BEFORE A HEARINGS PANEL OF THE GREATER WELLINGTON REGIONAL COUNCIL AND MASTERTON DISTRICT COUNCIL

[GWRC Ref: WAR 070077]

In the matter of	a resource consent application to Greater Wellington Regional Council pursuant to section 88 of the Resource Management Act and its Amendments.
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In the matter of	a Notice of Requirement to Masterton District Council pursuant to section 168 of the Resource Management Act and its Amendments.
By	Masterton District Council
For	The Proposed Upgrade of the Masterton Wastewater Plant

STATEMENT OF EVIDENCE OF MALCOLM FRANKLIN
ON BEHALF OF MASTERTON DISTRICT COUNCIL

Subject Area: Infiltration and Inflow

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1. INTRODUCTION

1.1 I am Malcolm Bryce Franklin, Manager – Wellington Water at Beca Infrastructure Ltd, B.E. (Hons), MIPENZ, CPEng. I am a civil engineer and have thirteen years experience in the field of civil and water engineering, with a majority of that in the areas of water and wastewater reticulation (sewers) and pipeline systems. I have undertaken projects that involve both the design of new systems as well as the analysis and assessment of the performance of existing systems. Of particular relevance to this project I have previously taken part in projects assessing the performance of sewer systems including for Palmerston North City Council, Masterton District Council (MDC) and also for various developers in the United Kingdom.

1.2 In this matter, I have undertaken an ongoing role for MDC in providing advice and engineering input into assessment and improvement of the Masterton sewer network performance, since 1996. Work undertaken as part of that role includes flow assessment and performance analysis; as well as sewer system assessment projects including CCTV and smoke testing; and also the design and management of projects to improve the system condition and performance including sewer and manhole sealing projects, sewer cleaning, and sewer and manhole replacement.

1.3 I have read the Code of Conduct for Expert Witnesses issued as part of the Environment Court Practice Notes. I agree to comply with the code and am satisfied the matters I address in my evidence are within my expertise. I am not aware of any material facts that I have omitted or might alter or detract from the opinions I express in my evidence.

1.4 My evidence is structured as follows:

(a) scope of evidence;
(b) executive summary;
(c) infiltration and inflow (I/I) in Masterton;
(d) effect of I/I on MWTP and discharge quality;
(e) reducing Masterton's I/I;
(f) submitters' concerns; and
(g) conclusion.

2. SCOPE OF EVIDENCE

2.1 My evidence will address the issue of sewer system inflow and infiltration (I/I) and how it impacts upon the Masterton Wastewater Treatment Plant (MWTP) upgrade. I will discuss the high rates of I/I in Masterton and the reasons for this, the effects of I/I on the MWTP upgrade and the approach taken in its design, and the work being undertaken to address I/I.

2.2 I will also explain why I consider the proposed MWTP upgrade is consistent with a good approach to future management of the I/I problem.

3. EXECUTIVE SUMMARY

3.1 Significant levels of I/I occur in Masterton's sewer network, caused by factors including high groundwater and an aged sewer network constructed over extensive low-lying topography, sometimes using poor construction techniques.

3.2 The levels of I/I lead to a high volume of wastewater arriving at the MWTP during wet weather, but this does not substantially affect the performance of the MWTP ponds, and does not contribute significantly to the mass of contaminants discharged.

3.3 MDC has been undertaking work to reduce I/I since the mid 1990s, and MDC has provisionally allocated approximately $15 m to sewer improvement investigations and capital works over the next 10 years in its current LTCCP planning round. This spending is additional to the MWTP upgrade costs.

3.4 The MWTP upgrade has been designed to cope with a continuation of the current influent flows, including I/I, and it is also flexible in that any future reductions in I/I will result directly in reductions to river discharges.

3.5 The increased cost that resulted from designing the MWTP upgrade to cope with the full, existing influent flows compared with the lower typical design influent flows is approximately $2.5 m. Sewer works to reduce I/I and achieve the necessary flow reduction to save this $2.5 m increase in MWTP upgrade cost are estimated to be in the order of $50 m.

3.6 Most importantly, as described in Humphrey Archer's evidence section 13.53, reducing I/I would not achieve any significant environmental benefit.

3.7 In my opinion it is therefore appropriate to design the MWTP upgrade with capacity to receive the current levels of I/I, and to continue to reduce I/I as a project separate from the MWTP upgrade.

