6. STORMWATER DRAINAGE

6.1 General

This section covers the Kaipara District Council requirements for the design and construction of stormwater control devices and associated structures. Design and quality assurance shall comply with Sections 1 to 3 of these Engineering Standards.

6.1.1 Minimum Requirements

The following requirements shall be met:

(a) Stormwater drainage in subdivision and land development shall:

(i) Comply with the permitted activity rules of the Regional Water and Soil Plan for Northland or have a resource consent from the Northland Regional Council;

(ii) Recognise and protect existing overland flow paths, ephemeral watercourses and natural wetlands, streams and rivers;

(iii) Protect buildings from flooding in accordance with clause 6.2.3 and 6.2.4;

(iv) Provide for any future increase in runoff from upstream catchment land zoned for development in accordance with the District Plan.

(b) In Urban areas, on-site stormwater detention shall be provided to attenuate post-development peak stormwater flows to no more than pre-development peak flows for storm events of up to 100 year ARI (1%AEP).

(c) In Residential and Business Zones all drains shall be piped except for Swale Drains designed in accordance with clause 6.4.3, natural streams (as defined in the RMA), contour cut-off drains and as provided for in clause 6.1.1(d).

(d) Where a Drain requires a pipe in excess of 1200mm in diameter the Drain may remain open, provided that the channel is designed not to scour during design flows (e.g. by lining the sides or installing energy dissipating weirs). Adequate permanent access shall be provided for the Council to all Open Drains to allow maintenance to be carried out.

(e) Stormwater systems shall drain by gravity unless pumping is specifically Approved by Council.

Guidance Notes:

1. *In Rural areas stormwater may be taken to open drains or existing natural watercourses*

2. *Where stormwater attenuation is required, stormwater detention ponds or basins should be provided to serve the entire site catchment. A proliferation of small stormwater ponds or individual detention tanks will not generally be accepted because they are not as reliable or efficient as larger detention ponds or basins.*

3. *Water quality treatment options should be considered where appropriate, particularly in conjunction with stormwater attenuation.*

6.1.2 Drainage Reserves and Easements

The following requirements shall be met:

(a) In areas zoned Residential and Business, all stormwater pipelines, overland flowpaths and stormwater treatment / detention ponds or basins that are not contained within Roads or private ways shall be within a reserve vested with Council or easement in gross in favour of Council.

(b) In areas zoned Rural, all overland flow paths on lots of less than 4.0ha shall be identified and protected by an easement in gross in favour of Council.

(c) The minimum width of land to vest or easement shall be 3.0m

Guidance Notes:

1. *In Rural areas with lot sizes of 4.0ha and greater, stormwater control is expected to be via existing overland flow paths, ephemeral watercourses and natural wetlands, streams and rivers.*
2. *Stormwater overland flow paths and detention ponds or basins should be designed as an integral part of a subdivision or land development. As well as providing for stormwater requirements, these areas can provide recreational, access and aesthetic opportunities.*

6.1.3 Catchment Management Planning

Guidance Notes:

1. *Stormwater planning should be carried out on a coordinated and comprehensive catchment-wide basis. Although this is primarily the responsibility of Council, consideration should be given to catchment-wide issues by designers at the concept design stage.*
2. *The implications of future development upstream of the site and the cumulative effects of land development on water quality and flooding downstream are important considerations. The larger the scale of the development the more significant the catchment management planning issues are likely to be.*
3. *Any catchment management planning issues should be discussed with Council at an early stage.*
4. *At present (September 2009), Council has draft Stormwater Management Plans for Mangwhai, Dargaville and Baylys Beach. Council will review the need for Stormwater Management Plans in other Urban areas and update those that are considered appropriate.*

6.1.4 Low Impact Design Principles

Guidance Notes:

1. *The new NZS4404 has a section 4.3.7 on Low Impact Design. This section covers stormwater systems aimed to minimise environmental impact. It incorporates the use of detention ponds, wetlands, rain gardens, rainwater tanks and the like.*

6.2 Design Criteria

6.2.1 Design Methods

The following requirements shall be met:

(a) Stormwater conveyance systems (including pipes, open drains, and channels through junctions) shall be designed using Manning's equation with the value of Manning's "n" shown in Table 6.1.

