INFRASTRUCTURE ASSESSMENT REPORT

For Shotover Property Investments Ltd
January 2011

CLARK FORTUNE MCDONALD & ASSOCIATES
REGISTERED LAND SURVEYORS, LAND DEVELOPMENT & PLANNING CONSULTANTS

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1.0 INTRODUCTION

Clark Fortune McDonald & Associates (CFM) has been engaged by Shotover Property Investments Ltd to assess infrastructure options for a plan change on land located on Hansen Road adjoining the recently completed Terrace Junction commercial development.

The proposal seeks to amend the zoning of the site from its current low density residential zoning to a 'mixed use' zone comprising commercial, business and residential activities.

The site is legally described as Pt Sec 5, BLK XXI, Shotover S.D. and Lot 1, DP26426. The total site area comprises 3.4063ha and is contained in CT OT18B/922.

The site has frontage to Frankton – Ladies Mile Highway (SH6) and Hansen Road. The site is bisected by an unformed portion of legal road.

This report is for the plan change only. Further information and detailed engineering design will be required as development proceeds.

The report considers infrastructure demands based on permitted low density residential activities, commercial activities, high density residential activities, and combined commercial/business activities with high density and/or offices occurring above 50% of the study area.

2.0 SCOPE OF WORK

The scope of work includes examination of existing QLDC as-built records, confirmation of capacity of existing services to determine the adequacy of the existing infrastructure, and recommendation of infrastructure servicing options.

3.0 DESIGN STANDARDS

Site development standards include, but are not limited to, the following:

- NZS4404:2004, Land Development and Subdivision Engineering, incorporating the QLDC amendments dated 20 September 2005.
- Drinking-Water Standards for New Zealand 2005.
- NZS PAS 4509:2008, New Zealand Fire Service Fire-fighting Water Supplies Code of Practice.
- Water for Otago, Otago Regional Council regional water plan.
- Document for New Zealand Building Code Surface Water - Clause E1 / Verification Method 1.

4.0 BASELINE – PERMITTED ACTIVITIES

The development area is presently zoned low density residential under the QLDC District Plan (the Plan). The Plan specifies that residential activities which comply with the site and zone standards have permitted activity status.

Section 7.5.5.3 specifies that *"In the Low Density Residential Zone, the minimum net area for any site shall be 450m² for each residential unit contained within the site…";* which means that one residential unit can be erected for every 450m^2 net area (site area minus the area required for access) on a permitted activity basis.

The site area currently zoned low density residential is 2.05ha. Based on preliminary development schemes it is estimated that 41 residential units could be erected on the site.

The figure of 41 dwelling equivalents is used in determining baseline demands for wastewater and water supply in the following sections of the infrastructure report.

5.0 WASTEWATER

5.1 Baseline flows – low density residential

Demand based on permitted activities has been determined in accordance with the development standards:

Refer QLDC amendments to NZS4404:2004.

No of residential units:	41.
Average dry weather flow:	300 l / person / day.
Dry weather diurnal peak factor:	2.5.
Infiltration factor:	2.
Occupancy:	3.5 person / du.
Dry weather average daily flow:	***43.05 m^3 / day.***
Peak hour flow:	***2.49 l / sec.***

5.2 Commercial flows

Peak sewage flow has been calculated in accordance with Table 5.2 of NZS4404, assuming light – medium industry type. Peak flow is based on the following:

Gross development area$_a$:	2.26 ha.
Roading and access$_b$:	0.50 ha.
Net development area:	1.76 ha.
Permitted site coverage:	75 %.
Commercial building floor area:	1.32:
Peak flow rate:	0.55 l / sec / ha.
Peak flow:	0.73 l / sec.
Wet weather peak factor:	2.
Dry weather average daily flow:	0.36 l / sec.
Average dry weather flow:	***31.1 m^3 / day.***
Peak hour flow:	***0.72 l / sec.***

$_a$ includes portion of closed road.
$_b$ reasonable estimate.

5.3 High density residential flows

Gross development area$_a$:	2.26 ha.
Roading and access$_b$:	0.50 ha.
Net development area:	1.76 ha.
Density:	1 Unit / 250m^2 (net).
No of residential units:	70.
Average dry weather flow:	300 l / person / day.

