END RESULT ASPHALT PAVEMENT SPECIFICATION FOR P3 PROJECTS – BENEFITS FOR THE OPERATOR AND CONTRACTOR

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Abstract

In 2005 Brun-Way Highways Operations Inc. (Operator) entered into a 28-year operation, maintenance and rehabilitation (OMR) contract with the Department of Transportation (Client) for 275 4-lane kilometres of Routes 2 and 95 within the Province of New Brunswick. Long term Public Private Partnership (P3) contracts often contain specifications that allow the Operator to determine and implement the quality control methods they feel are necessary to ensure the end product exceeds minimum acceptable levels and meets specified performance criteria at the end of the contract term. This results in the financial risk being transferred from the Client to the Operator when fulfilling the contractual obligations.

Brun-Way's pavement rehabilitation programs are sourced out to Contractors for competitive pricing. Due to this, Brun-way recognised that the contract specifications associated with pavement rehabilitation operations needed some clarification, to decrease the risk being borne by the Operator. In 2009 Brun-Way began researching specifications and best practices to further develop the quality control / assurance measures and payment adjustments for pavement rehabilitation contracts, to establish criteria, thereby increasing pavement performance associated with this P3 project.

Without eliminating or reducing any contractual requirements, Brun-Way considered this to be an opportunity to be innovative and develop pavement rehabilitation specifications that allow Contractors to control their own work and be measured on their results and end performance.

This paper describes the QC / QA measures, including IRI smoothness requirements and payment adjustments and the challenges encountered during development and implementation, from the Operator's and Contractor's perspectives over a two year period.

1.0 Introduction

In 2005 Brun-Way Highways Operations Inc. (Operator) entered into a 28-year operation, maintenance and rehabilitation (OMR) contract with the Department of Transportation (Client) for 275 4-lane kilometres of Routes 2 and 95 within the Province of New Brunswick. Long term Public Private Partnership (P3) contracts often contain specifications that allow the Operator to determine and implement the quality control methods they feel are necessary to ensure the end product exceeds minimum acceptable levels and meets specified performance criteria at the end of the contract term. This results in the financial risk being transferred from the Client to the Operator when fulfilling the contractual obligations.

The asphalt concrete pavement specification (Item 261 which originated from the 2003 New Brunswick Department of Transportation General Specifications) that is included in the contractual agreement with the client states that it shall be the "responsibility of the Operator to provide an acceptable product as specified and that they shall implement and maintain a quality control system that will provide assurance that all components meet the end result." Therefore the Item 261 specification outlines the asphalt concrete aggregate and mix requirements but does not detail the quality control (QC) or quality assurance (QA) that should be performed to ensure those requirements are met. *Table I Asphalt Concrete Mix Requirements* shows the requirements for Item 261 that asphalt concrete must meet.

Brun-Way's pavement rehabilitation programs are sourced out to Contractors for competitive pricing and in developing these contracts; Brun-Way recognized the need to develop a clear QC and QA system to decrease the risk borne by the Operator. In 2009 Brun-Way began researching specifications and best practices in order to decide what was important to Brun-Way and to improve the asphalt pavement performance through the duration of the P3 project.

There are a number of items that Brun-Way determined to be important when it comes to the asphalt pavement specifications. First, it is most important that we meet all of the contractual requirements that are stated in our agreement with the Client. The first step was to perform a detailed review of Item 261 and understand all of the requirements that Brun-Way must meet. Another equally important item to Brun-Way is that the specification will produce a long-lasting asphalt pavement. Finally, Brun-Way determined that there was a need to develop an End Result Specification that would recognize the Contractor's results for payment and verify these with QA results.