Table 6.1: Values of Manning's "n"

Channel Surface	**Manning's "n" ($m^{1/3}$-s)**
PVC and PE pipes	0.009
Concrete pipes	0.012
Corrugated pipes and flumes	0.024
Swale drains with mown grass	0.040
Swale drains with dense unmown grass or reeds	0.060

Unlined open channels in earth and gravel with some bends in fair condition	0.025
Unlined open channels with rough stoney bed or with weeds on earth bank and natural streams with clean straight banks	0.030
Winding natural streams with irregular cross section and some obstruction with vegetation and debris	0.045
Irregular natural streams with obstruction from vegetation and debris	0.060
Very weedy irregular winding stream obstructed with significant overgrown vegetation and debris	0.100

(b) Other systems, including grassed swales and channels, shall be designed using the Building Industry Authority New Zealand Building Code E1: Surface Water and the Auckland Regional Council Technical Publication 10.

Guidance Notes:

1. *Design of outfalls should assume the receiving stream is flowing at its 2% Annual Exceedance Probability (AEP) flood level. If this level is higher than the pipe inlet invert level, then an Approved flood gate should be installed at the pipe outlet.*

2. *When super-critical flow will be experienced in the primary design system at flows less than its capacity, specific design should be carried out to prevent scouring of the pipe or ground at the outlet. Care should also be taken to design intermediate manholes of these pipes to be adequate for the energy losses which will occur in them.*

6.2.2 Primary and Secondary Flow paths

The following requirements shall be met:

(a) The Primary Design Flow shall be confined entirely within the defined stormwater system and shall not spill into overland flow channels.

(b) The required design Annual Exceedance Probability (AEP) / Average Annual Recurrence Interval (ARI) for the design flow of primary stormwater systems shall be as specified in Table 6.2.

Table 6.2: Design Periods for Primary Design Flow of Stormwater Systems

Land Use	Design AEP	Design ARI
Rural and Residential	20%	5 year
Industrial	10%	10 years
Commercial	5%	20 years
Rural Road Culverts	10%	10 years

(c) Secondary flow paths shall be designed for an AEP of 1% (100 year ARI) for all land uses, with an additional freeboard of 100mm. Secondary or overland flow paths shall be provided to give protection to surrounding buildings and service when flow exceeds the primary flow and/or the primary system becomes blocked.

Guidance note:

When assessing the capacity of the stormwater system downstream of a development, the effect of any flow concentration by the confinement of flows into primary or secondary flow paths within the development should be considered.

6.2.3 Freeboard

The following requirements shall be met:

(a) The minimum freeboard height to floor level above the 100 year ARI flood level shall be as follows.

Table 6.3: Freeboard

Building	Minimum Freeboard
Habitable Building floors	500mm
Commercial and Industrial Buildings and non-habitable buildings such as garages and sheds	300mm

6.2.4 Tidal Areas

The following requirements shall be met:

(a) The minimum floor level of any new dwelling shall be 5.0m above mean sea level.

Guidance Notes:

1. *In low lying areas, stormwater flows may be influenced by backwater effects from the tide. In these areas, the effects of high tide, storm surges and rising sea levels should be allowed for.*
2. *The minimum floor level of 5.0m above mean sea level is a conservative estimate of minimum requirements in the absence of a site specific analysis.*
3. *A short term increase in sea level can arise from low atmospheric pressure and wind driven sea water during storms. Guidelines should be sought from NRC and NIWA on storm surge heights applicable in low lying areas.*
4. *A rise in sea level is anticipated as a result of climate change. Developments should allow for changes in sea level as recommended by the Ministry for the Environment. The current guidelines are contained in the publication 'Coastal Hazards and Climate Change: A Guidance Manual for Local Government in New Zealand' published by the Ministry for the Environment, July 2008.*
5. *The current guidelines for subdivision and development (planning and decision timeframes to 2099) are:*

- *a base value sea-level rise of 0.5 m relative to the 1980–1999 average should be used, along with*
- *an assessment of the potential consequences from a range of possible higher sea-level rises (particularly where impacts are likely to have high consequence or where additional future adaptation options are limited). At the very least, all assessments should consider the consequences of a mean sea-level rise of at least 0.8 m relative to the 1980–1999 average.*

6. *For planning and decision timeframes beyond 2100 where, as a result of the particular decision, future adaptation options will be limited, an allowance for sea-level rise of 10 mm per year beyond 2100 is recommended (in addition to the above recommendation)*

6.2.5 Rainfall Intensity

The following requirements shall be met:

(a) Stormwater systems shall be designed for storm events of up to 100 year ARI, including an allowance for the anticipated effects of climate change.