Dry weather diurnal peak factor:	2.5.
Infiltration factor:	2.
Occupancy:	3.5 person / du.
Dry weather average daily flow:	***73.50 m^3 / day.***
Peak hour flow:	***4.25 l / sec.***

5.4 Combined commercial and high density residential flows

This option considers commercial development with maximum permitted site coverage. In addition, high density residential activities above half of the commercial area have been taken into consideration. Peak sewage flow has been calculated in accordance with Table 5.2 of NZS4404, assuming light – medium industry type. Peak flow is based on the following:

Commercial

Gross development $area_a$:	2.26 ha.
Roading and $access_b$:	0.50 ha.
Net development area:	1.76 ha.
Permitted site coverage:	75%.
Commercial building floor area:	1.32:
Peak flow rate:	0.55 l / sec / ha.
Peak flow:	0.73 l / sec.
Wet weather peak factor:	2.
Dry weather average daily flow:	0.36 l / sec.

High Density Residential

Net development area:	0.88 ha.
Density:	1 Unit / 250m^2 (net).
No of residential units:	35.
Average dry weather flow:	300 l / person / day.
Dry weather diurnal peak factor:	2.5.
Infiltration factor:	2.
Occupancy:	3.5 person / du.
Dry weather average daily flow:	0.42 l / sec.
Dry weather average daily flow:	***67.39 m^3 / day.***
Peak hour flow:	***2.85 l / sec.***

5.5 Comparison of wastewater flows

Commercial wastewater average dry weather average daily flow is 70% of low density residential dry weather ADF. High Density dry weather ADF is 167% of low density dry weather ADF. The combined dry weather ADF is 153% of low density dry weather ADF.

5.6 Existing infrastructure

QLDC as-built records shown that 150mm diameter gravity pipework is present in SH6. This pipework extends down to the 600mm diameter Council trunk main on the banks of Lake Wakatipu.

5.7 Proposed connection

Consideration has been given to the high density residential scenario as this has the greatest potential to generate wastewater flows.

The most suitable connection for the proposed development will be at manhole SM12869, which is adjacent to the BP petrol station. The as-built invert level at this manhole is RL353.07 above mean sea level which provides approximately 2.6m fall from the lowest part of the site. It is feasible that a 150mm diameter main, laid at 0.55%, could provide a gravity connection to service the development area.

Modelling of the existing downstream pipe network up to manhole SM12900 (the point at which the 150mm diameter pipework joins the 600mm diameter Council trunk main) has been completed. Refer to the Appendix 1A – plan 'Foul Sewer Modelling' and the calculation sheet in Appendix 1B. Pipe capacity has been calculated using Manning's Formula.

The existing wastewater network is laid at reasonably steep gradients. Accordingly the pipework has considerable capacity. The section of pipe with least capacity is between SM12869 and SM12867 which, even allowing for the proposed development, has spare capacity for 858 residential units. Further downstream, allowing for the proposed development, the pipework has spare capacity in excess of 3000 residential units.

Any effects on the greater infrastructure including the 600mm main, pump stations and treatment will be mitigated by the imposition of headworks fees at the time of connection to Council's service. The baseline of 41 residential units under the current financial contribution policy would net Council 40 (assuming 1 existing credit) x $3,800 = $152,000.00 ex GST.

6.0 STORMWATER

Commercial development of the site area has the potential to increase stormwater runoff and introduce contaminants into the receiving aquatic environment.

6.1 Baseline stormwater runoff – low density residential

Peak runoff based on the permitted activity land use has been determined in accordance with the development standards:

Catchment area:	2.26 ha.
Runoff coefficient$_a$:	0.55.
Time of concentration:	10 min.
Average recurrence interval:	10 years.
Rainfall intensity:	34.8 mm / hr.
Peak runoff$_b$:	***120 l / sec.***

$_a$ based on land use.
$_b$ determined using the Rational Method.

6.2 Commercial / high density / combined residential stormwater runoff

Peak runoff for these has been determined in accordance with the development standards. The runoff coefficient is identical for each option.

Catchment area:	2.26 ha.
Runoff coefficient$_c$:	0.65.
Time of concentration:	10 min.
Average recurrence interval:	10 years.
Rainfall intensity:	34.8 mm / hr.
Peak runoff$_d$:	***142 l / sec.***

$_c$ based on land use.

$_d$ determined using the Rational Method.

6.3 Comparison of stormwater runoff

Commercial/business / high density residential / combined stormwater peak runoff is 18% higher than low density residential.

6.4 Existing infrastructure

QLDC as-built records shown that 300mm diameter pipework is present in McBride Street. This pipework extends down through Birse Street to 375mm diameter pipework in Stewart Street, which has an outlet in Lake Wakatipu.

6.5 Disposal options

This report considers three disposal options: connection to Council's stormwater network in McBride Street; new pipework to Lake Wakatipu; and on-site sustainable urban development (SUD) options such as disposal by infiltration.