Table I Asphalt Concrete Mix Requirements

Sieve Size ASTM Designation	Type B/HRB	Type C	Type D
	% (by mass) Passing Each Sieve		
Coarse Aggregate 25.0 mm	100	-	-
19.0 mm	84-98	-	-
16.0 mm	72-90	100	-
12.5 mm	60-83	88-98	100
9.5 mm	51-75	68-90	76-98
6.3 mm	41-66	54-77	60-84
Fine Aggregate 4.75 mm	34-60	46-69	52-70
2.36 mm	22-50	28-58	36-65
1.18 mm	12-42	20-50	25-55
600 µm	6-32	13-40	16-44
300 µm	3-20	7-27	8-26
150 µm	2-8	3-10	4-12
75 µm	2-6	2-7	2-7

Physical Requirements For Asphalt Concrete			
Air Voids %	3.5-4.5	3.5-4.5	3.5-4.5
VMA % (min)	13	14	15
Voids Filled with Asphalt %	65-75	65-75	65-77
TSR (Average of Conditioned and Freeze/Thaw TSR values) (min) ASTM D 4867	80.0	80.0	80.0
Dust to Binder Ratio	0.6-1.2	0.6-1.2	0.6-1.2
Number of Gyrations	N initial = 8, N design = 100, N max = 160		

Physical Requirements For Coarse Aggregate			
Freeze/Thaw % (max) - DOT method	14	12	12
Micro Deval %(max) – MTO LS-618	18	15	15
Petrographic No.(max) – MTO LS-609	230	180	180
Flat & Elongated Particle % (max @4:1) – DOT Method	20	15	15
Crushed Particles (min % by wt., one face) (min % by wt., two face) – DOT Method	95 80	95 80	95 80
Absorption %(max) – ASTM C 127	2.00	1.75	1.75

2.0 Developing the Specifications

Brun-Way's goal was to improve the original Item 261 asphalt concrete pavement specification, into an end result specification that would meet and exceed all the original requirements. The first step for Brun-Way was to compare our original Item 261 to the current New Brunswick Department of Transportation's (NBDOT) general asphalt end result specification Item 261 (1). Where possible, Brun-Way tried to be consistent with the NBDOT and surrounding agencies. The goal was not to re-invent the asphalt specification, but to tailor the specifications to meet the needs of Brun-Way's requirements and long-term pavement objectives.

Brun-way met with NBDOT representatives to discuss general ideas and to determine the direction in which they were heading with respect to the asphalt pavement specification. Once Brun-Way had a good understanding of the areas that we could improve, we consulted with Contractors and Consultants to get their input.

The Nova Scotia Transportation and Infrastructure Renewal (NSTIR) was an integral source in developing the International Roughness Index (IRI) specification (2). They had developed and successfully implemented an IRI specification, and Brun-Way was able to incorporate NSTIR's requirements as a starting point for Brun-Way's IRI specification.

2.1 Asphalt Cement Adjustment

Brun-Way includes a number of adjustments in relation to the change in asphalt liquid cement prices. The asphalt cement price can vary greatly from the time the Contractor bids on the contract to when the work is being performed. Brun-Way did not have any asphalt cement adjustments in the original specification and knew that this must be included prior to tendering the work

The assumed asphalt cement content for each mix and the base price index is provided to the Contractor in the request for proposal, so that all the Contractors are on equal ground for bidding. In our contracts, the assumed asphalt cement content for Type D asphalt concrete surface mix is 6.0% and the base price for asphalt cement is based on the OHMPA's price index for the month prior to tender opening (3).

Brun-Way's asphalt cement price adjustment contains two main adjustments:

Adjustment 1
Adjustment 1 is based on OHMPA's price index and the assumed asphalt cement content (4). An adjustment is made for each month in which paving occurs when the price index for the month differs by more than 5% from the price index provided to the Contractor in the request for proposal. If the price index differential is less than 5% no payment adjustment will be established. *Table II Adjustment 1* shows the equation used for payment adjustment 1. In cases when progress payments will be issued and the actual OHMPA's price index is not posted for the month in which the paving occurs, Brun-Way

will use the previous months price index for the calculation and re-adjust once the correct price index is available.

