ON SITE WASTEWATER MANAGEMENT FOR A UNIQUE PROJECT- HAMPTON DOWNS MOTORSPORT PARK

Greg Maddren, Director, Fraser Thomas Ltd, 152 Kolmar Rd, PO Box 23 273, Hunters Corner, Manukau 2155

ABSTRACT

Fraser Thomas were commissioned by GP Farms Ltd to prepare a water and wastewater management plan for a new and unique motorsport complex covering some 90 ha at Hampton Downs, North Waikato. The site is located between State Highway 1 and the Waikato River, four kilometers south of Meremere.

The motorsport complex comprises a 3.8 km long International Grade Two motorsport track and associated ancillary facilities, motel style accommodation, convention centre, restaurant, industrial units, car showrooms, spectator seating with associated food and ablution facilities, driver training school, pit garaging with corporate entertainment facilities and car parking. Outside the track complex are; a rural residential subdivision and future developments comprising a business/industrial subdivision and campground.

The wastewater management system is designed to cater for regular site usage and event flows catering for up to 5,000 spectators and participants. Portable ablution facilities are to be provided for events from 5,000 to 20,000 people. Treatment comprises at source septic tankage followed by a secondary treatment plant with treated effluent disposed of by sub surface drip irrigation into 4 ha of land. The effluent disposal area is to be managed as a cut and carry grass crop.

Wastewater is intercepted at source in Septic Tank Effluent Pump (STEP) tanks with additional tankage for flow balancing of event flows proposed in order to optimise conveyance infrastructure, the capacity of the wastewater treatment plant and the area required for effluent disposal.

This paper describes the wastewater management systems adopted for the complex and the issues experienced from concept through consent, construction and implementation in a unique motorsport raceway environment.

KEYWORDS

Wastewater, motorsport, STEP

PRESENTER PROFILE

Greg Maddren is an environmental engineer with over 26 years experience. Greg is a Director of the Fraser Thomas Civil and Environmental Division, and is a Chartered Professional Engineer. He Specialises in the development of appropriate, alternative solutions to stormwater and wastewater management.

1 INTRODUCTION

GP Farms Ltd are currently developing a new and unique motorsport complex at Hampton Downs, North Waikato. The site is located between State Highway 1 and the Waikato River, four kilometers south of Meremere.

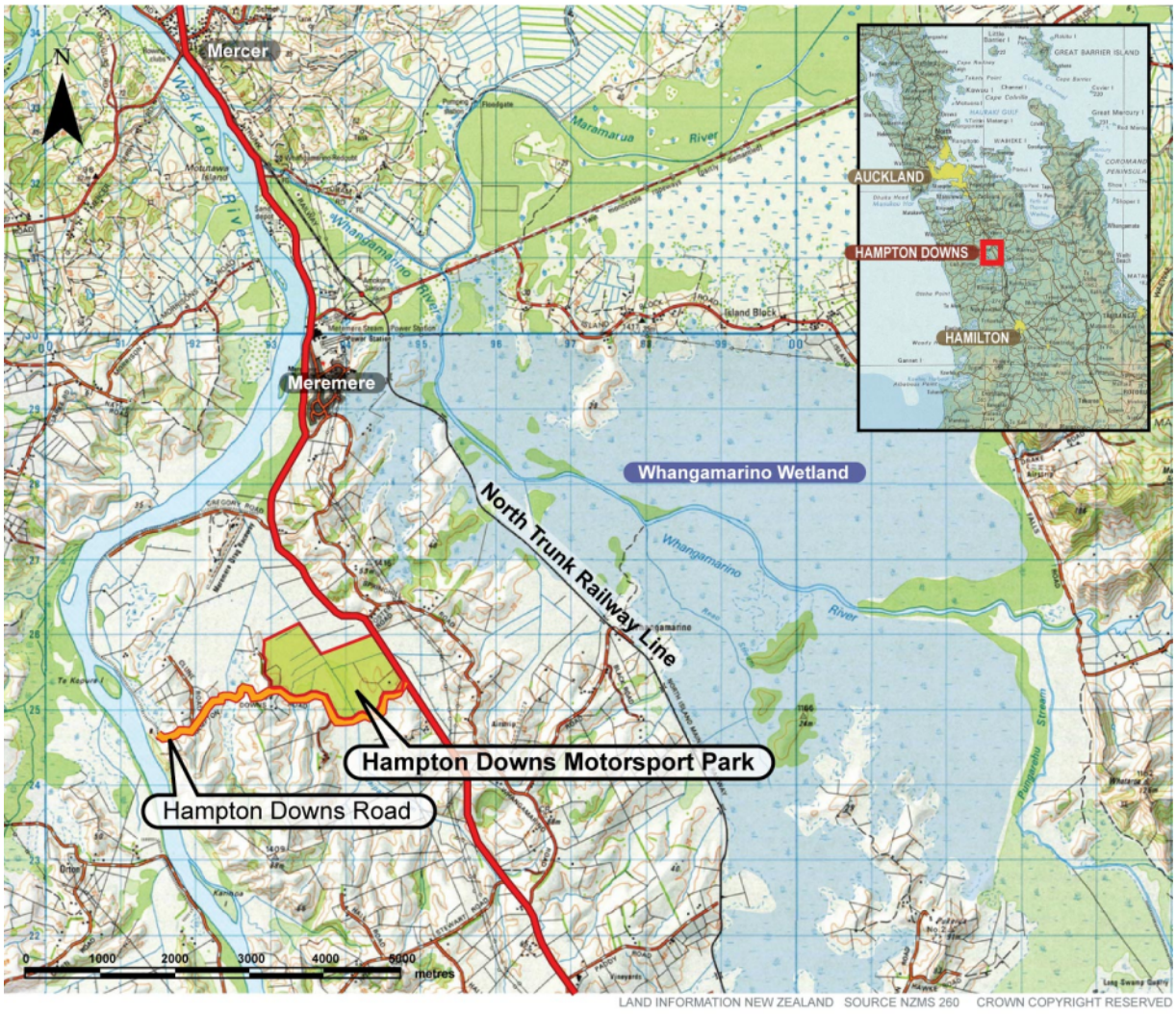


Figure 1: Motorsport Development – Site Location Plan

The motorsport comprises an approximately 3.8km long motorsport circuit with pit garages and associated ancillary facilities, including spectator seating, convention centre/restaurant, driver training school, motel style accommodation, car parking, etc.

Construction of the motorsport complex and associated wastewater system is largely complete, except for a proposed future extension of the track, which is to be constructed along with the Business Park in the near future.