6.6 Objectives

The following objectives should be recognised while assessing stormwater management options for the development area:

- Minimum primary protection for 10% storms (10 year ARI);
- Secondary protection (overland flow paths) for 100 year ARI storms;
- Regulatory Compliance;
- Avoidance of significant increases in downstream peak flows resulting from the increase in developed surface areas;
- Sustainable management of the effects of the proposed development;
- Minimisation of pollution of receiving waterways through the reduction of stormwater contaminants from roadways;
- Erosion protection in the stormwater discharge zone;
- Keeping construction and maintenance costs to a reasonable level.

6.7 Hydrological analysis

Assessment of the two options has been carried out using 12d civil and surveying software - Drainage Network Editor (DNE).

Runoff method: Rational.
Rainfall method: IFD table.
Rainfall data: NIWA HIRDS.
ARI used in the simulation runs: 10 years.
Tc: 10 minute direct.

Runoff coefficients based on surface type:
Pervious surfaces: 0.9.
Impervious surfaces: 0.3.
% impervious based on land use:
Medium density residential: 41.2%.
Commercial / Industrial: 58.3%.
Composite C values based on land use type:
Medium density residential: 0.55.

Commercial / Industrial: 0.65.

6.8 Option 1 - Connection to Council's stormwater pipe network

This option calls for an extension of the existing pipe network from existing manhole DM12820 to the site. DM12820 has an invert level of R.L. 351.81 which provides 3.9m fall from the lowest part of the site. A gravity connection to this manhole, which would service the development area, is therefore possible.

It will be necessary to construct 375mm diameter pipework, at gradients around 0.7%, from the development site to DM12820 to provide necessary cover and capacity.

6.8.1 Existing Network

The first simulation run was performed on the existing network, considering no stormwater discharge from the development site. Based on level and pipe diameter records from the QLDC GIS, and making reasonable assumptions of catchment boundaries, it would appear that three sections of pipe are presently undersized. These sections of pipe require the following upgrades:

From	To	Existing Diameter	Required Diameter
12839	12838	300	450
12748	12749	375	525
12749	10396	375	525

6.8.2 Additional Upgrades to Existing Network

To provide capacity for the development site the existing pipework will need to be upgraded as follows:

From	To	Existing Diameter	Required Diameter
12820	12821	300	450
12821	12826	300	450
12826	12824	300	450
12824	12825	300	450
12825	12839	300	450
12838	12748	375	525

This option effectively requires a total re-build of the existing pipe network to provide capacity for the development area. Refer to Appendix 2A.

6.9 Option 2 – new pipework to Lake Wakatipu

This option calls for the construction of a new pipework from the site down to Lake Wakatipu parallel to the existing pipework referred to above. Based on preliminary calculations pipework would be nominally 375mm diameter, and would follow the existing pipework to Lake Wakatipu to the existing outlet structure. The outlet structure would be upgraded to allow for the new pipework.

6.10 Option 3 - infiltration

The general stratigraphy comprises topsoil at depths between 0.2m and 0.4m; overlying a layer of silt and loess; overlying gravel and sand deposits typical of those associated with the

Shotover Delta formation. Below this layer lake sediments and bedrock are believed to lie at depths greater than 5m. The gravel and sand layer ranges at depths from 1.2m – 3.5m below ground level and is ideally suited to provide drainage by infiltration for the development.

6.10.1 Infiltration rates

Infiltration rates for Shotover Delta gravels vary from 3.6×10^{-3} m / sec up to 1.0×10^{-2} m / sec. A reasonably conservative estimate of 5.0×10^{-3} m / sec has been adopted in the calculations. This estimate can be confirmed as design work proceeds.

6.10.2 Infiltration Gallery

Preliminary calculations have been carried out for in an infiltration gallery comprising plastic tank modules as set out below:

The calculations in Appendix 2B show that protection up to 100 year ARI is feasible due mainly to the high infiltration rates of the Shotover Delta gravels. An infiltration gallery 14m long x 4m wide x 1m deep would be required. Refer to the routing computations in Appendix 2B.

6.11 Construction estimates

It is fair to assume that the internal reticulation will be fairly similar between both options. The construction estimates therefore take into consideration only the infrastructure at the end of the internal pipework as follows:

Option 1: pipe connection from the site to DM12820 extension, and upgrading the existing pipework down to Lake Wakatipu.
Option 2: infiltration gallery.