Table II Adjustment 1

Adjustment 1, PA_1	
$I_p > 1.05\ I_{TO}$	$PA_1 = U_B + ((I_p/I_{TO}) - 1.05) \times (I_{TO} \times (AC_T/100))$
$I_p < 0.95\ I_{TO}$	$PA_1 = U_B + ((I_p/I_{TO}) - 0.95) \times (I_{TO} \times (AC_T/100))$

Where:

PA_1 = Adjusted asphalt concrete Unit price

I_{TO} = performance graded asphalt cement price index for the month prior to Tender Opening

I_P = performance graded asphalt cement price index for the month in which paving occurs

U_B = Accepted Tender unit price per tonne of asphalt concrete

AC_T = Assumed Asphalt Content (5% for Type B, 3.1% for Type HRB, and 6% for Type D asphalt concrete)

Adjustment 2

Adjustment 2 only applies to the difference in asphalt cement content between the average of the test results for each lot of the work being invoiced and the assumed asphalt cement content. If the actual asphalt cement content is higher than the assumed asphalt cement content, then Brun-Way will reimburse the Contractor using the actual invoiced amount of asphalt cement supplied to the Contractor including delivery charges. On the other hand, if the actual asphalt cement content is less than the assumed amount, the Contractor shall reimburse Brun-Way for the difference. The payment adjustment 2 is determined with the equation shown in *Table III Adjustment 2*.

Table III Adjustment 2

Adjustment 2A, PA_{2A}	
$AC_A > AC_T$ or $AC_A < AC_T$	$PA_{2A} = ((AC_A - AC_T)/100) \times Q \times P$

Where:

PA_{2A} = Payment Adjustment for asphalt cement in Dollars

AC_A = Asphalt cement content determined by the average of the test results

AC_T = Assumed Asphalt Content (5% for Type B, and 6% for Type D asphalt concrete)

Q = Quantity in tonnes of asphalt concrete accepted.

P = Invoiced unit price for PG asphalt cement supplied by Contractor including delivery.

The two payment adjustments worked for all virgin asphalt mixes. However Brun-Way gave the Contractor the option of using a HRB mix in certain locations. This meant that Brun-Way had to determine the amount of virgin asphalt cement being used for the purpose of calculating the payment adjustments. Brun-Way decided to do this through daily tank measurements in the presence of the Contractor.

2.2 Quality Assurance/ Quality Control

2.2.1 Testing Frequency

Brun-Way wanted to create an end result specification (ERS) that focused on recognizing the Contractor's QC results. The common practice in New Brunswick is to collect loose samples and core samples based on a lot size of 2400 tonnes of asphalt concrete. For each lot, both the NBDOT and the Contractor collect and test, three loose samples and five core samples. Therefore, essentially the testing is doubled. The payment adjustments are based on the NBDOT's results, while the Contractor's results are used to make adjustments to the mix if required.

When developing the testing frequency for QC and QA, Brun-Way wanted to change the focus to the Contractor's results while still maintaining a level of QA. After researching and meeting with Contractors, NBDOT representatives and Consultants, Brun-Way decided to change the testing requirements.

The revised testing requirements for each 2400 tonne lot would require the Contractor to collect three loose samples and five core samples for QC. At the same time, the Contractor will collect and provide Brun-Way with one loose sample at one of the three locations where the QC samples were collected and two core samples at two of the five locations where the QC samples were collected. The Brun-Way samples are for QA purposes and are only used for payment purposes if the results are different from the QC samples. A Brun-Way representative is present during all the sampling and determines the sampling locations.

Brun-Way had to address if the results from the QA and the QC did not match, so a method was developed to incorporate the QA results into the equations for payment adjustments if required. An example of how Brun-Way incorporated the QA results is described below for the loose samples of each lot.

> *Brun-Way tests the QA loose sample while saving enough asphalt mix to perform a retest in the event that the result falls outside the specifications or are not consistent with the QC result. The results from the QA sample will be compared to the QC result for the corresponding loose sample, at the same location. If it is found that the QA result is subject to penalty /rejection or is not consistent with the QC result then the Contractor will be notified. Brun-Way will then test the remaining portion of the loose sample. If the retest still confirms the QA result then the QC result will be substituted with the QA result at that location. The lot average will be calculated using the remaining two QC results and the QA result. If it is found that the results of the retest of the QA sample are acceptable or confirm the QC result, then the result of the first QA sample will not be considered and the payment adjustment will be based on the Contractors QC results only.*

A similar process is used when verifying core results was also developed.