Fraser Thomas' wastewater commission was challenging, providing wastewater planning and engineering expertise for a dynamic and unique project, with the goalposts changing frequently throughout project design and construction.

Photograph 1: Pre-development situation – farm land.

Photograph 2: During construction, showing extensive modifications of Motorsport catchment.

Photograph 3: National circuit opened 24 January 2010.

2 BACKGROUND

The MP was granted Land Use Consent in November 2006 for the proposed activities and land modification.

At this time the Wastewater Management system proposed was as follows:

a) The circuit complex will be provided with onsite wastewater treatment and disposal on the basis of 2,000 spectators on a fortnightly basis, subject to design approval and consent for the discharge of treated effluent to land.
b) The driving school would be serviced by a local domestic system.
c) For spectator numbers greater than 2,000 up to the maximum consented 20,000, temporary portable toilet facilities would be provided.

d) The business/industrial subdivision wastewater disposal would be addressed separately in conjunction with the subdivision consent application for that part of the development.

Subsequently, the scope changed for the resource consent application for discharge of treated effluent to land in November 2007 to include several changes from that preliminary Wastewater Management report as follows:

a) The circuit complex will be provided with onsite wastewater and treatment and disposal on the basis of 5,000 spectators on an event schedule.
b) The driving school is incorporated in the decentralised wastewater management system.
c) For spectator numbers greater than 5,000 up to the maximum consented 20,000, temporary portable toilet facilities will be provided.
d) Allowance for the business/industrial and rural residential subdivisions wastewater disposal is incorporated in the decentralised wastewater management system.
e) The effluent disposal area has been relocated from between SH1 and the track to an area on the north western side of the site.

2.1 MOTORSPORT PARK COMPONENTS THAT CONTRIBUTE TO WASTEWATER GENERATION

The MP complex comprises the following components with their occupancies noted, if applicable.

2.1.1 TRACK COMPLEX

The track complex will comprise a number of facilities that will produce wastewater, apart from the vehicle racing infrastructure. A brief description of the facilities follows.

Track Associated Facilities
Ancillary facilities including spectator seating and supporting facilities, pit garages, comprising 32 units, each with two work bays, Corporate facilities above the pit garages comprising a 300m^2 single storey building; race control facilities and car parking.

Driver Training
Driver training facilities and school and associated concrete driver training skid pan. The driver training circuit will be contained within the main circuit. This is expected to be utilised up to five days per week, involving 100 persons.

Apartments
An apartment complex located trackside. Up to 80 individually owned, two bedroom, motel style accommodation units each with two bay parking underneath, and balcony viewing over the circuit, in four blocks of 20 apartment units. The apartments will incorporate standard water use facilities, including basic cooking, without garbage grinders etc. A swimming pool and tennis court facilities are proposed to be provided for the use of apartment occupants.

Convention Centre, Restaurant, Administration
A convention centre including administration facilities and a restaurant, located adjacent to the apartment complex. The MP complex will cater for workshop, team building, corporate type exercises, where a group of staff from a business are accommodated in the apartments and utilise the complexes facilities including the convention centre, the driver training and possibly the corporate facilities above the pit garages.

Such exercises are likely to take place during the week, as the complex would be hosting club racing events during most weekends. Assuming the capacity of the driver training school gives an indication of corporate activities and 1/3 of the apartment complex is occupied for a convention (or team building, corporate type exercises), the capacity of the convention centre would be some 60 persons.

The restaurant has a seating capacity of 100 persons, and will be available to the wider community. Additional catering would be provided over and above the restaurant when conventions are being held. This is reflected in the wastewater flow allowance.

The number of administration staff is estimated at 5, one live in Manager in a two bedroom apartment and 4 day staff (general complex maintenance and administration).

Industrial Units
Up to 12 industrial units for Motorsport utilities and servicing industries. These will be utilised for dry type industries and storage of race vehicles etc., where the wastewater discharge is solely of a domestic nature from the staff. The equivalent occupancy is therefore low, and allowance for two persons per unit is considered reasonable.

Motor Industry Related Showrooms
Future motor industry related showrooms located to the south of Hampton Downs Road. The proposed floor area is approx 1,000 m^2. The expected wastewater discharge would be solely of a domestic nature from the staff. The occupancy of these and the Corporate Showrooms, Vehicle Workshops and Helipad Facilities below have been estimated at a total of 50 persons.

Corporate Showrooms, Vehicle Workshops and Helipad Facilities
Future corporate showrooms, vehicle workshops and helipad facilities are proposed within the track complex. The floor area proposed is approximately 1,000 m^2. The wastewater discharge would be solely of a domestic nature from the staff as noted for the Motor Industry Showrooms.

2.1.2 OUTSIDE THE TRACK COMPLEX

The balance of the 150ha site will include the following:

Business Park
The Business Park will contain 20 lots covering an area of approximately 12.4 ha. This area is expected to be developed as a mix of retail, business and industrial premises together with a central precinct containing restaurants and bars. Wastewater flows have been calculated based on a mix of businesses typical of this type of development.

Rural Residential Subdivision
A 16 hectare Rural Residential Subdivision is proposed to the west of the site, containing 15 lots. The subdivision has been consented on the basis of conventional onsite septic tank based treatment and disposal systems.

The rural residential housing is assumed to be up-market, high specification five bedroom houses. Allowance has been made for these houses to include up-market water usage/ wastewater producing facilities, but with the industry standard 6/3 litre toilet cisterns and an occupancy of 8 persons.

Wastewater servicing from this subdivision is to be provided for by the MP, i.e. off-site wastewater disposal, as an alternative to the onsite treatment and disposal on which the subdivision consents were granted. Any Building Consent applications lodged for Rural Residential sites prior to the MP

decentralised wastewater management system being operational and available for connection will require individual on-lot wastewater treatment and disposal in accordance with the Waikato District Plan and as provided for in the subdivision consent which states:

Campground
A campground / travellers accommodation area located to the west of the track, of approximately 6 ha catering for up to 100 people. The camp site will likely be occupied on weekends for spectators attending race meetings. If this is the case, the water usage and wastewater generation requirements will be general washing and ablution facilities, but not clothes washing etc. However, as a reticulated water supply is provided, and it is defined as fully serviced, the higher water usage allowance from TP58 has been assigned.

Balance of the Site
The balance of the site will comprise additional car parking for the MP complex and be used for outdoor Motorsport recreational activities.