Option 1 – Connect to existing pipe and upgrade:

Item	Description	Unit	Qty	Rate	Sum
1	375mm dia connection to DM12820	m	236	$180	$42,480
2	Upgrade existing pipework to 450mm dia	m	346	240	$83,040
3	Upgrade existing pipework to 525mm dia	m	103	$280	$28,840
4	Manholes	No.	6	$3,000	$18,000
5	Reinstatement	m	685	$120.00	$82,200
6	P & G	LS	1	$12,000	$12,000
	Total (excluding GST)				$266,560

Option 2 – Construct new pipe to Lake Wakatipu:

Item	Description	Unit	Qty	Rate	Sum
1	375mm dia pipework	m	685	$180	$123,300
2	Manholes	No.	12	$3,000	$36,000
3	Outlet Structures	No.	1	$1,500	$1,500
4	Reinstatement	m	685	$120	$82,200
5	P & G	LS	1	$12,000	$12,000
	Total (excluding GST)				$255,000

Option 3 – Galleries:

Item	Description	Unit	Qty	Rate	Sum
1	Excavation	m3	56	$10	$560
2	Plastic tank modules	No.	92	$106	$9,752
3	Freight	LS	1	$500	$500
4	Labour to install	hr	20	$40	$800
5	Filter Fabric	m2	100	$3	$300
6	Inspections	No.	5	$800	$4,000
7	P & G	LS	1	$800	$800
	Total (excluding GST)				$16,712

6.12 Preferred option

After consideration of the options specified above Option 3, infiltration gallery, is preferred as it is likely to:

- have the greatest flexibility;
- require the least amount of land;
- have the lowest ongoing cost to the QLDC;

Should connection to Council's reticulation be chosen, a combination of upgrades and/or payment of headworks fees may be required to mitigate the effects of the added demand. The cost of remedying Council's existing undersized infrastructure may be offset against headworks fees payable. The extra over of the increased demand generated by the change in zone may be paid for by the developer. The current baseline of 41 residential units under the current financial contribution policy would net Council 40 (assuming 1 existing credit) x $1,138 = $45,520.00 ex GST towards upgrades to the infrastructure.

7.0 WATER RETICULATION

7.1 Baseline demand – low density residential average daily demand

Demand based on permitted activities has been determined in accordance with the development standards:

Refer QLDC amendments to NZS4404:2004.

No of residential units:	42.
Average daily demand:	700 l / person / day.
Occupancy:	3.0 person / du.
Peak hour demand:	4.0.
Average Daily demand:	***88.2 m^3 / day.***
Peak hour demand:	***4.1 l / sec.***

7.2 Commercial ADD

Water demand has been calculated in accordance with Table 5.2 of NZS4404 (wastewater demand), assuming light – medium industry type, and making some allowance for irrigation. Demand is based on the following:

Gross development $area_a$:	2.26 ha.
Roading and access:	0.5 ha.
Net development area:	1.76 ha.

Permitted site coverage:	75 %.
Commercial building floor area:	1.32:
Peak sewage flow rate:	0.55 l / sec / ha.
Peak sewage flow:	0.73 l / sec.
Wet weather peak factor:	2.
Dry weather average daily sewage flow:	0.36 l / sec.
Allowance for irrigation:	20%.
Average daily water demand:	0.44 l sec.
Peak hour demand:	4.0.
Average daily demand:	***37.6 m^3 / day.***
Peak hour demand:	***1.7 l / sec.***

[a] includes portion of closed road.

7.3 High density residential ADD

Demand based on high density residential activities has been determined in accordance with the development standards:

Refer QLDC amendments to NZS4404:2004.

No of residential units:	70.
Average daily demand:	700 l / person / day.
Occupancy:	3.0 person / du.
Peak hour demand:	4.0.
Average Daily demand:	***147.0 m^3 / day.***
Peak hour demand:	***6.8 l / sec.***

7.4 Combined commercial and high density residential ADD

Net development area:	1.76 ha.
Average daily demand:	37.6 m^3 / day.
No of residential units:	35.
Average Daily demand:	73.5 m^3 / day.
Average Daily demand:	***111.1 m^3 / day.***
Peak hour demand:	***5.1 l / sec.***

7.5 Fire fighting demand

7.5.1 Low density and high density residential fire fighting demand – reticulated supply - non sprinklered

Water supply classification:	FW2.
Required water flow within 135m:	12.5 l / sec
Additional water flow within 270m:	12.5 l / sec.
Max No. of hydrants to provide flow:	2.

7.5.2 Commercial fire fighting demand – reticulated supply - non sprinklered

Fire hazard category:	FHC2.