A benefit for Brun-Way as a result of not performing dual testing is a direct cost savings for the QA. The cost savings can be in the range of 65% when compared to the alternative of duplicating all of the tests. The benefit for the Contractors is that their QC results get recognized for payment.

2.2.2 Sampling Locations

Since Brun-Way was controlling when and where the QC and QA samples would be taken, we wanted to have a random sampling procedure for determining these locations.
In 2010 our approach was to have the loose samples determined by a random number related to the tonnage for each portion of the lot. We used a random number generator to determine this and our pavement inspector notified the Contractor when a sample was required.
The core locations proved to be a little more complicated. We started with a random number that was converted to relate to a distance. The reason for this was to be able to find the core location easily in the future and not to identify the location before the Contractor completed the rolling pattern. The problem occurred when converting it to a distance because the scope of our operations was often changing. One location might have required a 4.3m width and in the same lot the paving width could change to 6.7m wide. Since the random number for tonnage was converted to an estimated distance that relied on spread rates and widths, we discovered that the lot size was often reached before the distance was reached. This forced our pavement inspector to adjust the randomly sampled core locations as required in the field.

In 2011 our goal was to improve upon the sampling location procedure. After discussing the issues from 2010 we decided to create a random number related to the lot tonnage for all of the loose and core sample locations. We had concerns that if our pavement inspector marked the location of a core sample while the Contractor was still compacting the asphalt it could affect the results. To get around physically marking the locations, the pavement inspector would simply obtain the GPS coordinates of the location when the sample tonnage was reached. Then at a later time the pavement inspector would mark out the core location using the GPS coordinates. Not only did this make it easy to determine the sample location during the paving operations, but it allowed us to have a record of exactly where the cores and loose samples were collected. This was also valuable information if we had an issue with a base lift that was subsequently overlaid.

2.2.3 Payment Adjustments

The 2003 Item 261 specification that was included in Brun-Way's contractual agreement did not contain any payment adjustments for the asphalt concrete pavement. Instead Brun-Way is required to meet hand back standards for the asphalt concrete pavement at the end of the contract. The hand back standard requires Brun-Way to provide a minimum remaining life on the entire asphalt concrete pavement of 6 years. In an effort to ensure long term pavement performance Brun-Way wanted to include payment adjustments with the new specification, so we had to decide how and which ones were important to include. Many payment adjustments in other jurisdictions include both bonuses and penalties; however since Brun-Way has a fixed price contract we wanted to carefully decide which asphalt concrete pavement properties are important enough to provide the Contractor with a bonus

option. On the other hand we also had to decide what limits we needed to establish when considering the penalties to Contractors. Asphalt concrete density is a property that Brun-Way considered very important to assist in achieving the expected pavement life.

2.2.4 Density

Brun-Way agrees that achieving the appropriate compaction is considered critical to the performance of an asphalt concrete pavement (5). We felt that with the proper construction methods, the density could easily be achieved by the Contractors. However, the impact if they do not meet the compaction criteria would reduce the remaining life of the asphalt concrete pavement and increase maintenance issues for Brun-Way over the pavement life. Therefore Brun-Way considered density to be very important for pavement longevity. This is illustrated in *Table IV Payment Adjustment Table for Density* where it shows increasing penalties for lower compaction.

Brun-Way expects that the lot average of the densities should be 92.5% at a minimum. The penalties start once the lot average drops below 92.5% and increase in amount until the density falls below 91.0. Anything below 91.0% for the lot average would be considered rejected. This is quite different from the New Brunswick standard which pays a bonus above 92.5% and does not reject until below 89.5%.