3 WASTEWATER FLOWS AND LOADS

Wastewater flows are summarised in Table 1 and are based on the following:-

- The MP will be provided with a potable reticulated water supply.
- Wastewater flow allowances are based on ARC TP No.58 (3rd edition, 2004).
- Standard water saving facilities will be fitted to all accommodation units and permanent ablutions facilities. TP58 allows 165l/c.d but the more conservative value of 180l/c.d has been adopted.
- A higher water use has been allowed for the rural residential dwellings.
- In the absence of readily available actual Event wastewater flow information, Event Flows have been considered analogous to "Marae Day only visitors" (ARC: TP58) at 40 l/c.d. *(This allowance is likely to be conservative as it allows for lunches to be served for all attendees).*

Table 1: Estimated Wastewater Flows

Activity	Population	Event Frequency	Event Duration	Design flow (L/c.d)	Flow (m^3/d)
Seven Day per week activities					
Apartments	80 units x 4pp = 320	Daily	24h	180	57.6
Industrial units	12units x 2pp = 24	Daily	8h	40	0.96
Rural Residential	15 units x 8pp = 120	Daily	24h	200	24.0
Business Park	max 702[(1)]	Daily	16h	varies	40.58
Motor industry showrooms, Corporate showrooms	50	Daily	8h	40	2.0
Restaurant	100 seat[(2)]	Daily	8h	55	2.75
Administration (day staff)	4	Daily	8h	40	0.16
Managers Flat	2	Daily	24h	180	0.36
Typical 7 day week total					***128.41***
Week day only activities					
Driver training facility	100	5 days/ wk	8h	40	4.0
Conference Facility	60	5 days/ wk	8h	40	2.4
Week day only activities	160				6.4
Seven day activities					128.41
Typical Week day flows					***134.81***
Typical Weekend Activities					
Camp Ground	50 units x 2pp = 100	Typically w-end	24h	130	13.0
Peak restaurant flows	100 seat[(2)]	Typically w-end	16h	55	16.5
Peak restaurant / bar flows from Business Park	4x50 seat, 2x200 seat	Typically w-end	16h	varies	154.08
Regular club events	1,000 - 3,000 (avg 2,000)	Typically w-end	2 d, 8h/ d	40	80.0
Typical Weekend Activities only					***263.58***
Seven day activities (excl. routine restaurant and Business Park Flows)					85.08
Total Typical weekend					***348.66***
Major Meetings (in place of regular club events above)					
Special Events (Major meetings)	To 5,000pp	12pa	2 days	40	200
	To 12,000 pp	8 pa	3 days	20	240
	To 20,000 pp	3 pa	3 days	20	400

Notes:

1. See Tables 3 & 4 breakdown. Allowance for public facilities incorporated in population estimate.
2. Assumes normal operation at 50% seating capacity, peak operation at 300% (i.e. 3 sittings).

Tables 2 and 3 below give a more detailed breakdown of flow allowances for the Business Park area for both the average flow and peak weekend flow scenarios.

Table 2: Business / Industrial Subdivision Average Daily Flow Breakdown

Activity	No. units	Population	Event Frequency	Event Duration	Design flow (L/c.d)	Flow (m^3/d)
Office space (1-10pp)	10	100	Daily	8h	40	4.00

Office space (10-50pp)	2	100	Daily	8h	40	4.00
Warehousing	7	42	Daily	8h	40	1.68
Industrial units	10	60	Daily	8h	40	2.40
Retail/shopping	25	100	Daily	8h	40	4.00
Cafes/Bars (up to 50pp)	4	100	Daily	16h	55	5.50
Restaurants/Bars (up to 200pp)	2	200	Daily	16h	55	11.00
Public Facilities	16	800	Daily	16h	10	8.00
Total		***702***				***40.6***

Table 3: Business / Industrial Subdivision Peak Flow Breakdown

Activity	**No. units**	**Population**	**Event Frequency**	**Event Duration**	**Design flow (L/c.d)**	**Flow (m^3/d)**
Office space (1-10pp)	10	100	Daily	8h	40	4.00
Office space (10-50pp)	2	100	Daily	8h	40	4.00
Warehousing	7	42	Daily	8h	40	1.68
Industrial units	10	60	Daily	8h	40	2.40
Retail/shopping	25	100	Daily	8h	40	4.00
Cafes/Bars (up to 50pp)	4	600	Daily	16h	70[(1)]	42.00
Restaurants/Bars (up to 200pp)	2	1200	Daily	16h	70[(1)]	84.00
Public Facilities	16	1200	Daily	16h	10	12.00
Total		***2202***				***154.1***

Notes:

1. Additional flow allowance for extra bar flows

3.1 RAW WASTEWATER LOADS

Flows and loads generated from the MP facilities are variable and intermittent, requiring considerable thought to evaluate rigorously. The method used to arrive at the raw wastewater loadings was to analyse the pollutant loadings per person (g/person/day) relative to the activity, and compare the constituent concentration to those recorded in literature for those facilities, such as restaurants. That is, the per capita pollutant loading was adjusted according to the duration a person is present for the given activity resulting in the pollutant load calculated. Daily per capita pollutant loadings for raw wastewater are listed in Table 4.

Table 4: Raw Pollutant Loadings per Person (g/person/day)

Constituent	**(1)**	**(2)**	**Adopted**
BOD_5 (mg/L)	50-120	71	72
TN (mg/L)	9-21.7	13.2	13
TP (mg/L)	2.7-4.5	4.6	3.6

Source:

(1) Crites & Tchobanoglous (1998) Small & Decentralised Wastewater Management Systems. McGraw Hill

(2) Dr. Margaret Findley

The adjusted per capita pollutant loading for the given activity was based on the percentages outlined in Table 5.

Table 5: Percentage of Daily per Capita Pollutant Loading Applied to Activity (%)

Activity	**Percentage of daily per capita pollutant loading applied to activity**
Apartments	100%
Industrial units	25%

Rural Residential	100%
Business/Industrial subdivision	25%
Motor industry / Corporate showrooms	25%
Restaurant	30-80%
Administration (day staff)	25%
Managers Flat	100%
Driver training facility	25%
Conference Facility	45%
Camp Ground	100%
Regular club & major events	25%

Raw wastewater loads generated at the MP facilities on an event basis are summarised in Table 7.

Table 6: Raw Wastewater Loads Generated (kg/d)

Event	BOD_5	TN	TP
Week day	67.6	9.9	2.9
Typical Weekend, club meeting	205.8	32.3	9.6
5,000 Event	265.8	44.3	11.7

Balanced effluent loads from STEP/G's and storage tanks follow.