4. INFILTRATION AND INFLOW IN MASTERTON

4.1 The Masterton sewer network comprises approximately 127 km of sewers ranging in size from 100 mm diameter to 825 mm diameter, 2,100 manholes, three pumps stations and 7,500 private property laterals. These private laterals are estimated to comprise an estimated additional 120 km of 100 mm diameter pipe. The sewer materials are predominantly earthenware, reinforced concrete, asbestos cement and PVC. These pipelines contain joints between individual pipes at intervals ranging from approximately 0.6 m to 1.8 m. Manholes are constructed from insitu concrete or precast concrete components. The sewer system is significantly aged – more than 30% of it is more than 80 years old.

4.2 I/I comprises water that enters the sewer network other than wastewater discharged by customers. Typically, it consists of some combination of rainwater that enters the sewer network through holes in the 'near-ground' parts of the sewer pipes and manholes, or by stormwater drains incorrectly connected to the sewer network (inflow) and water that enters the sewer network from the ground via holes in the sewer pipes or manholes (infiltration). The result is high total flows in the sewer network that can lead to overflows from the manholes and such flows can also cause problems or additional costs at the treatment plant and ultimate discharge to environment.

4.3 In Masterton's sewer network, significant I/I occurs. Typical influent flows into the MWTP are set out in Table 1 below. On average, the MWTP receives 15,750 m^3 total influent per day, including I/I.

Table 1 (Table 2 in the AEE) Existing Influent Flow to the Ponds

Flows	m^3/day
Dry weather (summer time minimums)	8,200 (including 670 m^3/day trade waste flow)
Peak wet weather	60,480 (during a July 2006 storm event)
Average	15,750 (including 670 m^3/day trade waste flow)

4.4 While I/I is a common characteristic of sewer network systems, the rate of I/I in Masterton is relatively large. In 1997, the Ministry for the Environment reported the national average wastewater treatment plant influent flow was approximately

0.41 m^3/person/day, including trade waste. In 1995, the New Zealand Water and Wastes Association reported that the average wastewater treatment plant influent flow was approximately 0.35 m^3/person/day across 17 operating wastewater treatment plants. The Masterton population is almost 18,000, and the trade waste flow is approximately 670 m^3/day so the average per capita wastewater in Masterton is approximately 0.85 m^3/person/day excluding trade waste. This indicates that Masterton has wastewater flows more than twice what are typical in New Zealand as a result of high I/I. Typical domestic wastewater flows are 0.25 m^3/person/day or a total of approximately 4,400 m^3/day. Therefore from Table 1, the average daily MWTP influent flow includes approximately 15,750 – 670 - 4,400 = 10,700 m^3/day of I/I. Masterton has the following features which are major contributing factors to this high I/I:

(a) a relatively aged sewer network. Deterioration in the pipes, manholes and joints has lead to a large number of cracks and holes that allow I/I,

(b) poor construction techniques employed for sewers installed in the mid-20th century including manhole jointing and support quality have resulted in sewer and manhole cracks and hole problems in those areas leading to I/I also. Often, this poor construction was partly caused by high groundwater and unstable soils that make deep sewer construction a difficult job in Masterton,

(c) the topography of the town which is low-lying compared with watercourses, has resulted in stormwater drainage problems. This has resulted in a large number of deliberate connections of surface water drainage to the sewer reticulation network by private property owners as an ‘easy fix’,

(d) fluctuating and at times high groundwater levels, that allow a lot of water to leak in through the sewer network defects,

(e) fluctuating groundwater levels also make the sewer environment more corrosive, potentially exacerbating sewer defects,

(f) an extensive sewer network relative to the population,

(g) a large coverage of trees which result in major root intrusion into the sewers causing joints to open and sewers to crack.

4.5 The high I/I results in a greater volume of wastewater arriving at the MWTP than otherwise would be anticipated. During wet weather, the influent flows can be very high as indicated in Table 1 above. However such flows are of course considerably more diluted.

4.6 A study of the sewer network (Beca 2004c) concluded that groundwater infiltration appears to be the dominant issue in Masterton for the reticulation system. This infiltration is persistent when the groundwater levels are high. However, high direct inflows due to direct connections of stormwater pipes to the sewer reticulation also occur for shorter periods during and immediately following periods of heavy rainfall.

4.7 Studies also show the I/I problem is widespread across Masterton and while the severity of the problem in different areas has been ranked, most sections of Masterton's sewer network are subject to high I/I.

4.8 The replacement value of the public sewer network is estimated at $80 m, with the private laterals estimated at an additional $35 m. Therefore replacement of the entire system is not considered to be a feasible approach to resolving Masterton's I/I problem. However, the effects of the high I/I on the treatment and disposal of wastewater at the MWTP and the sewer overflows that occur in Masterton are concerns and reduction of I/I is a key objective for MDC in its ongoing infrastructure planning. Submitter 242578 (Fish & Game New Zealand) is also concerned about the effects of possible exfiltration (wastewater leaking to groundwater from sewers at times of low groundwater levels) on water bodies. This is another driver for improving the functioning of the reticulation system.

