major water crossing valves to protect the Salmon River. Combined they provide a volume reduction of 948 m^3 (5,964 bbl) to the Salmon River. It provides volume reduction to surrounding OPAs, DW and ESAs. KP 3272.32 is a conversion valve so it takes advantage of an existing valve site.

Valve #16: KP 3375.65 Cut-in



KP 3375.65 was placed as a water crossing and volume reduction valve. It provides an average volume reduction of 258 m^3 (1,624 bbl) (max of 511 m^3 (3,214 bbl)), over a 15.45 km footprint. It protects three water crossings which flow into the St. Lawrence in less than 29 km. It provides volume reduction to surrounding OPAs, DW, ESAs, and CNWs.

Valve #17: KP 3390.08 Cut-in



KP 3390.08 was placed as a water crossing and volume reduction valve. It provides an average volume reduction of 445 m^3 (2,798 bbl) (max of 822 m^3 (5,169 bbl)) over a 7.76 km footprint. It protects three water crossings which flow into the St. Lawrence in less than 13 km. It provides volume reduction to surrounding OPAs, DW, ESAs, and CNWs.