Winnipeg, 24 January 2011
Dear Mr Szoke:

Thank you for the opportunity to review the latest cost figures. We (EAP) are not convinced they establish comparable solutions in terms of design approach and safety factors between the three options.
The need for bringing the options to common level for equitable comparison is illustrated by a few examples:

1. Flow
Compared to the highest currently observed average flows, around 70.7 ML/d in spring and summer, the Program design report recommends an average flow of 88 ML/d But the design is then done on a much higher value, for the spring max month of 120 ML/d.

Program : regarding the average flow, 70.7 ML/d is the year over year average flow during the Spring and Summer seasons. It does not represent the highest monthly average during these years. In addition, the 70.7 ML/d represents historical data and not the future design value for Year 2031 that includes anticipated population growth. 88 ML/d represents the Annual Average PROJECTED flow in Year 2031.
Regarding the spring max month of 120 MLD, the explanation is that, since the effluent guarantees are provided on a 30-d average basis, the design must be done on the maximum 30d influent load so that effluent requirement can be reached during this max month period. Any prudent designer will apply historical peaking factors on average flows. 120 MLD represents the max month flow during spring after application of the peaking factor based on historical data. Please refer to the explanation and tables in Part II of the PSR.]

This approach tends to favour Option 4 versus 2 and 3, as overdesigning on flows accentuates the differences between the three Options.

Program : as mentioned earlier, the system is not being overdesigned. However, higher flows accentuate the difference in CAPEX AND in OPEX. Therefore, high flows impact the 3 options and one can hardly predict if one option will be promoted compared to the other without making calculations.

Clarifiers tend to be limited by flow, biological filters limited by load

Program: not necessarily. BAF do have hydraulic limitations and, in diluted peak conditions, hydraulic limitations are quite often the limiting design factor of BAFs.

Options 2 and 3 are at a disadvantage because the high design flow leads to very large clarifiers, especially with the rather prudent design criteria used by the Program (0.75 m/h at peak flow in Option 2, vs 1.2 m/h in Option 3. By comparison the typical design for average load is 1 m/h and for peak flow 1.7-2.6 m/h (Metcalf & Eddy 2003)

Program: the secondary clarifiers in option 3 can be designed more aggressively as the secondary effluent then undergoes tertiary filtration (BAF) where lots of the secondary TSS will be filtered out.

2. Temperature

The design case is based on the max *month* load (spring max month), with a minimum *daily* temperature of 9℃ – not the average monthly temperature of 12 ℃. By choosing this very low temperature (daily extreme instead of monthly low) for design, another bias towards Option 4 is introduced, as the amount of biofilm reaction is largest in such a case - and BAF is less sensitive to temperatures than the activated sludge elements of Options 2 and 3.

Program: daily temperature has been considered, as the requirement of the license on ammonia limit is a daily never to exceed value.

3. Post-DN Loading

The Post-DN design of the biofilters is not consistent:
- in Option 3, they operate at 7.5 m/h average feed flow
- in Option 4, they operate at twice the average velocity - 15 m/h - with a peak of 20 m/h (extremely high). Yet the feed characteristics to the DN filters and treatment objectives are not much different:
- Option 3 has 16 mg TSS/L and 11.4 mg N-NO_3/L
- Option 4 has 20 mg TSS/L and 8 mg N-NO_3/L

One could argue that in Option 3 the biofilters should be designed more aggressively; they get less solids and get better kinetics with higher N-concentration...

Program: all options can be designed more aggressively. Actually, the PDN cell of option 3 has first been designed at the same size as N cells: 147 m2. Then, the Program decided to use 2 smaller cells instead of 1 big to allow some redundancy. 147m2 / 2 cells = 73m2, so 84m2 cells were selected (standard sizes). 65 m2 cells could probably have been chosen as well, which would have slightly reduced the CAPEX of option 3. However the difference between the peak velocities is less significant than for the average velocities, with 15 m/h for option 3 versus 20 m/h for option 4.

4. Biological Phosphorus Removal

In terms of P-removal we mentioned previously "…*the Program neglected the BIOWIN simulation, which is proven in terms of biological P removal in North America, because of its conservativeness. As a result, the updated design does not contain the optimization of anaerobic tank ".* The Program responded*: "…The retention time for the anaerobic zone is kept at 1.5 hour. This could be reduced to 1 hour, but in this case this would lead to the increase of the average concentration in the activated sludge trains from 4.0 g MLSS /l to 4.2 g MLSS/l which is not acceptable".* In fact, the hydraulic retention time in the anaerobic tank seems to be 1.6 hrs (8000 m^3 / 5000 m^3/h) for the maximum flow of 120 ML/d – meaning that under average conditions of 88 ML/d, the anaerobic tank has an HRT of 2.2 h – which is not a common design (even more at the current max month flow of 70 ML/d, it would be 2.8 h). It would be more economical during peak periods to enhance the bio-P with chemicals, that are provided anyway in the current design, rather than cumulating all conservative factors, such as max month load (spring max month), with a minimum temperature of 9℃, in a situation where low P and low VFA concentrations will not allow for efficient Bio-P removal.