4.9 Reducing the level of I/I into, and leakage of, the sewer network is a key imperative to improving the functioning of the Masterton sewer system, in conjunction with the upgrading of the MWTP itself.

5. EFFECT OF I/I ON MWTP AND DISCHARGE QUALITY

5.1 For the currently proposed MWTP upgrade, design influent flows and loads had to be assessed for the full design life of the new WWTP. It was recognised that a reduction in the high influent flow that resulted from high I/I would be desirable. However, it was also recognised that the following factors affected the extent to which that could be factored into the MWTP upgrade design:

(a) the cost and success rate of I/I reduction programmes are notoriously variable both in New Zealand and overseas,

(b) because a 'one-off' replacement of the network is not feasible, sections of sewer that are not targeted by a repair or replacement programme will continue to deteriorate in condition thereby increasing I/I,

(c) spending on the reticulation system to reduce overflows would likely include works that would improve the hydraulic capacity of the sewer network thereby actually increasing the potential influent flows into the MWTP.

5.2 The existing MWTP and proposed new pond scheme are both pond-based. The nature of this treatment methodology is that it is not particularly sensitive to short-term, high direct inflows. The effect of high flows due to rainfall was investigated and reported in *Sampling After Rainfall Events* (Beca 2004e). This report concluded that while there was a small increase in the *E.coli* levels in the MWTP effluent, the rainfall events did not affect the overall performance of the ponds. It is important to recognise that the additional flow from I/I of any type does not contribute significantly to the mass of contaminants discharged to the river. These events also occur at times of high river flow and poorer upstream water quality, so their environmental effects are further mitigated by dilution and often, the condition of the receiving water.

5.3 The primary problem for the MWTP (both existing and proposed new designs) is the longer term, high groundwater infiltration as this causes a sustained high rate of influent flow to the MWTP.

5.4 The implications of a sustained high rate of influent flow for the proposed MWTP upgrade design are:

(a) a need for a combination of a greater land irrigation area and a greater annual volume of discharge to the river. (If the river discharges were kept the same as currently proposed then for a town of similar size that had New Zealand average amounts of I/I the irrigation area required would be approximately halved ie. approximately $2 m in construction cost would be saved.)

(b) ponds that have an unchanged total surface area but with an increased embankment height to create more storage volume. The embankments are approximately 0.5 m higher than they would need to be for a town of similar size that had New Zealand average amounts of I/I. This is an embankment height 20% higher, equating to a 30% greater pond embankment volume. This represents approximately $0.5 m in extra pond construction cost resulting from the high I/I occurring.

5.5 Therefore, the cost difference between designing an upgrade scheme for the current MWTP influent flows and those for a town of similar size that had New Zealand average amounts of I/I would be approximately $2.5 m in construction cost. From the estimated I/I removal costs in section 7.2 below, sewer works to achieve the necessary flow reduction to save this cost are estimated to cost in the order of $50 m (estimated average $10,000/$m^3$/day I/I reduction cost for 5,400 m^3/day flow reduction).

5.6 It was concluded that the lack of sensitivity of construction cost to I/I reduction expenditure and the minimal environmental effects of the additional flow, meant that the design should allow for the current, high influent flow. The design loads for the MWTP upgrade were based on this assumption. Therefore, the current and projected total influent loads (comprising domestic and trade waste loads) are shown in Table 2 below:

Table 2 (Table 22 in the AEE) Current and Projected MWTP Flows and Loads, 2005 to 2015

	Current (2005)				Future (2015)			
	Av. flow (m^3/d)	Peak Flow (litres/sec)	BOD (kg/d)	SS (kg/d)	Av. flow (m^3/d)	Peak Flow (litres/sec)	BOD (kg/d)	SS (kg/d)
Domestic	15,080	692	1,316	1,530	15,080	692	1,316	1,530
Trade	670	8	516	292	1,220	14	710	429
TOTAL	15,750	700[1]	1,832	1,822	16,300	706	2,026	1,959

Note: Peak flow recorded during 5-7 July 2006 storm event.

5.7 It was also concluded that the scheme needed to be flexible as future reductions in I/I that are achieved can result directly in equivalent reductions in river discharges. The scheme design achieves this.

