



27 January 2017

INFRASTRUCTURE DEMAND ASSESSMENTS PROPOSED MORAY PLACE DUNEDIN HOTEL

The purpose of these notes is to describe the anticipated demand on various Dunedin City service infrastructures that is likely to be generated from implementation of the proposed Moray Place Dunedin Hotel. These assessments are intended to assist the resource consent process.

1.0 Foul Sewerage Infrastructure

The method selected to assess the anticipated demand on the City's foul sewerage network from the proposed hotel is the method described under section 5.3.5.1(a) of NZS4404:2004. This method evaluates residential flows and includes all typical residential discharges, including those from bathrooms and kitchens. No special consideration of the Hotel's commercial kitchen and/or shared guest facilities has been included in this assessment as these flows are built into the normal residential flows (for instance, guests eating at the restaurant will presumably not make use of in-room kitchen facilities).

Base data:

1. Average dry weather flow: 200 litres per day per person.
2. Peaking factor: 2.5
3. Wet weather infiltration rate: 2
4. Average number of people per unit: 2.5
5. Number of Hotel units: 280 (mixture of studio, 1-bedroom and 2-bedroom units).
6. Average high-season occupancy rate: 80%

Note 1: Method 5.3.5.1(a) specifies an average dry weather flow of 180 to 250 litres per day per person. This assessment has applied a value of 200 litres per day per person which is towards the lower end of the specified range. This is considered appropriate as Hotel guests are expected to be away from the Hotel for much of daytime period, thus their average 'at home' period is lower than the average residential 'at home' period.

Note 2: Method 5.3.5.1(a) specifies the number of people per dwelling (unit) as being between 2.5 to 3.5. Allowing an even mix of the proposed studio, 1-bedroom and 2-bedroom units, with average numbers of occupants of 1.25, 1.75 and 2.75 respectively, the overall average number of people per unit has been determined to be just over 1.9. However, adopting the low end of the range in method 5.3.5.1(a), at 2.5 persons per unit, is appropriate and provides some contingency to the calculations.

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Note 3: The target average year-round occupancy rate for a hotel is often considered to be 70%. The value of 80% is considered to be a realistic average high-season occupancy rate, bearing in mind also that some of the units are likely to be occupied as private apartments with permanent or long-term leases.

Flow Assessment:

Average wet weather daily flow, in litres per day, can be determined by multiplying the base data values above but excluding the peaking factor value (item 2 above)-

$$\text{Flow} = 200 \times 2 \times 2.5 \times 280 \times 0.8$$

$$\text{Flow} = 224,000 \text{ litres per day}$$

Average wet weather peak flow, in litres per second, can be determined by converting the average wet weather daily flow to a per-second flow and multiplying the peaking factor (item 2 above).

$$\text{Flow} = 224,000 / 86,400 \times 2.5$$

$$\text{Flow} = 6.5 \text{ litres per second}$$

Flow Summary:

This assessment concludes that the proposed Hotel will generate a foul sewage discharge flow of 6.5 litres per second into the local City network.

As there is no exiting foul sewage discharge from the site, this represents an increase of 6.5 litres per second from the present situation.

There is an existing 150mm diameter cast concrete public foul sewer (DCC asset) located within Moray Place adjacent to the development site. There is sufficient fall between the development site and this public sewer to support gravity drainage. At the time of preparing this assessment there are no known capacity issues associated with this sewer, and it would appear that a directly lateral connection from the development site will provide a suitable means of discharging foul sewage.

Trade Waste

Trade waste treatment will also need to be integrated into the development in support of the restaurant activities. A variety of proprietary systems are available to successfully achieve an acceptable discharge quality, including the Humes Grease Interceptor range (brochure attached). The proposed make and model of a suitable trade waste treatment system will be identified as part of the building consent process.

2.0 Water Infrastructure (Domestic Supply)

The method selected to assess the anticipated demand on the City's water supply network from the proposed hotel is the method described under section 6.11.5 of NZS4404:2004. This method evaluates the minimum demand that the Hotel will need to be designed to

meet for domestic purposes (i.e. kitchens, bathrooms, etc). This method does not assess the water supply demand to satisfy firefighting requirements. The water supply demand for firefighting purposes will be assessed under a separate report.