Water supply classification:	FW3.
Floor area of largest fire cell:	200 – 399 m^2.
Required water flow within 135m:	25 l / sec
Additional water flow within 270m:	25 l / sec.
Max No. of hydrants to provide flow:	3.

Fire flows up to a FW3 fire risk have been assumed at this time, although we note that big box retail and other commercial uses may have fire risk classifications which are greater than this. Higher fire risk classifications may need to be either sprinklered, or use some other fire fighting water supply.

7.6 Comparison of demands

Commercial ADD is 41% of low density residential ADD. High density residential ADD is 165% of low density residential ADD. The combined ADD is 124% of low density residential ADD.

7.7 Existing Infrastructure

The existing site is presently zoned low density residential to be serviced by Council infrastructure and there is an existing 200mm diameter watermain in State Highway 6 adjacent to the site.

The water supply to the Frankton Area is currently provided from the Kelvin Heights intake. The area is part of the Kelvin Heights Water Supply Pressure Zone that is fed from the 1,000m^3 Kelvin Heights Reservoir.

We understand that there are two main constraints on the Council Infrastructure:

- The existing reservoir is only marginally large enough to provide sufficient chlorine treatment contact time. Any increase in demand will result in insufficiently treated water entering the water reticulation network.
- The FW4 fire fighting classification at the Remarkables Park shopping centre is only marginally being provided for. Any increase in demand on the networks has the potential to result in loss of fire fighting availability to the shopping centre.

Given that there is likely to be large increases in demand in the Frankton Flats area in the foreseeable future, it is likely that either upgrades to Council's existing infrastructure or new infrastructure will be required or both. Developments at 5 Mile, Plan Change 19 – Frankton Flats, Plan Change 37 - Quail Rise Extension and potentially Plan Change 41 – Shotover Country will all require infrastructure solutions. Logically, a holistic approach to planning for this infrastructure will be required by QLDC. The difficulty, as always is understanding the timing of the creation of the demand and funding of such infrastructural projects.

7.8 Supply options

7.8.1 Option 1 – connect to existing reticulation

This option involves a connection to the existing reticulation in State Highway 6 to cater for the average daily demands. Some alternative fire fighting supply may be required if fire risk exceeds FW3 classification.

7.8.2 Option 2 – bore and pump station

This option involves drilling and development of a bore on or off site, construction of a pumping station and treatment facilities, pipework and fittings sufficient to provide a water supply which complies with the Drinking Water Standards for New Zealand 2005.

All buildings with a fire water classification greater than FW3 would either be sprinklered or be provided with an alternative source of fire fighting water storage.

7.9 Construction estimates

It is fair to assume that the internal reticulation will be fairly similar between both options. The construction estimates therefore include the following:

Option 1: pipe connection to the existing 200mm diameter main in SH6 and reinstatement.
Option 2: development of the bore, pump and storage.

7.9.1 Option 1 – connect to existing watermain:

Item	Description	Unit	Qty	Rate	Sum
1	Excavate for and connect to existing	LS	1	$2,500	$2,500
2	Valves and fittings	LS	1	1,500	$1,500
3	Pipework	m	20	$80	$1,600
4	Reinstatement	LS	1	$3,000	$3,000
5	Storage	LS	1	$50,000	$50,000
5	P & G	LS	1	$400	$400
	Total (excluding GST)				$59,000

7.9.2 Option 2 – bore & pump station:

Item	Description	Unit	Qty	Rate	Sum
1	Bore & pump station	LS	1	$60,000	$60,000
2	Treatment	LS	1	$30,000	$30,000
3	Storage	LS	1	$50,000	$50,000
4	P & G	LS	1	$6,000	$6,000
	Total (excluding GST)				$146,000

It is expected that future resource consent applications will be subject to headworks fees, levied in accordance with the provisions of the Local Government Act, to mitigate the increase in demand on Council's infrastructure.

7.10 Preferred option

After consideration of the options specified above Option 1, connection to the existing reticulation, is preferred as it is likely to:

- require the least amount of land;
- provide greatest guarantee of supply;
- have the lowest ongoing cost.

Some alternative fire fighting water storage may be necessary, depending on development figures and configurations.

Option 2 is also less desirable if bore water cannot be found on site.

This recommendation above acknowledges the current limitations on the Council infrastructure but anticipates that as demand increases in the area, solutions will be found to provide adequate servicing to developments. This may be driven in part by developers however Council are best placed to plan, manage and operate infrastructure services for the wider community.
It is recommended that the applicant also participate in the Annual Plan process at Council and to make submissions on the water supply infrastructure for the Frankton Flats to ensure that Council's engineering department are allocated resources to undertake planning for this infrastructure.