Environmental consequences of further reductions in I/I

5.8 As discussed above, the scheme has been designed to cope with projected loads and it is based on assumptions that I/I solutions would continue but that I/I will not be significantly reduced. If I/I expenditure was increased significantly then greater I/I reductions will be achieved. This would reduce the volume of the discharge to the river. It needs to be appreciated however that such reductions would be costly and would not eliminate the river discharge without the provision of additional irrigation land. Nor would they have any significant environmental advantage since the upgrade is already designed to adequately avoid remedy or mitigate adverse effects in the river by removing the discharge at times of lower flow, as described in Humphrey Archer's evidence section 13.53.

6. REDUCING MASTERTON'S I/I

6.1 Notwithstanding the approach to the MWTP upgrade outlined earlier, the MDC places a high priority on reducing I/I.

6.2 The Regional Freshwater Plan for the Wellington Region promotes a preference for land-based discharges of municipal wastewater where possible. As discussed, the MWTP's I/I rate is high by national standards which, if reduced by targeting key areas of the system, would result in a significant reduction in the volume of influent to be treated, thereby reducing the proportion of effluent discharged to the river.

6.3 The key benefit of the proposed wastewater upgrade is to remove the discharge from the river at times of low river flows when the river is most likely to be used for contact recreation, and to discharge to land. This is consistent with the policy preference set out in the Regional Freshwater Plan for municipal wastewater to be discharged to land where possible.

The proposed works programme and work completed to date

6.4 In parallel with the proposed upgrade of the MWTP, the MDC has undertaken ongoing work to reduce the amount of I/I into the Masterton sewer network since the mid 1990's.

These are two quite different projects, with different objectives, both of which involve a substantial investment by MDC.

6.5 The I/I reduction work undertaken by MDC since the mid-1990's includes:

(a) A number of flow monitoring studies to attempt to identify the worst performing parts of the network in terms of I/I,

(b) An extensive sewer network grout sealing contract in the Bentley Street catchment,

(c) Grout sealing of sewer network in the Lansdowne catchment,

(d) The repair of leaking manholes,

(e) CCTV covering approximately 30% of the 130km Masterton sewer network to further define poorly performing sewers in terms of I/I,

(f) Condition inspections of approximately 25% of the manholes in the Masterton sewer network to identify leaks,

(g) Private property I/I 'source detection' inspections of approximately 2,300 properties of the total number of 7,500 properties Masterton,

(h) Enforcement programmes to compel property owners found to have defects in their private laterals to repair them,

(i) Sewer maintenance work to arrest further deterioration, and

(j) The replacement of the Cockburn Street sewer. The Cockburn Street sewer has been demonstrated to have particularly high I/I, and the project included the replacement of approximately 2.4 km total length of mains and lower sections of laterals, and 16 manholes.

6.6 In addition to the above projects, MDC have let a number of consultancy contracts to investigate the nature of the Masterton I/I problem, identify its causes and potential solutions, and recommend improvement works to reduce I/I. Implementing cost-

effective I/I reduction requires significant investigation so this is consistent with an effective programme addressing this issue.

6.7 Submitter 242613 (Wairarapa Public Health) is of the view that I/I should be included as part of the overall MWTP upgrade. MDC have incorporated such an approach in their plans as MDC staff have allocated approximately $15 m in the 2009-2019 LTCCP for the purposes of sewer improvement investigations and capital works over the next ten years. MDC have not included this in the MWTP upgrade project because I/I is considered a distinct issue needing ongoing attention rather than being a component of the MWTP upgrade. The plans include expenditure up to $2 m per year on a combination of the following:

(a) CCTV, manhole inspections, and private property I/I source detection inspections to continue to seek to identify the areas with the worst I/I;

(b) sewer and manhole replacement to steadily reduce total system I/I;

(c) assessment of the effectiveness of work by before and after repair/replacement flow monitoring; and

(d) programmes to compel property-owners to repair defects found in their private laterals (the lateral from the boundary to the house is the responsibility of the property owner).

6.8 In my opinion this extensive work programme demonstrates the high priority MDC places on the reduction of I/I into the Masterton sewer network.

The effectiveness of sewer works for I/I reduction

6.9 Unfortunately, while there are significant benefits to be gained from a reduction in I/I and MDC has an extensive sewer improvement works programme in place, information from successful I/I reduction programmes around New Zealand and overseas indicates that the cost of achieving even a moderate reduction is relatively high.

6.10 There are many factors that influence the effectiveness of an I/I reduction programme – for example:

(a) The potential for groundwater infiltration to migrate to pipes that have not been repaired,

(b) The condition of sewage pipes throughout the system, particularly the water tightness of joints,

(c) The ability to have faults in private property remedied in conjunction with repairs on public faults (the private section of the lateral sewer network significantly contributes to I/I),

(d) The condition of the system continues to deteriorate with time. Significant expenditure is required to just 'hold the line' to existing flows.