As with the foul sewage assessment above, no special consideration of the Hotel's commercial kitchen and/or shared guest facilities has been included in the domestic water supply evaluation as these flows are similarly built into the normal residential demand.

Base data:

1. Daily consumption: 250 litres per person per day.
2. Peaking factor: 5
3. Average number of people per unit: 2.5
4. Number of Hotel units: 280 (mixture of studio, 1-bedroom and 2-bedroom units).
5. Average high-season occupancy rate: 80%

Note 4: Refer to Note 2 above for comment on the assessment of the average number of people per unit.

Flow Assessment:

The minimum daily demand for domestic water supply, in litres per day, can be determined by multiplying the base data values above but excluding the peaking factor value (item 2 above)-

$$\text{Flow} = 250 \times 2.5 \times 280 \times 0.8$$

$$\text{Flow} = 140,000 \text{ litres per day}$$

The minimum design demand flow for domestic water supply, in litres per second, can be determined by converting the assessed daily demand to a per-second flow and multiplying the peaking factor (item 2 above).

$$\text{Flow} = 140,000 / 86,400 \times 5$$

$$\text{Flow} = 8.1 \text{ litres per second}$$

Demand Summary:

This assessment concludes that the proposed Hotel will generate a minimum water demand for domestic purposes of 8.1 litres per second from the local City network.

As there is no existing domestic water supply to the site, this represents an increase of 8.1 litres per second from the present situation.

As discussed above, the minimum water demand for firefighting purposes will be assessed separately.

There is an existing 150mm diameter asbestos cement water main (DCC asset) located within Moray Place adjacent to the development site. Council advice indicates that the current working pressure of this main is in the order of 61-66mH, or around 600 to 650kPa. Council records also indicate existing flows at several nearby fire hydrants to be in the order

of 50 litres per second. It is anticipated that the existing working pressure and hydrant flows will be able to satisfy the demand requirements of the proposed Hotel. A backflow preventer valve and meter will need to be installed on the Hotel supply connection to ensure that the City's public reticulation network is not put at risk from reverse contamination issues.

Artesian Water

The Hotel development proposes to install a bore to source existing artesian water for the purpose of operating a hot pools facility on-site. This raises matters to consider in regard to the availability of artesian water, the consents required to source this water, treatment of the water within the hot pools facility, and the manner of water discharge.

Preliminary advice from GeoSolve has artesian water is potentially available at a depth of approximately 75m (at the Caversham sandstone layer) and at a supply rate of approximately 4-5 litres per second. This will need to be confirmed through installation of a test bore.

Otago Regional Council has advised that an approval is needed for the bore and then a consent is required for the ongoing water take. Neither of these processes are anticipated to be problematic.

The treatment of water within the hot pools will be by way of chlorine. The water will be re-used/recycled as much as possible to minimise water take and water discharge volumes. Large volume discharges, for instance when the pools very occasionally need to be emptied for maintenance purposes, will occur in the late evening or early morning hours when the public foul sewerage system is subject to lower average flows.

Water Feature

The water feature will source water from a combination of on-site collection of stormwater and the Hotel's water supply connection from the City network (the latter being used to top up the feature when on-site collection is not available). The water within the feature will operate on a cycle, so only minimal topping up will be required. Any necessary discharges, for maintenance purposes, will occur to the public stormwater network and these will only occur during periods of dry weather and at a controlled sustainable discharge rate so as to not overload the downstream capacity of the stormwater system.

Green Technology

Green technology is expected to be installed as part of the Hotel development. This will most likely include low flow devices and may include grey water reuse. Details of these devices/systems will be developed as part of the building consent plans and will be presented at Council at that time.

3.0 Stormwater Infrastructure

The method selected to assess the anticipated demand on the City's stormwater network from the proposed hotel is the method described below, using relevant information from E1/VM1 of the New Zealand Building Code. This method evaluates the anticipated increase in stormwater flows from the site from the existing situation to the post-development situation.