Table IV Payment Adjustment Table for Density

% of Theoretical Maximum Relative Density (Lot Average)	Unit Price Adjustment ($ per Tonne)
92.5	0.00
92.4	-0.35
92.3	-0.70
92.2	-1.05
92.1	-1.40
92.0	-1.75
91.9	-2.10
91.8	-2.45
91.7	-2.80
91.6	-3.15
91.5	-3.50
91.4	-3.85
91.3	-4.20
91.2	-4.55
91.1	-4.90
91.0	-5.25
< 91.0	Reject

2.2.5 IRI Smoothness

Brun-Way is required to collect and report a number of pavement indices each year as part of our pavement management system. These include IRI, rutting depth, and Surface Distress Index (SDI) for the complete 1200 lane kilometres of highway and ramps. The asphalt pavement specification for rehabilitation projects had a Profilograph Index (PRI) requirement and since there is no direct correlation between PRI values and IRI values it provided an opportunity to develop the same smoothness measure for the pavement rehabilitation programs. Brun-Way's contractual requirement has an upper IRI limit of 2.28 for any 100m section of the highway.

In 2010, as a starting point in developing the IRI specification, research was conducted to learn more about smoothness specification trends. Brun-Way determined what many of the United States agencies were requiring and what measures they included in their specifications, which varied greatly from state to state (6). Once we gained some knowledge, the next step was to research what local Canadian agencies were requiring. Through talking with the NBDOT we realized that NSTIR had developed and successfully implemented an IRI specification with a number of their pavement rehabilitation projects. It was also determined that the direction Brun-Way was heading was consistent with the NBDOT as well as Prince Edward Island. This was important to Brun-Way because it would keep consistency with the Contractors. Brun-Way also consulted with our pavement management consultants, Qualitas who is based in Quebec.

Since New Brunswick and Prince Edward Island were both working with Nova Scotia's IRI specification as their starting point, it made sense for Brun-Way to also start with Nova Scotia's IRI specification. Many aspects of our specification stayed consistent with Nova Scotia's, with a few main exceptions.

One part that Brun-Way focused a lot of time to develop was the payment adjustment table for each 100m IRI value. Since no 100m section can have a value above 2.28, Brun-Way knew where to establish the reject limit, but it was more difficult to determine the rest of the ranges and associated bonus/penalty. Brun-Way wanted to have a payment adjustment table that penalized the Contractor when the smoothness could impact life expectancy or cause a maintenance problem, but also was fair when the Contractor achieved the excepted smoothness. Brun-Way decided to create a range of IRI values that had no bonus or penalty. An IRI of 0.71 to 1.00 is what we considered the expected range and felt the Contractor could easily achieve that smoothness. Along with the zero payment adjustment zone, Brun-Way decided to have a small bonus and penalty on either side of that zone. The concept was to limit the bonus the Contractor could receive. The penalty was based on what it would cost Brun-Way to repair early or to maintain.

Brun-Way used the historical data available from the pavement management system to determine that on average the IRI values increase 0.1 per year. This explains the large increase in the penalties after 1.20 IRI, because Brun-Way is striving for a minimum of 12 years asphalt concrete pavement life before another rehabilitation cycle is required.

On the other hand Brun-Way was cautious in awarding bonuses, because it is difficult to relate a dollar amount on a 100m section with an IRI of 0.5 or lower to a potential increase in the life expectancy of that asphalt concrete pavement. It has been found that smooth roads last longer but a number of factors can affect the pavement life (7). *Table V Payment Adjustment for IRI* is the payment adjustment table that Brun-Way developed for the 2011 pavement rehabilitation.

Table V Payment Adjustment for IRI

Payment Adjustment for each 100 metre Segment in each Lane	
IRI (mm/m)	**Category A**
0.00 - 0.10	$300.00
0.11 - 0.20	$300.00
0.21 - 0.30	$300.00
0.31 - 0.40	$300.00
0.41 - 0.50	$200.00
0.51 - 0.60	$100.00
0.61 - 0.70	$50.00
0.71 - 0.80	$0.00
0.81 - 0.90	$0.00
0.91 - 1.00	$0.00
1.01 - 1.10	($50.00)
1.11 - 1.20	($100.00)
1.21 - 1.30	($450.00)
1.31 - 1.40	($740.00)
1.41 - 1.50	($1070.00)
1.51 - 1.60	($1260.00)
1.61 - 1.70	($1480.00)
1.71 - 1.80	($1720.00)
1.81 - 1.90	($2040.00)
1.91 - 2.00	($2750.00)
2.01 - 2.10	($3300.00)
2.11 - 2.20	($4700.00)
2.21 - 2.28	($4700.00)
>2.28	**Reject**