6.11 Another avenue for I/I reduction is the enforcement of the repair of defects by private property owners in the privately-owned sections of the network. The repair of many of these defects tends to be relatively low in cost as they are often surface-level works such as raising gullies or redirecting downpipes to the stormwater system. However, the nature of the 'cheap to repair' defects is generally such that they allow high inflows but for a relatively short duration. They are therefore less of a problem in terms of wastewater treatment and disposal. So while MDC is investigating and requiring repair of these types of defects in ongoing programmes as a high priority, that work is not expected to have a substantial effect on reducing average influent flows to the MWTP. It will tend to have a greater effect on the reduction of overflows from the system which is a separate objective of the MDC.

6.12 It is also important to consider the substantial sewer overflows that occur in Masterton during and after rainfall at times of high groundwater. Expenditure to address this health risk should consist of a range of options – this would generally include repair of inflow sources and sometimes it may include increasing sewer capacity locally. This type of expenditure may not contribute significantly to reduce the MWTP influent flow, and may in some cases actually tend to increase it. MDC therefore faces a substantial competing driver for sewer improvement expenditure.

7. SUBMITTERS' CONCERNS

7.1 Submitters 242577 (Department of Conservation, DoC) and 242578 (Fish & Game New Zealand) both suggest that I/I has significant environmental effects and the DoC submission states that I/I reduction should be aligned with this resource consent. While I agree that I/I reduction is important, I consider that attention should not be focused on reducing the MWTP influent flow at the expense of the health risks associated with overflows. I do not agree that I/I will cause any more than minor adverse environmental effects. This is because the residual discharge to the river will not have any significant adverse effects on the environment, as described in Humphrey Archer's evidence.

7.2 Given the potential benefits of additional I/I reduction, an analysis of the cost/benefit of accelerated expenditure on I/I reduction was undertaken. The analysis on the reduction of I/I showed that the cost would be in the order of $2,000-$15,000 per m^3/day reduction in daily influent flow to the plant – tending to the higher end of that band as large amounts of I/I are to be removed as this requires expenditure in better-performing parts of the network with a corresponding lesser I/I reduction per dollar of investment. These costs are based on removing groundwater infiltration rather than inflow. Inflow reduction tends to be cheaper but is of less significance for the MWTP design. Reliable, applicable cost information on this subject is limited and the cost band described above is approximate only and subject to a number of complex variables. I have used my experience and professional judgment in making allowance for these variables in developing that cost band for the purposes of considering potential impacts of I/I reduction on the MWTP upgrade. By way of comparison the cost of establishing an irrigation scheme is in the order of $1,000-4,000 per m^3/day of effluent irrigated (including land purchase costs).

7.3 Due to the above factors, while MDC is undertaking an I/I reduction programme, in my view it is not appropriate to attempt to constrain the outcome to a certain I/I reduction amount as this may raise affordability issues for the community and prevent the ability to also focus on overflow reduction.

8. CONCLUSION

8.1 In conclusion, reduction in I/I is a key imperative for MDC and a works programme is in place to achieve this. Overflow reduction is a competing driver for expenditure on the sewer network that MDC must also allow for.

8.2 MDC has been undertaking a works programme that incorporates I/I reduction as one of its objectives for sewer system asset management and intends to continue with this approach in the future. This is expected to continue to progressively reduce I/I and therefore progressively reduce river discharge flows. Provided high standards of construction are applied to sewer improvement work, the resulting reduction should increase until all parts of the network have been renewed, then be able to be maintained indefinitely via ongoing maintenance and renewal programmes. I consider that this is an appropriate approach.

8.3 The timing and quantity of I/I reductions that result from the works programme are highly uncertain and the setting of targets could result in affordability issues or lack of ability to deal with the overflow problem.

8.4 The design of the MWTP takes an appropriate approach to the uncertainty of the quantity of I/I reductions in allowing for a continuation of the current influent flows. It is also flexible in that any future reductions in I/I that are achieved will result directly in reductions to river discharges, while the scheme does not represent excessive 'overinvestment' in capital cost elements that would not be required for significantly lower MWTP influent flows. I consider increasing I/I reduction will not achieve any significant environmental benefit to the MWTP discharge because the residual discharge to the river will not have any significant adverse effects on the environment, as described in Humphrey Archer's evidence section 13.53.

Malcolm Franklin
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13 February 2009