Base data:

1. Run-off coefficients-
 - Existing asphalt and paving: 0.85
 - Existing green areas: 0.30
 - Developed structures: 0.90
 - Developed asphalt and paving: 0.85
 - Developed green areas: 0.30
2. Design event: 1:50 years (2%)
3. Time of concentration: 10 minutes
4. Average site elevation: 20m
5. Rainfall intensity: 97mm/hr
6. Site areas-
 - Total site area: 3,680m²
 - Existing asphalt and paving: 2,730m²
 - Existing green areas: 950m²
 - Developed structures: 1,300m²
 - Developed asphalt and paving: 1,720m²
 - Developed green areas: 760m²

Note 5: Run-off coefficients have been adopted from Table 1 of E1/VM1.

Note 6: The design event of 1:50 years (2%) has been selected in accordance with clause E.1.3.2 of E1/VM1. It may be possible to use apply a 1:10 year (10%) event to this assessment and still comply with V1/EM1, however local practice has been to adopt the higher-order event for design purposes as a more conservative approach.

Note 7: The time of concentration of 10 minutes as been adopted at the fastest period normally considered. This is due to the relatively small area of the site, its moderate grade and the level of existing and proposed hard-stand surfacing.

Note 8: The rainfall intensity has been determined from interpolation between Figures 2 and 3 of Raineffects Ltd report for Dunedin City Council dated December 2016.

Note 9: Site areas have been scaled from existing aerial photography and concept design drawings.

Existing Flow Assessment:

Using the stormwater flow equation $Q = 2.78 \text{ c i a}$, where Q is the flow quantity in litres per second, c is the run-off coefficient, I is the rainfall intensity, and a is the catchment area (in hectares), the existing stormwater site flow can be determined as follows-

1. For the asphalt and paving areas:

$$Q = 2.78 \text{ c i a}$$

$$Q = 2.78 \times 0.85 \times 97 \times 0.2730$$

$$Q = 62.6 \text{ litres per second}$$

2. For the green areas:

$$Q = 2.78 \text{ c i a}$$

$$Q = 2.78 \times 0.30 \times 97 \times 0.0950$$

$$Q = 7.7 \text{ litres per second}$$

Therefore, the total existing stormwater flow from the site, in a 1:50 year event of 10 minutes duration, is the sum of the above flow components, being 70.3 litres per second.

Post-Development Flow Assessment:

Using the same equation as above, but with the anticipated development values, the existing stormwater site flow can be determined as follows-

1. For the developed structure areas:

$$Q = 2.78 \text{ c i a}$$

$$Q = 2.78 \times 0.90 \times 97 \times 0.1300$$

$$Q = 31.6 \text{ litres per second}$$

2. For the developed asphalt and paving areas:

$$Q = 2.78 \text{ c i a}$$

$$Q = 2.78 \times 0.85 \times 97 \times 0.1720$$

$$Q = 39.4 \text{ litres per second}$$

3. For the developed green areas:

$$Q = 2.78 \text{ c i a}$$

$$Q = 2.78 \times 0.30 \times 97 \times 0.0760$$

$$Q = 6.1 \text{ litres per second}$$

Therefore, the total post-development stormwater flow from the site, in a 1:50 year event of 10 minutes duration, is the sum of the above flow components, being 77.1 litres per second.

Flow Summary:

This assessment concludes that the proposed Hotel will generate a stormwater discharge flow of 77.1 litres per second into the local City network.

As the existing site discharge, for the same design event, is 70.3 litres per second, this represents an increase of 6.8 litres per second from the present situation. This is a fairly modest increase, principally due to the fact that the site is predominantly surfaced in asphalt and paving areas at present.

The outlined design situation caters for a short, high-intensity event. A similar calculation carried out for a long-duration event (2 hours, being the longest duration shown in the Raineffects data), results in the following characteristics-

- Interpolated rainfall intensity: 19mm/hr.
- Existing site flow: 13.8 litres per second.
- Developed site flow: 15.1 litres per second.
- Developed site flow from structure areas: 6.2 litres per second.
- Difference in site flows: 1.3 litres per second.