Program: the balance between the biological and chemical P removal in option 2 can probably be optimized. However, the Program considered that the current design of option 2 is as per an expected balance between NPV optimization and compliance with the initial philosophy of option 2 (bioP removal). In addition, enhancing bio P removal with chemicals will reduce CAPEX but will increase OPEX at the same time.

The limiting design factor of option 2 is not the HRT or the kinetic of the bacterial reactions; it is plainly a matter of mass balance. We selected an SRT of 8.5 days and limited to MLSS to a maximum of 4 g/L to allow for acceptable secondary clarification efficiency. With these two parameters fixed, the total reactor volume needs to be 42 000m3 by simple mass balance.

With the current un-optimised comparison, the costs, as submitted, are showing the options being different in capital and operating costs. At 6% interest rate and 20 years amortization there would appear to be some advantage to Option 4 on a life-cycle basis. However, it is unclear whether the cost to manage the solids that will be sent to the North End facility is included in the annual costs. We believe this is an important factor since there will be more solids, including chemical solids, produced for Option 4 versus the other two options

Program: as indicated in the email sent by Nick Szoke on Jan 07, 2011 to the Professor: "*the operating costs do include sludge hauling to NEWPCC, but do not include sludge treatment. However, a subsequent evaluation of potential sludge treatment costs does not change the ranking of the options, but does bring options 2 & 4 closer on a total NPV basis, taking into account forecast operating costs*" (extract from T. Pearson's email on Jan. 6th, 2011, attached to the transmission email of N. Szoke to the Professor on Jan. 07th, 2011).

We also question whether there are other factors that are not being included, particularly since:

• The OPEX for South End are approaching the present annual costs of West End facility - a substantially smaller plant. This indicates that some costs have been excluded and it is unclear what has been excluded

Program: please refer to the "OPEX estimation" paragraph of PSR in which the OPEX breakdown is detailed and in which it is said that the CAPEX and OPEX estimations are for the unique purpose of comparison between the 3 pre-selected options and thus cannot be compared to the WEWPCC values. It is also clarified that not all the costs are considered in the OPEX but only the cost category where a difference could arise due to different process selection.

• The proposed OPEX are two times lower than the costs submitted by Stantec almost

4 years ago. It is clear that different approach to costing has been adopted.

Program: please refer to the "OPEX estimation" paragraph of PSR

In short, it is impossible to make a sound analysis of the options without some additional level of detail regarding the capital and operating costs (at least categorised by process units). Given the fact that Options 2 and 4 both scored high on non-cost factors and are both deemed sound technical options equitable process costs are needed to complete our assessment.

Program: the scoring was performed by the Program Team and is not to influence your assessment of the process selection. The city is well aware of the result and the Management Team will evaluate the result according to their proposed weighting.

Based on the cost presented, and assuming that the cost for solids management are higher for option 4 versus the other options, it appears that the Program has identified three options with nearly the same life-cycle costs

Program: as indicated in the email sent by Nick Szoke on Jan 07, 2011 to the Professor: "*the operating costs do include sludge hauling to NEWPCC, but do not include sludge treatment. However, a subsequent evaluation of potential sludge treatment costs does not change the ranking of the options, but does bring options 2 & 4 closer on a total NPV basis, taking into account forecast operating costs*" (extract from T. Pearson's email on Jan. 6th, 2011, attached to the transmission email of N. Szoke to the Professor on Jan. 07th, 2011).

– certainly, well within the accuracy of cost estimation being used. All three options will meet the permit requirements.

Program: the costing methodology having been the same for the 3 options, the accuracy of the estimation is the same for the 3 options.

The other financial factor that should be incorporated into the selection is how would either option affect cash-flow for the City, and which option allows a better phasing of the investments . Does a lower initial capital offer the City advantages versus a higher initial construction cost and lower O&M costs?

Program: we do not believe that this comment has any relevance with the EAP scope of work, but for your information this is the reason why the Program assessed the NPV of the 3 options and the Program Management Team proposed some weighting of the scoring according to their priorities.

Thus, other considerations such as operability, sustainability, will form the basis of the choice of options

Program: operability and sustainability have been assessed in the technical scoring (criteria #12 and 14). Please refer to the PSR and the minutes of the review workshop.

The integrity of comparison of the options would best serve the Program if the costs of all solutions are estimated by an independent third party to provide an apples-to-apples comparison. This should include the new Stantec Option 2, which is designed using the same raw wastewater parameters but a design approach tested in a number of North American facilities. EAP suggests that these new costs be estimated by a local independent estimator, thoroughly familiar with the construction market, constructability issues, and operation costs in Winnipeg

Program: Again, this comment has no relevance with the EAP scope of work, but we appreciate your concern. For your information, please refer to the PSR for the costing methodology. The methodology, the unit rates and all the costs have been validated by a local cost estimator with respect to construction market, constructability issues, and operation costs issues. This external cost estimator has also checked the consistency between the Program's cost estimations and Stantec's updated cost of option G.