3.2 FLOW BALANCING

Flow balancing of wastewater generated from the MP complex is incorporated in the system by using a series of in ground septic tanks located at source, prior to conveyance of effluent to the centralised onsite treatment system. The flow balancing enables more efficient wastewater conveyance and reduces shock loading on the treatment plant from MP events. The storage, flow and load balancing calculations for MP generated wastewater were made on the following premises:

1. Event flows include flows and loads from 7 day per week daily activities.
2. Flows from events are concentrated between 8 am and 7 pm.
3. Storage volumes have been calculated based on the above, with stored effluent conveyed continuously over 24 hour periods to optimise the effluent pipe size, reduce shock loading to the WWTP and minimise the required effluent disposal area.
4. Storage, flows and loads have been assessed for Events occurring on consecutive weekends, with the flows balanced over a period of one week, thereby ensuring that the storage tanks have volume available to accommodate an Event that occurs on the subsequent weekend.
5. BOD, N and P concentrations based on Table 7 above apply for 7 day per week activities on non event days and outside event hours. A slightly higher proportion of N has been assumed for event flows.

The balanced discharge flows and balance tank storage volumes for routine, club and 5,000 person events when occurring on consecutive weekends are listed in Table 7.

Table 7: Preliminary Balanced Flow Rates & Storage Volumes

	5,000 Event	Club Event	Routine	Annual Average
Balanced MP Flow Discharge to WWTP (m^3/d)	280	197	134	220
Max. discharge rate (m^3/hr)	11.7	8.2	5.6	-
Required Storage (m^3)	664	360	36	-

Flow balancing will be provided for up to the 5,000 person event in a number of fiberglass cylindrical storage tanks.

4 WASTEWATER MANAGEMENT OPTIONS ASSESSED

Several treatment and disposal options were investigated. Additionally an alternative of conveyance for treatment and disposal off-site has been studied. The evaluation of these options is summarised below:

4.1.1 OFF-SITE TREATMENT AND DISPOSAL

Conveyance of wastewater for treatment and disposal off-site was studied in detail. This option comprised conveyance from the park to the existing Meremere Wastewater Treatment Plant. An assessment for a significant upgrade of this plant, and continued discharge of treated effluent to the Waikato River. The Territorial Authority was approached and discussions were had on the feasibility of sharing the cost of the Meremere WWTP upgrade and if implementation timescales could be aligned with Council's LTCCP and the programme for implementation of the Motorsport Park. Council advised that the upgrade of this facility was not on Council's fiscal planning horizon, and Council could not respond to this initiative in the time required. This option was therefore rejected.

In the event that a reticulated sewage facility was made available within an economic distance of the MP track complex, consideration could be given to connection to such a facility. However, none exists at present.

4.1.2 ON-SITE WASTEWATER MANAGEMENT ALTERNATIVES

a. Conventional reticulation was investigated. A number of constraints presented including the low-lying, high groundwater, peat (compressible) soils presenting significant construction difficulties with respect to pipeline depth and potential for groundwater infiltration with consequential effects on treatment and disposal systems.

b. Individual on-site effluent treatment and disposal systems for each facility, activity or building were found to be only feasible for the rural residential properties. These properties have sufficient land that meets the permitted activity criteria for effluent disposal. Other activities, where multiple treatment facilities and effluent disposal areas would be required was considered to present an overly complicated requirement for operations and maintenance by the Motorsport Park. Additionally the variable nature of the occupancy of the various facilities determined that a centralised treatment and effluent disposal system would be more likely to receive a more continuous base flow and load and thereby improve the efficacy of any treatment and disposal system.

c. Package plant treatment requires damping of variable wastewater flows and loads as far as practicable that will be regularly generated due to the event type nature of the proposal. An alternative small bore reticulation system offers many advantages in management of these flows in stage vessels and that will balance load and flow to the treatment plant and minimise the likelihood of operational problems with a package treatment plant.

d. Alternative effluent disposal methodologies and crops were assessed.

4.2 EFFLUENT QUALITY

The WWTP discharge requirements of the resource consent conditions were as stated in Table 8.

Table 8: Consent Effluent Quality

Effluent Parameter	Units	Maximum	Average Monthly
BOD	mg/L	30	20
Total Suspended Solids	mg/L	30	20
Total Nitrogen	Kg/d		11

	mg/L	57	50

The consent conditions state that for the purposes of determining compliance with this condition the average may be taken as the average of the preceding 12 samples.

4.3 EFFLUENT DISPOSAL OPTIONS

Spray and surface and sub-surface drip line irrigation on to a range of crops was assessed.

4.3.1 SPRAY IRRIGATION

Spray irrigation has the following key advantages, the loss of effluent to the atmosphere, relative ease of access and servicing and lower supply and installation costs when compared to drip irrigation. A proportion of the applied effluent will be lost to the atmosphere via direct evaporation between the spray nozzle and the crop. In summer when the peak wastewater flows at the scheme are experienced this could be significant.

However, spray irrigated effluent also causes aerosols. These aerosols may contain pathogenic organisms and therefore there could be a risk to neighbouring land users/ residents (NZLTC, 2000)[1]. The removal of pathogenic organisms could be addressed by additional treatment such as ultraviolet (UV) disinfection or ozone or a combination thereof. Membrane treatment comprising an Membrane Bioreactor (MBR) or a membrane device post treatment can almost definitively remove all viruses (the smallest pathogenic organisms). However this issue remains contentious regardless of disinfection of the applied effluent due to the presence of human viruses. Aerosols or spray drift may also give rise to pathogens being distributed over adjacent land. Direct application of treated wastewater onto fodder crops does have issues with respect to non-acceptance by dairy industry, and therefore the market for crop- long term could be problematic.

Spray irrigation was rejected by the proprietor due to the potential for spray drift from the effluent disposal area to adjacent Rural Residential properties and future development areas of the Park.

4.3.2 SURFACE DRIP IRRIGATION

Driplines can be placed and pinned on the land surface to reduce installation costs and simplify observation and maintenance of the dripline. Surface installed dripline is typically covered with mulch to prevent prolific weed growth, and the area is usually planted in water tolerant species to promote evapotranspiration. Incident rainfall can saturate the soil resulting in short circuiting of the applied effluent with runoff. Similarly if surface soils are saturated by the loading rates proposed the rainfall runoff component would increase.

4.3.3 CROP OPTIONS

The relative merits of each crop, the irrigation system options and how the best option could be integrated into the MP development were considered in order to determine the most appropriate system. These are discussed in Table 9 below.

The grass cut and carry fodder crop has 2.5 times the nitrogen uptake capacity than a eucalyptus plantation. There is sufficient land disposal area available for the nitrogen load applied if a grass cut and carry crop is adopted, but there is insufficient land area available for a eucalyptus crop. Leaching of nitrogen may occur from a eucalyptus crop. Alternatively the treatment plant could be configured to reduce nitrogen to lower levels, but at a consequence of increased complexity of the treatment system processes and requiring more skilled operation.