Guidance notes:

Designers may use the rainfall depth tables provided in Tables 6.4 to 6.7 below. Design rainfall depths have been based on the NIWA High Intensity Rainfall Design System (HIRDS) version 2 database, adjusted to provide 95% confidence level.

Table 6.4: Dargaville Rainfall Depth (mm)

ARI	*Duration*									
years	*10 min*	*20 min*	*30 min*	*60 min*	*2 hour*	*6 hour*	*12 hour*	*24 hour*	*48 hour*	*72 hour*
2	*12.5*	*17.6*	*21.4*	*29.6*	*38.4*	*56.9*	*73.2*	*93.2*	*111.5*	*123.6*
5	*15.5*	*21.6*	*26.2*	*36.1*	*46.6*	*69.1*	*88.7*	*113.1*	*133.9*	*147.7*
10	*18.4*	*25.6*	*31.0*	*42.5*	*54.9*	*81.2*	*104.3*	*132.9*	*156.3*	*171.8*
20	*21.4*	*29.7*	*35.9*	*49.2*	*63.3*	*93.8*	*120.4*	*153.2*	*179.0*	*196.2*
50	*26.3*	*36.3*	*43.8*	*59.9*	*77.2*	*113.7*	*146.2*	*186.0*	*215.0*	*234.5*
100	*31.0*	*42.6*	*51.3*	*70.0*	*89.9*	*132.6*	*170.3*	*216.5*	*248.2*	*270.0*

Table 6.5: Tinopai Rainfall Depth (mm)

ARI	*Duration*									
years	*10 min*	*20 min*	*30 min*	*60 min*	*2 hour*	*6 hour*	*12 hour*	*24 hour*	*48 hour*	*72 hour*
2	*13.9*	*19.5*	*23.8*	*33.3*	*43.3*	*64.9*	*83.1*	*107.0*	*126.9*	*138.9*
5	*16.8*	*23.6*	*29.0*	*40.5*	*52.7*	*79.0*	*101.1*	*130.5*	*153.2*	*166.6*
10	*19.7*	*27.8*	*34.2*	*47.8*	*62.2*	*93.1*	*119.2*	*154.0*	*179.4*	*194.4*
20	*22.6*	*32.0*	*39.3*	*55.3*	*72.0*	*107.5*	*138.0*	*178.3*	*206.0*	*222.4*
50	*27.2*	*38.6*	*47.6*	*67.2*	*87.9*	*131.2*	*168.6*	*217.5*	*248.1*	*266.9*
100	*31.6*	*44.7*	*55.3*	*78.6*	*102.8*	*153.0*	*197.2*	*254.2*	*287.1*	*307.7*

Table 6.6: Maungaturoto Rainfall Depth (mm)

ARI	*Duration*									
years	*10 min*	*20 min*	*30 min*	*60 min*	*2 hour*	*6 hour*	*12 hour*	*24 hour*	*48 hour*	*72 hour*
2	*13.7*	*19.4*	*24.0*	*33.9*	*45.6*	*72.8*	*97.9*	*131.8*	*159.3*	*176.5*
5	*16.6*	*23.6*	*29.2*	*41.4*	*55.5*	*88.4*	*119.1*	*160.3*	*191.9*	*211.5*
10	*19.6*	*27.8*	*34.4*	*48.9*	*65.5*	*104.0*	*140.2*	*188.8*	*224.4*	*246.5*
20	*22.5*	*32.1*	*39.6*	*56.6*	*76.0*	*120.5*	*162.0*	*218.4*	*257.5*	*281.8*
50	*27.4*	*38.9*	*48.1*	*69.1*	*92.9*	*146.6*	*197.6*	*265.6*	*309.9*	*338.0*
100	*31.7*	*45.3*	*56.0*	*80.7*	*108.8*	*171.4*	*231.0*	*309.9*	*358.6*	*389.8*

Table 6.7: Mangawhai Rainfall Depth (mm)