Furthermore, any effects on the greater infrastructure including the existing 200mm main, pump stations, storage reservoirs and treatment will be mitigated in part by the imposition of headworks fees at the time of connection to Council's service. The baseline of 41 residential units under the current financial contribution policy would net 40 (assuming 1 existing credit) x $5,136 = $205,440.00 ex GST.

8.0 SUMMARY

Infrastructure demands are summarised in Table 8.1 below:

Land Use	Wastewater		Stormwater	Water Supply		
	ADF (m^3 / day)	Peak hour (l / sec)	Peak flow (l / sec)	ADF (m^3 / day)	Peak hour (l / sec)	Fire fighting
Low Density Res	44.1	2.55	120	88.2	4.1	FW2
Commercial	31.1	0.72	142	37.6	1.7	FW3+
High Density Res	73.5	4.25	142	147.0	6.8	FW2
LDR & HDR	67.39	2.85	142	111.1	5.1	FW3+

Table 8.1 infrastructure demands

9.0 POWER, TELECOMMUNICATIONS AND GAS

Trunk Power, Telecommunications and Gas mains run adjacent the site underground in Frankton-Ladies Mile Highway (SH6). The subject site is approx. 400m from the Aurora Frankton Substation site at the termination of the Transpower High Tension lines.

It is not anticipated that there will be any supply or capacity issues for these services and connection will be made available from existing infrastructure at the time of development in accordance with the relevant service providers specifications. Further confirmation and supply detail will be provided at resource consent or building consent time.

10.0 CONCLUSION

Wastewater infrastructure is available to service the development area irrespective of the development scenario. Stormwater infrastructure is presently not available; however

alternatives are available such as infiltration galleries on site. Water reticulation is available adjacent to the site which will cater for average daily flows for each of the development scenarios, however additional fire fighting storage may be required depending on ultimate development figures if water supply classification is greater than FW3. Power, Telecommunications and Gas services are available to the site to cater for the proposed activities.

11.0 APPENDICES

11.1 Appendix 1A – proposed wastewater connection

NORTH

SITE

SH6A

SM12869
SM12867
SM12871
SM12873
SM12868
SM12876
SM12875
SM12893
SM12886
SM12892
SM12894
SM12901
SM12900

600mm DIA COUNCIL
TRUNK SEWER

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Rev.	Date	Revision Details	By
-	-	-	-

APPENDIX 1A - PROPOSED WASTEWATER CONNECTION

Client: SHOTOVER PROPERTY INVESTMENTS LTD

Notes:
All dimensions shown are in meters unless shown otherwise.
Any person using Clark Fortune McDonald drawings and other data accepts the risk of:
- Using the drawings and other data in electronic form without requesting and checking them for accuracy against the original hard copy versions.

Surveyed	Signed	Date	Job No.	Drawing No.
			10499	APP1A
Drawn: TS	Signed	Date: 10.10	Scale: NTS	
Designed: TS	Signed	Date: 10.10	Datum & Level: OMD	Rev.: -