The characteristics of this long-duration event are an important consideration when determining appropriate retention facilities, discussed below.

New internal pipework should be designed to satisfy the flows resulting from the 1:50 year event of 10 minutes duration. There is an existing 600mm by 400mm egg-shaped brick stormwater public stormwater sewer (DCC asset) located within Moray Place adjacent to the development site. There is sufficient fall between the development site and this public sewer to support gravity drainage. There are known capacity issues with this public stormwater sewer, however provided that suitable on-site retention can be provided (discussed below) then it is considered appropriate for stormwater discharge from the development site to be discharged into this public sewer.

Stormwater Retention

Council advice has confirmed that there are known stormwater flooding issues in the area and that there is an expectation that detention / attenuation measures will be integrated into the Hotel design to ensure that peak flows are captured and stored on-site prior to a gradual discharge into the public stormwater network.

The simplest method of providing on-site retention may be the installation of an underground storage tank to intercept the flow from the developed structure areas, and to release these flows at a restricted rate. This is generally easy to achieve as this flow results from an elevated catchment which can be intercepted usually without a complex drainage system.

The increase in site flows, for the design 1:50 year event of 10 minutes duration, has been assessed at 6.8 litres per second. The flow from the developed structure areas (under the same event conditions) is 31.6 litres per second. If the incoming flow was to be captured in a storage tank which had a discharge rate of 24.8 litres per second (thereby retaining water at a rate of 6.8 litres per second), the total flow leaving the site would be maintained at the existing rate.

The same assessment of the increase in site flows, but for the long-duration 1:50 year event of 2 hours, has resulted in 1.3 litres per second. The flow from the developed structure areas (under the same event conditions) is 6.2 litres per second. If the incoming flow was to be captured in a storage tank which had a discharge rate of 4.9 litres per second (thereby retaining water at a rate of 1.3 litres per second), the total flow leaving the site would be maintained at the existing rate for assessed long-duration event.

In the design 1:50 year event of 10 minutes duration, the total volume of stormwater being retained (if retained in the manner described above) would be 4,080 litres (6.8 litres per second x 60 seconds x 10 minutes). This volume could be satisfied by the installation of a standard 5,000 litre tank.

In the design 1:50 year event of 2 hours duration, the total volume of stormwater being retained would be 9,360 litres (1.3 litres per second x 60 seconds x 120 minutes). This volume could be satisfied by the installation of a standard 10,000 litre tank.

However, both of the above scenarios need to be satisfied. Simply selecting the larger of the two volume assessments is not an appropriate solution as the discharge rates of the storage tanks in the two assessments is different. A 10,000 litre tank, discharging at a fixed rate of 4.9 litres per second, will not satisfy the short high-intensity event because the discharge rate is much lower than the high-intensity event would otherwise support.

Instead, an integrated solution is needed. For instance, a tank with a total capacity of 12,000 litres will satisfy both the 10 minute event and the 2 hour event provided that there are difference sized discharge restrictions placed at appropriate levels in the storage chamber. The first 10,000 litres of storage should be released at the rate applicable to the long-duration event, i.e. 4.9 litres per second, which will satisfy the retention requirements for that nature of event. The remaining 2,000 litres should be released at the rate applicable to the short, high-intensity event less the 4.9 litres per second already being discharged, i.e. a rate of $24.8 - 4.9 = 19.9$ litres per second. The total 12,000 litres of storage capacity, and the two different release rates associated with the two chamber-parts, will satisfy the required storage volume for the 10 minute duration event.

Retention Summary

The proposed activity will need to provide stormwater retention on-site in support of the proposed development. This will be required to ensure that post-development flows do not exceed existing site flows.

The retention facility will need to ensure that it is able to be effective under both short, high-intensity events and long duration events. This can be achieved in a number of ways, however the most suitable method might be by way of a 12,000 litre storage tank with multiple controlled discharge outlets, as described in the assessment above. The exact nature of the retention facility should be reviewed by Council at the building consent stage of the development, which will allow the detailed calculations to be updated following completion of the final construction plans.

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