[1] NZ Guidelines for Utilisation of Sewage Effluent on Land, NZ Land Treatment Collective, 2000.

The proprietor's preference was for a 'simple and robust' treatment plant to operate and maintain without the associated on-going costs of consumables that would be required for UV disinfection, for example.

Opportunities for the proprietor arose of an operator to undertake cut and carry fodder crop operations that would benefit the park, hence this option was taken forward to implementation.

Table 9: Advantages and Disadvantages of Crop Options

Crop	**Nitrogen application rate (kgN/ha.pa)**	**Advantages**	**Disadvantages**
Grass Cut and carry	500-550	Existing crop (grass) may be able to be retained. Preferred grass species is perennial ryegrass. Flat to gentle sloping land is ok.	
		Cropping 3-5 times per year to haylage or silage. 70-75% of applied N taken up by the grass	Skilled management required. Monitoring required of plant health and crop feed value. Market for crop- long term, non-acceptance by dairy industry. Harvesting access required.
		Cropping undertaken by current leaseholder at his cost and under his management.	Demarcation of responsibilities between MP (effluent supplier) and cropping leaseholder. Flow of wastewater never stops!
		More suited to spray irrigation. Subsurface drip irrigation is feasible. Surface drip irrigation viable- cheaper	Aerosols from spray. Effluent application device (sprinkler) damage & soil compaction by harvesting machinery. Subsurface drip irrigation expensive installation. Surface drip irrigation requires more input- removing driplines when cropping.
Trees- eucalyptus plantation	200kgN/ha	Water tolerant species such as eucalypts	Lower nitrogen uptake than grass crops. Need to establish new crop.
		Cropped as fuel wood	Demand for crop may be limited. High cost to fell.
		Coppiced on 3 to 5 year rotation	May become an unwanted visual barrier to residential properties.
		Surface drip irrigation: viable - less frequent cropping. Spray irrigation - less opportunity for spray drift when trees established.	
		Irrigation rates can be higher	Pest control.

4.4 SELECTED WASTEWATER MANAGEMENT SYSTEM

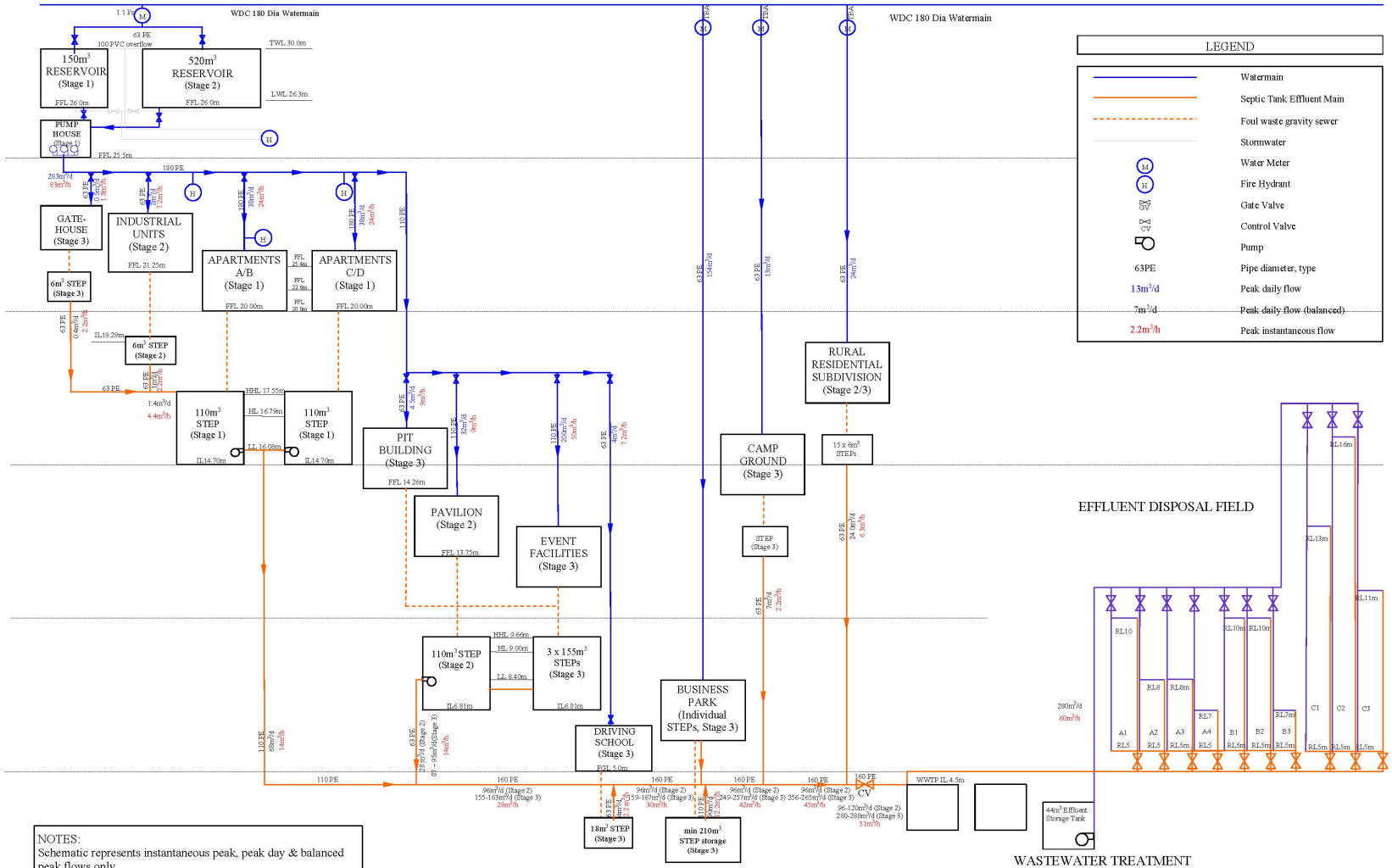
The selected wastewater management system incorporates wastewater interception at source in Septic Tank Effluent Gravity or Pump (STEG/P) tanks with additional, pre-treated tankage for balancing of event flows such that the capacity of the wastewater treatment plant (WWTP) and the area required for effluent disposal can be optimised. The system is shown schematically in Figure 2.