The other important modification in the IRI specification is the inclusion of the start and end construction joints. Brun-Way understands that the Contractor does not have total control over how smooth these joints can be constructed because they are matching to existing asphalt. However, considering that these joints will be included in the data collection for the whole pavement network the following year, Brun-Way didn't want these joints causing roughness which could result in a financial penalty or a non-conformance to Brun-Way.

The specification already included an isolated roughness penalty, that is any 10m value over 1.2 is subject to a penalty but this value is unrealistic for start and end joints so Brun-Way increased this value

to 3.0 at these locations. The joints are also included in the 100m average calculation. Brun-Way felt that this will help eliminate any surprises when the IRI data is collected throughout the network survey the following year. *Table VI Localized Roughness Payment Adjustments* shows the limit and corresponding payment adjustment that Brun-Way included in the specification.

Table VI Localized Roughness Payment Adjustments

Roadway Classification	**Localized Roughness IRI (mm/m) for 10 metre Segments**	**Payment Adjustment (for each occurrence)**
Rte 2/ Hwy 95	>1.20	($250) *
Start and end joints (5.4)	>3.0	($500)

2.2.6 Asphalt Thickness

The asphalt concrete pavement specification that Brun-Way started with did not have a thickness requirement. Most of the work prior to 2010 was only mill and fill so a thickness requirement was not important. Once our pavement rehabilitation programs started to include overlays, the need to include an asphalt thickness specification was realized. Brun-Way included the NBDOT thickness specification, because the Contractors are accustomed to that and it met any concerns that we had in ensuring the thickness was achieved.

3.0 Experiences

Since Brun-Way started developing the specification in the fall of 2009 we have issued two contracts. In the spring of 2010 we issued a tender that totalled 80,000 tonnes of asphalt concrete. This was the largest asphalt rehabilitation project that Brun-Way had tendered to date. We knew it was important to have a well trained internal staff to oversee the day to day operations in the field. Brun-Way hired a consultant to put on a 2 day course that covered all aspects of pavement production and placement. In addition to this training, Brun-Way also held a one day session to specifically cover the project responsibilities of each internal staff member and also point out the important specifications relating to their role. The scope of the work involved many different locations, asphalt thicknesses, widths and milling depths. The main objective of the work was to correct surface defects in the driving lane through a mill and fill and provide additional strength through an overlay. Different thicknesses of asphalt concrete were specified depending on the strength improvement required. The job was completed on schedule and on budget with no major concerns associated with quality.

In the spring of 2011 we issued a tender that totalled 40,000 tonnes of asphalt concrete and about half of that contract called for warm mix asphalt. The training in 2011 for the internal staff was done by Brun-Way and it was more of a refresher course, since almost all of the same crew that worked in 2010 was available. One of the most notable improvements to the specifications in 2011 was the inclusion of

the IRI specification. Similar to the rehabilitation in 2010, the scope of the work involved many different locations and a variety of mill and fill in the driving lane with overlays. Once again this project was completed on schedule and on budget with no major concerns associated with quality.

The IRI specification is one of the most important specifications for Brun-Way. After the pavement rehabilitation was completed and the smoothness was collected, Brun-Way took the time to analyze the data to evaluate the Contractor's performance to make future adjustments to the IRI specification.

The 2011 pavement rehabilitation had a variety of treatments included. These ranged from mill and filling the driving lane, to mill and filling the driving lane followed by an overlay and in some areas an overlay only. As part of the data analysis Brun-Way matched up each 100m section from the IRI data after paving to the 2011 annual pavement management system values collected prior to the work. This allowed Brun-Way to determine the percent improvement from each type of treatment.