ARI	*Duration*									
years	*10 min*	*20 min*	*30 min*	*60 min*	*2 hour*	*6 hour*	*12 hour*	*24 hour*	*48 hour*	*72 hour*
2	*14.7*	*21.0*	*25.6*	*36.3*	*47.1*	*70.0*	*88.8*	*114.7*	*137.7*	*152.9*
5	*17.9*	*25.5*	*31.1*	*44.4*	*57.4*	*85.1*	*108.1*	*139.7*	*166.3*	*183.8*
10	*21.1*	*30.0*	*36.6*	*52.4*	*67.8*	*100.2*	*127.3*	*164.8*	*194.8*	*214.6*
20	*24.3*	*34.9*	*42.5*	*60.8*	*78.8*	*116.3*	*148.0*	*191.4*	*224.8*	*246.8*
50	*29.8*	*42.8*	*52.0*	*74.8*	*96.9*	*142.9*	*182.2*	*235.2*	*273.4*	*299.2*
100	*35.1*	*50.2*	*61.1*	*88.3*	*114.7*	*168.5*	*215.3*	*277.2*	*319.8*	*348.8*

For other locations, rainfall data for the closest specified town may be used. Alternatively, designers may use HIRDS Version 2 rainfall depths + 1.65 standard error + 17% climate change allowance.

An increase in storm frequency and severity is predicted as one of the anticipated outcomes of predicted global warming. The publication 'Climate Change Effects and Impacts: A Guidance Manual for Local Government in New Zealand' published by the Ministry for the Environment, May 2008 estimates a mean air temperature increase of 2.1℃ by 2090. For extreme storm events, an 8% increase in rainfall is anticipated for each 1℃ increase in temperature. An additional 17% has therefore been allowed for the effects of climate change.

6.2.6 Specific Area Requirements for Stormwater Control

The following requirements shall be met:

Carriageway drainage in Urban areas shall comply with Table 5.3 unless otherwise Approved by Council.

6.2.7 Stormwater Discharge Consents

The following requirements shall be met:

(a) The consent holder shall obtain all necessary consents from NRC before commencing physical works on site.

(b) In the cases where the consent is to transfer to Council, the Applicant shall present a copy of the proposed NRC conditions to Council for approval prior to uplifting the consent.

(c) Once maintenance certificates have been issued at the satisfactory completion, of the maintenance period, such consents shall be transferred to Council.

6.3 Piped Stormwater System

The requirements specified in clauses 6.3.1 to 6.3.15 inclusive shall be met:

6.3.1 Minimum Requirements

(a) Piped stormwater systems shall be provided where specified in clause 6.1.1.

(b) Stormwater lines to be vested with Council shall not be less than 300 mm diameter.

(c) The minimum pipe size shall be 375mm diameter under Roads unless the inlet is protected by a sump.

(d) The piped system shall be designed to cater for the design flow, without surcharge.

(e) A minimum flow velocity of 0.7m/s for pipes flowing full shall be provided.

(f) The velocity at the point of discharge shall be dissipated using approved dissipation methods.

(g) Manholes shall be provided at each change of grade or direction, and the upper end of all primary piped stormwater reticulation and at all changes of direction or pipe junctions and at a spacing of not more than 100 metres.

6.3.2 Minimum Cover over the Pipe

All pipes shall have a minimum cover of 600mm from the top of the pipe to the ground level. An exception is for Vehicle Crossings where 300mm cover is allowed.

Alternative depths may be approved with supporting documentation. This will be dependent on pipe type and class, location and length.

6.3.3 Reticulation Layout

The layout of the primary reticulation shall follow the street pattern unless it can be demonstrated that this is not possible. Any deviation from this alignment will require approval from Council's Assets Manager.

6.3.4 Pipe Locations

In the case of subdivision, the stormwater drainage system shall be constructed over the entire area of land subject to the subdivision.

Where the reticulation lines are located in the front yard of lots the invert level shall be deep enough not to interfere with any future driveway construction.

6.3.5 Pipe Materials

(a) Stormwater Pipes shall be:

- uPVC pipe to AS/NZS 1254 Class SN 4
- PE pipe to AS/NZS 5065 Class SN 4 or
- Corrugated aluminium pipe to NZS2041:1998.

Other pipe types may be permitted subject to the approval of the Council.

(b) Stormwater pipes under Roads or pipelines to be vested with Council shall be reinforced concrete rubber ring jointed pipes unless the specific written approval of Council's Asset Manager is obtained.