The STEP/G and effluent conveyance system is referred to as a Modified Effluent Drainage Servicing (MEDS) system. This system is proposed as it offers the following features:

1. A Septic Tank Effluent Pump or Gravity (STEP/G) chamber located at each wastewater source (facility, dwelling or lot), with integral screened effluent filter and discharge flow control device.
2. The rural residential on-lot STEP/G and future Industrial subdivision STEP chamber will incorporate one days emergency storage capacity in the event of a maintenance issue in the system that would require discharge to cease, and provide storage volume for use when the collection pipe work is under pressure thereby providing effective peak flow damping,
3. Event flows can be balanced in combination STEP/G and storage tankage, which will minimise the capacity of the treatment plant and the area required for land disposal.
4. Staging of the development of the Motorsport park facilities and availability of funding resulted in the first stage of water and wastewater infrastructure being installed without treatment and disposal. The wastewater was stored in the STEP tanks for tankering for disposal off-site. To optimise tankering and flow balance large events flows two 110 m^3 STEP tanks were installed.
5. There is no requirement for special cleaning facilities in the storage tanks as the effluent is pre-settled, and screened at each STEP/G chamber. This also reduces maintenance and the potential to generate odours.
6. Future developments can be readily connected to the MEDS system, such as the industrial subdivision STEP chamber.
7. Small bore, shallow, sealed effluent pipes convey wastewater from the outlet of each STEP/G and connect to the sealed conveyance system.
8. MEDS is an efficient method of conveying effluent from the MP complex and Rural Residential Subdivision to the WWTP. This negates the need to construct deep sewers over long distances of low lying, high groundwater level land or the requirement for a transfer pump station to convey wastewater to the treatment plant, as would be the case if conventional sewerage was adopted.
9. Inflow and infiltration will not occur provided that there is appropriate construction and monitoring of the wastewater system, and if found to occur can be readily traced by inspection and or testing of the MEDS system. Sections will be valved to enable pressure testing, location and repair of leaks.

The proposed wastewater treatment plant will comprise a robust advanced secondary wastewater treatment plant (eg. submerged aerated filtration or packed bed reactor) capable of producing a high quality secondary effluent suitable for land disposal. Treated effluent will be disposed of to land to a dedicated area within the MP.

Figure 2: Water and Wastewater System Schematic



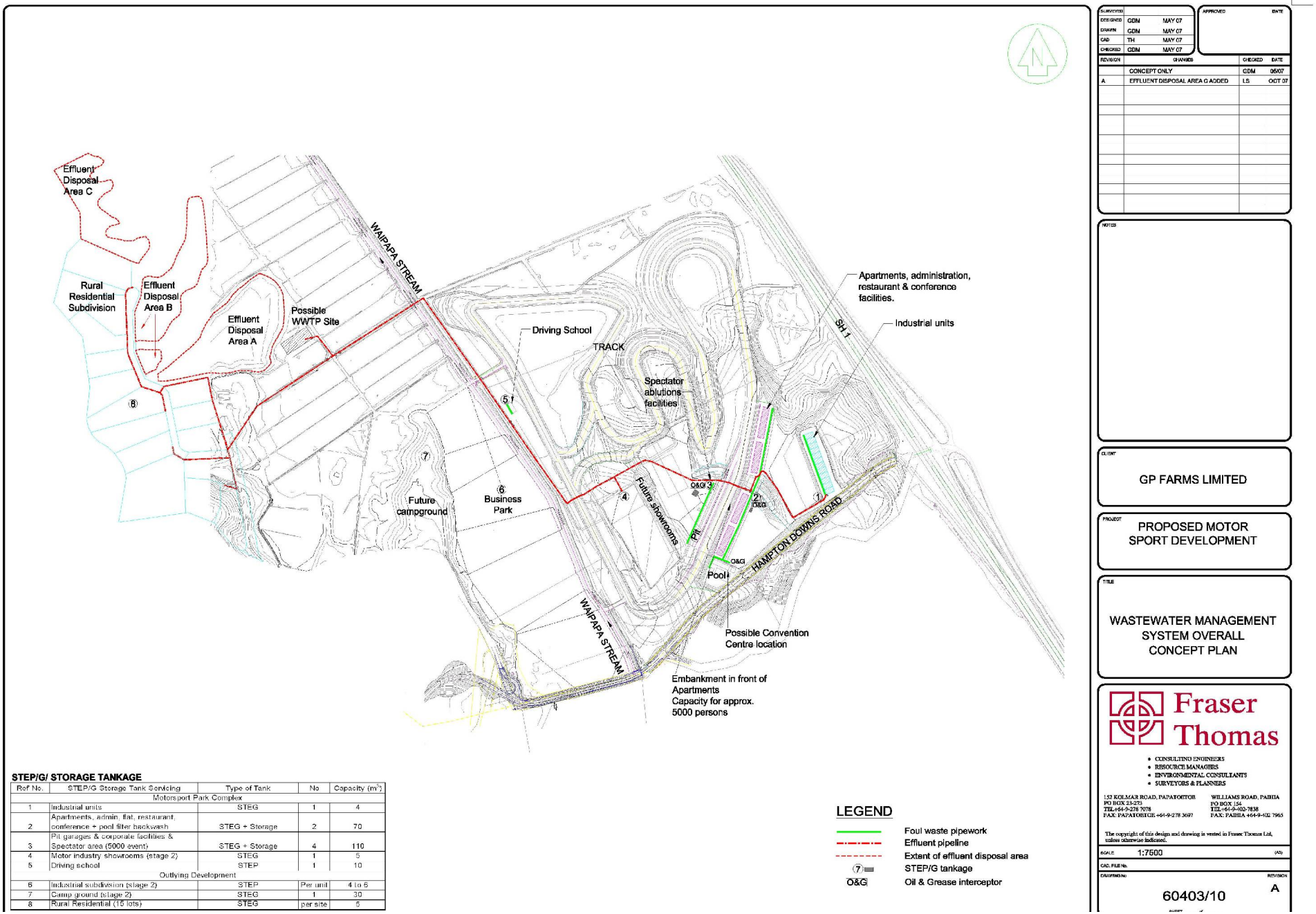
A Schematic model layout plan was included in the Management Plan entitled 'HAMPTON DOWNS MOTORSPORT PARK- SYSTEM SCHEMATIC, Event Design Flow. The effluent flows in this diagram are the event flows balanced over the ensuing week, together with the peak hydraulic flows which are based on the STEP tank pump capacities. The hydraulic grade line was assessed utilizing EPAnet under peak flow conditions.