11.2 Appendix 1B – wastewater modelling

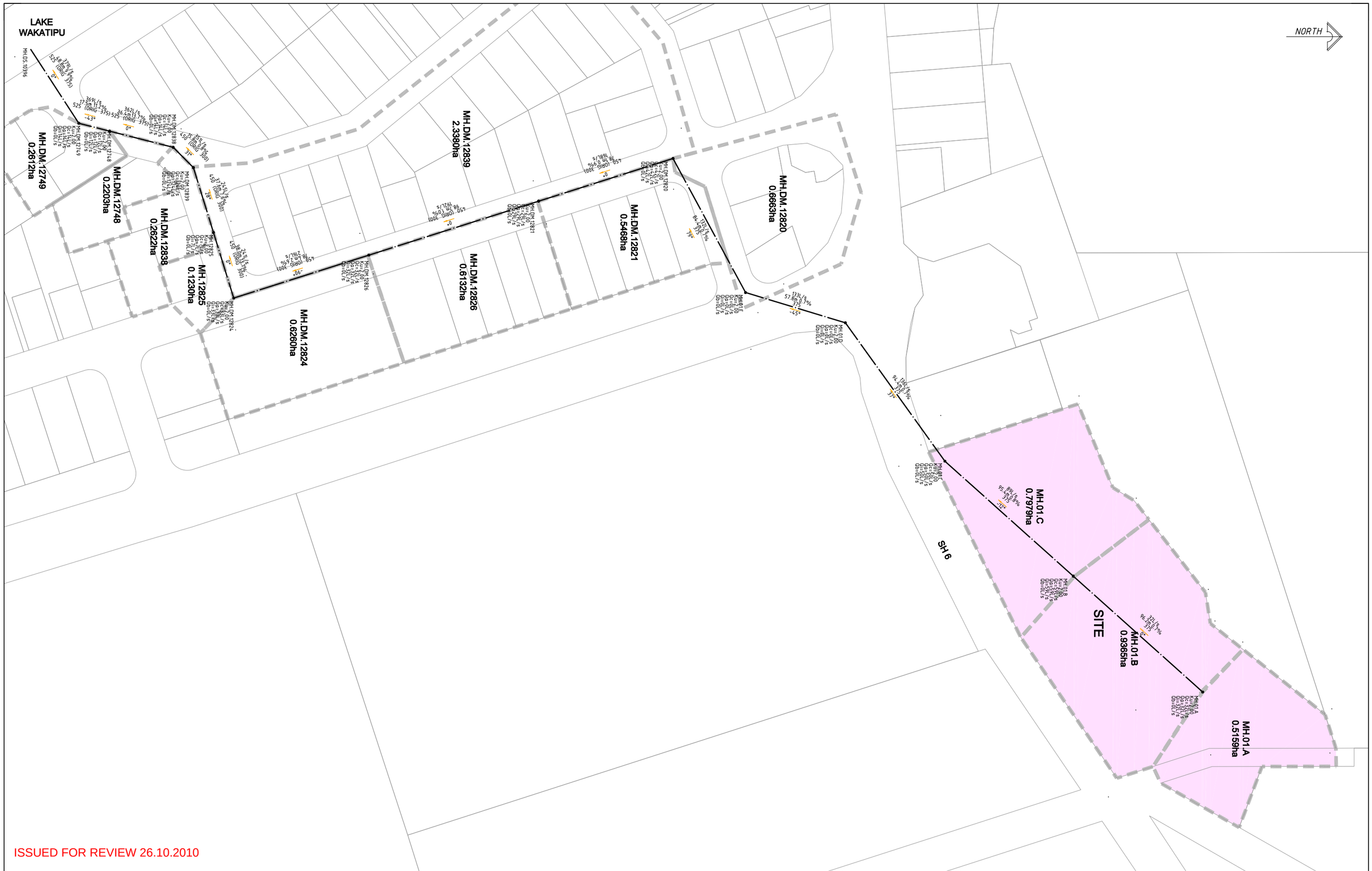
APPENDIX 1B - WASTEWATER MODELLING
SHOTOVER PROPERTY INVESTMENTS LTD

HANSEN ROAD

CLARK FORTUNE MCDONALD & ASSOCIATES
REGISTERED LAND SURVEYORS, LAND DEVELOPMENT & PLANNING CONSULTANTS

FROM NODE	TO NODE	Dev Area	Comm		Tot	Q ave dry	Q peak	IL up	IL down	LENGTH	GRADE	DIA	RAD	XSA	WP	R	GRAD	N	VELOCITY	PIPE CAPACITY	SPARE CAPACITY	SPARE CAPACITY
		DU	EDU	DU	DU	l/sec	l/sec	m	m	m	%	mm	m	m	m				m/sec	l/sec	l/sec	DU
12869	12867	70	70	0	70	0.9	4.3	353.07	352.42	97.8	0.66	150	0.075	0.01767144	0.4712385	0.0375	0.00664622	0.011	0.83032611	14.6730612	10.4	858
12867	12868	0	0	7	77	0.9	4.7	352.42	352.11	23.7	1.31	150	0.075	0.01767144	0.4712385	0.0375	0.01308017	0.011	1.16484495	20.5844919	15.9	1309
12868	12873	0	0	12	89	1.1	5.4	352.11	351.05	35.5	2.99	150	0.075	0.01767144	0.4712385	0.0375	0.02985915	0.011	1.75994948	31.1008483	25.7	2115
12873	12871	0	0	8	97	1.2	5.9	351.05	346.95	50.3	8.15	150	0.075	0.01767144	0.4712385	0.0375	0.08151093	0.011	2.90783247	51.3855979	45.5	3744
12871	12876	0	0	4	101	1.2	6.1	346.95	338.54	103.7	8.11	150	0.075	0.01767144	0.4712385	0.0375	0.08109932	0.011	2.90048127	51.2556916	45.1	3714
12876	12875	0	0	10	111	1.3	6.7	338.54	329.48	117.7	7.70	150	0.075	0.01767144	0.4712385	0.0375	0.07697536	0.011	2.82577327	49.9354935	43.2	3555
12875	12886	0	0	10	121	1.5	7.4	329.48	323.93	72.1	7.70	150	0.075	0.01767144	0.4712385	0.0375	0.07697642	0.011	2.82579274	49.9358375	42.6	3505
12886	12893	0	7	46	174	2.1	10.6	323.93	321.65	32.7	6.97	150	0.075	0.01767144	0.4712385	0.0375	0.06972477	0.011	2.68939748	47.5255362	37.0	3042
12893	12892	0	0	3	177	2.2	10.8	321.65	319.54	30.9	6.83	150	0.075	0.01767144	0.4712385	0.0375	0.06828479	0.011	2.66148139	47.0322187	36.3	2986
12892	12894	0	0	2	179	2.2	10.9	319.54	316.64	41.3	7.02	150	0.075	0.01767144	0.4712385	0.0375	0.07021792	0.011	2.69889146	47.6933086	36.8	3030
12894	12901	0	0	4	183	2.2	11.1	316.64	313.82	40.4	6.98	150	0.075	0.01767144	0.4712385	0.0375	0.06980198	0.011	2.69088611	47.5518426	36.4	2999
12901	12900	0	0	79	262	3.2	15.9	313.82	309.46	63	6.92	150	0.075	0.01767144	0.4712385	0.0375	0.06920635	0.011	2.67938064	47.3485243	31.4	2587