It is important to note that the pavement rehabilitation locations and treatments were determined in an effort to increase the strength of the pavement. During construction of the highway in 2005 through to 2007, the Construction division built the highway with a 130mm pavement structure with a planned overlay of 40mm about 7 years later. A combination of factors have led to doing the planned overlay in some sections earlier and also correcting some surface defects in the driving lane that developed.

The *Table VII 2011 IRI Percent Improvement* shows the pre-IRI value collected during our annual network survey versus the post IRI values collected after the pavement rehabilitation program. These IRI values shown are the average of 100m values. It is important to note that the pre-IRI values in almost all of the sections were relatively low to start with. The post IRI values are generally consistent in the 0.7 and 0.9 range.

If the goal is based solely on IRI improvement the best way to achieve this is to give the Contractor at least two attempts to improve. Notice the 70mm overlay had some of the lowest percent improvements. If these sections had been done in two lifts, the improvement could have been greater.

Table VII 2011 IRI Percent Improvement

Treatment Type	Pre-IRI	Post IRI	% Improvement
MF 47mm and OL 40mm DL	1.86	0.72	60%
MF 47mm and OL 70mm DL	1.12	0.64	42%
MF 60mm DL	1.96	0.77	59%
MF 60mm DL	2.29	0.96	57%
MF 60mm DL	1.57	0.91	46%
OL 40mm DL	1.44	0.82	43%
OL 40mm PL	1.14	0.76	31%
OL 40mm PL	1.26	0.81	35%
OL 50mm PL	1.16	0.76	32%
OL 50mm DL	1.08	0.77	27%
OL 50mm PL	1.20	0.87	26%
OL 70mm PL	1.22	0.86	28%
OL 70mm PL	1.23	0.95	19%

Where:

MF = Mill and Fill OL = Overlay DL= Driving lane PL= Passing Lane

4.0 Contractors View

Brun-Way felt that it was important to interview the Contractor's to get some feedback on the specification and overall project.

The Contractor's generally supported the new testing frequency and stated that the recognition of the QC results was helpful. This is similar to how many contracts are tendered in parts of Western Canada.

They had some concerns about the density specification. Having the lot average below 91% as reject might cause financial concern to some Contractors, especially with no opportunity for a bonus. A suggestion was made to reducing the lower limit to 90% or keeping it at 91% but include a bonus.

An observation was made during one of the projects that a large percentage of the tests were being taken near the start or end of the day's production and wanted Brun-Way to ensure that the random numbers are equally distributed throughout the lot size.

The addition of the IRI specification in 2011 raised some concerns with the Contractors since many of the New Brunswick Contractors were not used to this performance measure. Brun-Way had some concerns from Contractors during the bidding period about the IRI payment adjustment table. After the pavement rehabilitation was complete, the Contractor that performed the work felt that the payment adjustment table was achievable.

Overall the Contractors felt that Brun-Way have a very reasonable specification and although they think certain requirements are very aggressive they understand the importance for Brun-Way to make sure the asphalt pavement provides long-term serviceability and performance. They thought it was fair have an end result specification that recognized their QC results.

5.0 Consultants View

Just as it was important for Brun-Way to have the Contractor's view points after completing the pavement rehabilitation projects, Brun-Way wanted to follow up with the quality assurance Consultant to have their opinion on our specification.

The Consultant felt that we had a good specification and something that Brun-Way can improve on as knowledge and experiences are gained through future projects. The Consultant recommended that Brun-Way could develop ranges for accepting the QC and QA results. For example it was suggested that the QA air voids must be within 0.5 % of the QC air void result.

Also currently Brun-Way only collects and tests one loose sample per lot of asphalt concrete. The Consultant recommended that Brun-Way could collect three loose samples at the same locations as the QC samples, but only test one. Which loose sample to be tested would be determined randomly, therefore the Contractor would not know which one was going to be tested. There would not be any additional costs for Brun-Way to do this.