STEP tank stage/volume analysis was undertaken to optimize and check the conveyance flows and storage requirement to accommodate peak event flows. The tank volumes assessed on the basis of a cylindrical tank and on an assessed hourly spread of routine and expected peak day flows over an event weekend, where events occur on consecutive weekends with flow balancing being provided in the tanks. STEP tank hydrograph calculations, defined the average pumping rate required to transfer the peak weekend effluent flows over the ensuing week is 1.1L/s. The STEP5/circuit tank pumps are rated at 3.2L/s which is sufficient to meet this average rate. A value of 4L/s has been used in the peak flow condition design calculations to represent the maximum possible flow from the pump when the STEP tank is full. It is, however, proposed to restrict this flow to maintain flow within the normal operating range of the pump.

A preliminary layout of the wastewater management system is shown in Figure 3. The wastewater management system comprised:

- 3 x 110m^3 FRP STEP tanks at apartments and circuit
- Some 2.7 km of 63 OD PE to 160 PE conveyance pipework.
- WWTP
    - Hynds SAF System
    - 40m^3 primary tank
    - 65m^3 aeration tank
    - Clarifier tank
    - 2x 22m^3 irrigation tanks
    - 4.5m high x 3.0m diameter IMHOFF tank
- Effluent disposal area:
    - 3.5 Ha of effluent disposal area (Stage 1)
    - 490m of 160 PE100 SDR11 delivery main
    - 670m of 110 PE100 SDR11 collector main
    - 880m of 50mm LDPE pipe

Figure 3: Wastewater Management System Overall Concept Plan



STEP/G/ STORAGE TANKAGE

Ref No.	STEP/G Storage Tank Servicing	Type of Tank	No	Capacity (m³)
	Motorsport Park Complex			
1	Industrial units	STEG	1	4
2	Apartments, admin, flat, restaurant, conference + pool filter backwash	STEG + Storage	2	70
3	Pit garages & corporate facilities & Spectator area (5000 event)	STEG + Storage	4	110
4	Motor industry showrooms (stage 2)	STEG	1	5
5	Driving school	STEP	1	10
	Outlying Development			
6	Industrial subdivision (stage 2)	STEP	Per unit	4 to 6
7	Camp ground (stage 2)	STEG	1	30
8	Rural Residential (15 lots)	STEG	per site	5

P:\60 Site\60403\60403-10 Rev A.dwg

5 EFFLUENT DISPOSAL SYSTEM

5.1 SITE DESCRIPTION

The Effluent Disposal site, as described in the Effluent Disposal consent, is located within the MP property, to the northeast of the Rural Residential Subdivision access that adjoins Hampton Downs Road. The site is comprises three spurs of gently sloped pasture covering an area of approximately 8 hectares. Typical topsoil depths are approximately 200mm-400mm and in terms of the TP58 Soil Category Description the soils immediately underlying the topsoil layer could be typically described as categories 4-6, corresponding to drip irrigation aerial loading rates of 2-3 to 5mm/day. The available disposal areas and soil capacity assessment are summarized in Table 10 below. Full geotechnical details of the site, including test pit logs were provided in the consent application for discharge to land.

Table 10: Disposal Area Summary

	Area (m^2)	Slope	Topsoil depth (mm)	ARC TP58 Soil Category
Area A	34,800	1V:10H-1V:5H	200-400	5-6
Area B	25,500	1V:10H to 1V:6H	200-400	5-6
Area C	18,900	1V:5H	200-300	4-6
Total	**79,300**			

5.2 DESCRIPTION OF DISPOSAL SYSTEM

Effluent disposal will be via subsurface drip irrigation to the Effluent Disposal Area and will irrigate a cut and carry grass crop. The total effluent disposal area consists of three irrigation areas, divided into 11 zones of between 0.18 and 0.88 ha. Stage 1 will involve irrigation of Area A (4 irrigation zones) only, with Areas B and C being constructed to accommodate Stage 2 flows. Irrigation of each zone will be controlled by an irrigation controller, to build in flexibility in operation and management.

Flushing of driplines will be a maintenance requirement. Flushing valves enable each irrigation zone to be flushed to a common flushing pipeline which returns flushed effluent to the treatment plant inlet.

5.3 DESIGN FLOWS

The Motorsport Park wastewater treatment plant and hence the Stage 2 effluent disposal system has been designed for a maximum daily flow of $280m^3$/day. This design has been based on momentary peak flows of up to $60m^3$/h, however, in order to maintain maximum operational flexibility within the system flows of up to $72m^3$/h have been accommodated within the design effluent storage and pump capacity. Irrigation pump flows will be variable in accordance with effluent irrigation tank levels, up to 8-10l/s for stage 1 and up to 16-20l/s for stage 2.

Table 11: Design Flows

		Stage 1			Stage 2			
Flow	**Units**	**Extreme Low**	**Routine**	**Balanced Event**	**Extreme Low**	**Routine**	**Balanced Event**	**Future Peak**
Treatment Plant	m^3/d	10	95	105	10	144	280	400
Peak hour	m^3/h			30-36			60-72	60-72

Irrigation rate	l/s			8-10			16-20	16-20

Peak event flows will generally occur over a weekend with flows balanced over the ensuing week ("Balanced Event" flows). Up to 22 events occur annually. Routine flows are the flows expected when there is no event on at the Motorsport Park. The extreme low flow is the minimum daily flow expected through the treatment plant.

The future peak is based on the maximum resource consent flow which is based on maximum soil capacity. This is not a current design flow but the effluent disposal system design has the flexibility to accommodate this flow in future.

5.4 HYDRAULIC LOADING

Normally, either a club or special event will occur each weekend with flows balanced over the ensuing week. The larger 5,000 event flows (including 5,000 to 20,000 events) will occur over 22 weeks, generally over summer. The smaller club events conditions will prevail over 30 weeks of the year, thereby enabling resting of the balance of the effluent disposal area for more than half of the year. Effluent Disposal Areas Required for each flow condition are summarised in Table 12 below.

Table 12: Hydraulic Loading- Effluent Disposal Area

Flow Condition	**Irrigation Area Required (ha)**		**Rested Irrigation Area (ha)**	
	3.5mm/d	5mm/d	3.5mm/d	5mm/d
Club Events (balanced flow)	5.6	3.9	2.4 (43%)	4.1 (103%)
5,000 Events (balanced flow)	8.0	5.6	0 (0%)	2.4 (43%)

On an annual basis the total flow is some 79,500 m^3 resulting in an average annual irrigation loading rate of 2.7mm/day over the 7.9ha irrigation area.

5.5 SYSTEM DESIGN PARAMETERS

The overall effluent disposal system design including pumpsets and irrigation area sizing has been done to build in flexibility into the reticulation and pumping system which will accommodate a peak system flow of 20l/s.