11.3 Appendix 2A – existing stormwater reticulation



ISSUED FOR REVIEW 26.10.2010

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Rev.	Date	Revision Details	By
-	-	-	-

APPENDIX 2A - EXISTING STORMWATER RETICULATION SHOWING REQUIRED UPGRADES

Client: SHOTOVER PROPERTY INVESTMENTS LTD	Surveyed	Signed	Date	Job No. 10499	Drawing No. APP2A
	Drawn TS	Signed	Date 10.10	Scale NTS	
	Designed TS	Signed	Date 10.10	Datum & Level OMD	Rev. -

Notes:
All dimensions shown are in meters unless shown otherwise.
Any person using Clark Fortune McDonald drawings and other data accepts the risk of:
- Using the drawings and other data in electronic form without requesting and checking them for accuracy against the original hard copy versions.

11.4 Appendix 2B – routing computations for infiltration gallery

APPENDIX 2B
SHOTOVER PROPERTY INVESTMENTS LTD

STORMWATER ROUTING COMPUTATION SHEET

CLARK FORTUNE MCDONALD & ASSOCIATES
REGISTERED LAND SURVEYORS, LAND DEVELOPMENT & PLANNING CONSULTANTS

Develoment Area (ha)	2.3
$C_{commercial}$	0.65
CA (ha)	1.495

Outlet Gallery 01.C
Gallery Dimensions

L	14		Area	56		Inf Rate	m/sec	5.00E-03
W	4		Vol (gross)	56		Inf Rate	m3/sec	0.28
D	1		Vol (net)	53				

ARI 10 yr

Tc	Tc	i	Q	Vrunoff	Vinf	Peak Vstor	Bal
min	sec	mm / hr	l/sec	m3	m3	m3	m3
10	600	34.8	145	86.8	168.0	0.0	53.2
20	1200	26.1	108	130.2	336.0	0.0	53.2
30	1800	22.2	92	166.1	504.0	0.0	53.2
60	3600	16.6	69	248.4	1008.0	0.0	53.2
120	7200	11.5	48	344.1	2016.0	0.0	53.2
360	21600	6.4	27	574.5	6048.0	0.0	53.2
720	43200	4.5	19	807.9	12096.0	0.0	53.2
1440	86400	3.1	13	1113.2	24192.0	0.0	53.2

ARI 100 yr

Tc	Tc	i	Q	Vrunoff	Vinf	Peak Vstor	Bal
min	sec	mm / hr	l/sec	m3	m3	m3	m3
10	600	83.4	347	208.0	168.0	40.0	13.2
20	1200	57.9	241	288.8	336.0	0.0	53.2
30	1800	47.0	195	351.6	504.0	0.0	53.2
60	3600	32.7	136	489.3	1008.0	0.0	53.2
120	7200	21.9	91	655.3	2016.0	0.0	53.2
360	21600	11.6	48	1041.4	6048.0	0.0	53.2
720	43200	7.7	32	1382.5	12096.0	0.0	53.2
1440	86400	5.2	22	1867.3	24192.0	0.0	53.2