6.0 Lessons Learned

6.1 Training

Brun-Way focused most of the training efforts on making sure the internal staff members were prepared for the asphalt pavement rehabilitation program. As well, considerable time was spent with the Contractor and their QC people so that the specification was understood properly. The frequency of collecting the QA loose and core samples was quite different from the way they were accustomed to. This led to confusion in the field during the initial stage of the contracts.

In the future, Brun-Way will have a meeting with the Contractor and QC representatives to review the specifications so that everyone is clear how the QC and QA are performed.

6.2 QA Verifying QC Results

Brun-Way did run into some issues with the QA results not matching the QC results. Some of the differences were in the air voids of the loose samples and the density of the cores. In some cases the air voids had a difference of 1% or more. This caused one of the samples to be in specification when the other was just outside the limits. Similar observations occurred with the core samples, where one sample would be within specification while the other might be out.
Brun-Way did some further investigation and found that the differences could have been mitigated through better handling of the samples. There were two issues found with the core samples: sometimes they were taken too close together and the second core could have been damaged during the sampling. As well the transportation of the cores by Brun-Way to the QA consultant may have caused some damage prior to the testing. Going forward Brun-Way is going to ensure proper handling and

transportation procedures when delivering the samples to the QA consultant.
This problem was not a common occurrence and Brun-Way feels that we can mitigate the majority of these occurrences and are confident that our QA results reasonably verify the QC results.

6.3 Random Sampling Locations

Throughout the 2010 program and into the 2011 program Brun-Way was looking for a way to improve how we identify the random sampling locations. We wanted to have a method that was easy for our pavement inspectors to use, but also gave us a good record of where each sample was taken. Brun-Way feels that we took our experience in 2010 and improved on that for 2011 by using GPS coordinates to record the sample locations. Going forward, Brun-Way feels that this method will be effective and our staff found it easy to manage.

6.4 Verifying IRI results

After the project was completed Brun-Way compared the IRI results from after the pavement rehabilitation to the results from our annual IRI data collection. This proved to be difficult because the way the two sets of data are reported. The 100m sections in our annual network survey are related to each kilometer marker along the highway and the distance is reset to zero at each new kilometer. The data collection after the pavement rehabilitation started at the construction joint and continued to the end of the pavement section in 100m segments, with no regard to each kilometer marker. This would not be a concern or cause confusion if the kilometer markers were all exactly one kilometer apart, but that is rarely the case. The way the data is measured for the pavement rehabilitation is the best way for the enforcement of the IRI payment adjustments.

In the future, Brun-Way is investigating the advantages and disadvantages to the different style of reporting and if there is a need to directly compare the two.

7.0 Conclusions

Brun-way started with an asphalt concrete specification that was designed to transfer the financial risk from the Owner, by leaving the QC and QA program to the Operator. With minimal QC and QA requirements this allowed an opportunity to develop an end result asphalt specification that would transfer most of the risk to the Contractor while assuring that Brun-Way received a quality product that met all the original specifications.

Brun-Way started with the asphalt concrete pavement specification included in our contract and noted where improvements could be made. The revised specification made numerous additions and improvements to the QC and QA requirements.

The Contractor's that had the chance to work with Brun-Way using the revised specification felt that the specification was fair and they appreciated having the QC test results used in the payment for the work.

They thought that Brun-Way had some aggressive aspects to the specification but they understand why and generally agree that it is achievable.

The performance of the asphalt concrete pavement placed under the new specification is difficult to determine at this stage, because it is only 1 to 2 years old. Brun-Way will continue to monitor and is pleased with the results observed thus far. Even though Brun-Way is pleased with the end result specification that was used in 2010 and revised in 2011, we support and encourage continuous improvement. We are always looking for new developments with the ultimate goal of achieving cost effective, long lasting infrastructure.

Brun-Way's objective is to be successful in the Operation, Maintenance and Rehabilitation of the highway network. Through Brun-Way's pavement management system and team of people we will deliver the pavement back to the Province at the end of the OMR concession period in a condition that meets or exceeds the hand back standards.

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