Detailed design and layout of the dripline irrigation system, the following design parameters have been applied:

- Zones designed to take approximately equal flows (where within practical site limitations).
- Control valve pressures set to maintain dripline pressures between 10 and 35m.
- Maximum dripline run lengths in accordance with manufacturer's specifications for given pressure, flow and emitter spacings (worst case 170m@ 16m inlet P, 1.0lph, 0.6m dripper spacing).

EPANET analyses was undertaken on the main reticulation and flushing line flows to check sizing. The flushing line analysis has been undertaken to confirm that a flushing flow of 2.5l/s from the furtherest flushing valve can be returned to the WWTP inlet. The main reticulation analysis has been undertaken at a flow of 20l/s to confirm that the pressures required at the furtherest control valves can be met. This 20l/s flow can be accommodated at normal dripline capacity within zones and the EPANET analysis conservatively distributed the flow in this manner. Under extreme high flow conditions, all control valves would normally be set to open.

System Design Parameters are summarised below.

Table 13: Effluent Disposal System Design Parameters

Headworks	
Effluent Storage	2 x 22m^3 tanks
Pumpset	MPC–E 4 CRE32-4
Water Meter	Arad WST
Filter Unit	Arkal M524, 130 micron, 120 mesh.
Maximum Filter operating pressure	100m
Disposal Area	
Total irrigation area (Stage 1)	3.5ha
Total irrigation area (stage 2)	7.9ha
Setback to water courses	10m
Setback to Boundaries	5m
Proposed Waikato Regional Plan required separation to groundwater	0.3m
Irrigation Field Design Flows	
Stage 1 maximum irrigation flow	8-10l/s
Stage 2 maximum irrigation flow	16-20l/s
Hydraulic Loading	
Average annual application rate (stage 2)	2.7mm/day
Average application rate	3.5mm/day
Maximum application rate	5mm/day
Irrigation Network	
Irrigation method	Subsurface drip irrigation
Minimum elevation of dripline	RL5m
Dripline	17mm Unibioline
Emitter discharge	1.0L/h
Emitter spacing	0.6m
Dripline Depth	200mm
Dripline Spacing	1.0 m
Application rate	1.67mm/h
Flushing flow	9m^3/h (2.5l/s) per valve
Planting	
Crop	Grass cut and carry
No. Crop harvests per year	3-4
Nitrogen uptake allowance	500kgN/ha.pa
Riparian Planting	3m wide

An effluent irrigation control philosophy was adopted to take account of the staging of the wastewater management system, where operation would confirm wastewater flow generation and confirm the effluent hydraulic and nutrient application rates. Thereby there is an opportunity to optimize irrigation operations prior to full scale installation. Operation and Maintenance Plans are subject to a continuous improvement programme over the commissioning and initial operating phases to optimise use of the available irrigation area.

It is proposed to operate flushing valves manually under WWTP Stage 1 operation. This will allow the operator to gain an understanding of required flushing frequencies prior to installation of an automatic flushing programme and will also encourage the operator to regularly walk over the irrigation area to check for any leaks, wet areas of malfunctioning.

The flushing operation includes pumping through the control valve in an area and then sequentially opening flushing valves to discharge through the flushing line for pumping back to the WWTP. During initial operation, should failure of a control valve result in a rise in the level of the irrigation tanks, the irrigation controller will initiate a higher flow programme which opens further control valves. Irregularity in irrigation flow meter records would alert the operator to problems with control valve operation. In addition, regular maintenance checks will include checking of control valve operation and monitoring of operating pressure when each zone is operating.

6 CONSTRUCTION FEATURES AND ISSUES

Some of the Construction constraints features and issues encountered are illustrated below.

Low lying areas with peaty, compressible soils and high groundwater and surface water levels.

Sealed manhole system utilised

STEP tank installation

The project involved four simultaneous and interlinked contracts (Water and wastewater services, WWTP, WWTP Control Building, and power supply) as well as the ongoing operation of the Motorsport Park. This required close cooperation and effective communication between the Client, Engineer and Contractors which was facilitated through formal fortnightly site meetings.

The Principal was responsible for the communications contract which involved laying a fibre optic cable from the WWTP to the circuit. The Engineer had no control over this critical aspect of the project. Delays to the fibre optic cable installation necessitated that temporary wireless communication be put in place for the commissioning of the WWTP and Control Building.

Health and Safety was a top priority throughout the project. Open and effective communication between the Motorsport Park operator and Contractors was critical to delivering a safe work environment. Construction works within and around the circuit required extra vigilance as these areas were often accessible to the general public. All project works were completed with no reported H&S incidents.

Works for the Effluent Disposal Area comprised installation of dripline at a depth of 250 mm with any ground preparation required to be undertaken by the contractor to facilitate installation at this depth. The Contractor endeavoured to undertake mole plough installation to this depth, but due to dry ground conditions this provided to be ineffective. The entire area was subsequently rotary hoed to 300mm depth to break up the topsoils prior to mole ploughing.
It was evident that installing large effluent disposal fields required Contractors of such experience to prevent a trial and error approach which can extend the duration of the works. Experienced contractors were recommended for the contract, however the indentured main contractor initially undertook certain methodologies that were not appropriate.

7 MOTORSPORT COMPLEX MANAGEMENT

7.1 OPERATION AND MAINTENANCE

A Management Entity, Hampton Downs Services Ltd, has been established to manage the Hampton Downs Motorsport Park. This company's responsibilities include operation and maintenance of the water and wastewater systems.

Management STEP pumping systems and wastewater treatment plant have been sub-contracted to the suppliers/ installers of this plant.

Operation and maintenance manuals were completed for each component setting out the requirements to manage the entire wastewater system and packaged components in accordance with manufacturers' recommendations and standard practice. The irrigation area will be inspected as part of the routine wastewater treatment plant inspections. An alarm and telemetry system to the service provider will be installed for call-out attendance in the event of a failure in accordance with the attached Effluent Disposal System Control Philosophy.

8 CONCLUSIONS

The Motorsport development presented a dynamic and unique wastewater problem, with issues around funding affecting staging of the works requiring the wastewater system to initially comprise holding tanks for tankering of wastewater off-site, and subsequently incorporating on-site treatment and disposal, whilst accommodating large variations in wastewater generation of Motorsport events of up to 5,000 people.

Stage one of the wastewater management system is now completed and is operating well in coping with the large variations in flow and loads generated.

ACKNOWLEDGEMENTS

We wish to thank GP Farms Ltd for allowing Fraser Thomas to prepare and publish this conference paper.

REFERENCES

NZ Guidelines for Utilisation of Sewage Effluent on Land, NZ Land Treatment Collective, 2000.