(c) Galvanised steel shall not be used below ground level or the normal water level in streams.

6.3.6 Pipe Joints

All stormwater pipes shall have flexible sealed joints and be installed in accordance with the manufacturers specifications.

6.3.7 Bedding and Protection

All pipe bedding and protection shall be in accordance with manufacturer's recommendations and drawing S25.

6.3.8 Manholes

All Manholes shall comply with the following:

(a) Be located where pipelines join and at a maximum spacing of 100m centres. Where the main pipe exceeds 600 mm diameter, spacing may be increased to 150 m, and where the main pipe exceeds 1050 mm diameter, up to 200 m. For pipes over 1050 mm diameter curved lines may be approved, but Council shall be consulted about this at the design stage.

(b) Have a minimum internal diameter of 1050mm;

(c) Have a pre-cast base on the lowest riser. Cast in-situ bases are not acceptable except in the case of cast in-situ manholes Approved by Council.

(d) Consist of a single riser if shallower than 2.5m;

(e) Have joints between risers spaced a minimum 2.5m apart for manholes deeper than 2.5m;

(f) Where pipe sizes change at a manhole, the soffit of the outlet pipe shall be no higher than the soffit of the largest inlet pipe. The pipe sizes through a manhole shall not decrease in size.

(g) Have invert details that minimise energy loss. This shall include an invert channel which is at least the same depth as the outlet pipe. This channel shall be at the pipe gradient plus a minimum additional fall of 20 + 5mm per 10 degree of the angle of change of flow within the manhole. If the outlet cannot provide the required slope through the manhole, then the outlet shall be designed as a reservoir outlet with a head loss coefficient of 4 and a freeboard of 200mm to the lid or the invert of the incoming pipes at their inlets, at the design flows;

(h) Be stable under all load conditions likely to be imposed, including when completely empty;

(i) Where manholes are constructed in soft or unsuitable ground, the area under the manhole shall be excavated and backfilled with suitable granular fill.

(j) When installed on new fills or soft, under-consolidated soil, flexible joints 1.0m from the manhole on all inlets and outlets and / or have a larger pipe enclosing the inlets and outlets;

(k) Have non-slip step irons or a ladder installed over the outlet (or immediately alongside the outlet if its diameter is greater than 450mm). All steel components shall be galvanised.

(l) Manholes on pipelines of more than 900 mm diameter and on smaller pipelines where the use of standard manholes is not suitable, may be specifically designed utilising larger diameter manholes, cast in-situ reinforced chambers or a combination of the two.

(m) In areas where there is both stormwater and sewerage reticulation, stormwater manhole lids shall be painted blue and sewerage manhole lids shall be painted red.

6.3.9 Deep Manholes

(a) Where manholes are more than 5.0m deep they shall be specifically designed and shall incorporate intermediate landing platforms or grills not more than 3.0m from the surface and not more than 3.0m apart. These platforms shall be designed to carry two people with an adequate factor of safety.

6.3.10 Inlet and Outlet Structures

(a) Where stormwater drains discharge into open channels, the outlet shall be protected from scour. A suitable reinforced concrete outlet structure is shown on drawing S24. Other erosion protection, such as Reno Mattresses or stone pitching, may be installed as appropriate.

(b) Any inlets 375mm or greater in diameter without an alternative open exit point within 10m should have a grill fitted for child safety. Where appropriate, this includes securing manholes, and / or collection chambers (scruffy domes). Culvert outlets shall remain open or be hinged to allow objects to exit the system.

(c) All outlets shall comply with any Northland Regional Council requirements and, where adopted by Council, any Kaipara District Council stormwater management plan.

6.3.11 Sumps

All sumps shall:

(a) Discharge into a stormwater manhole unless Council or NRC consent is obtained for discharges to other sumps or direct discharges to waterways;

(b) Be designed as a reservoir and outlet with an outlet head loss coefficient of 4 (unless hydraulic calculations justify a lesser coefficient) and a freeboard of 200 mm to the top inlet at design flows;

(c) Have inlets designed in accordance with New Zealand Transport Agency's publication Highway Surface Drainage except that grates within carriageways at the edges of roads shall be perpendicular to the road centreline.

Guidance Note

Sump details are shown in drawings S28 to S30.

6.3.12 Soakage Pits

(a) Soakage pits may be used in free draining soils to reduce stormwater runoff. As soakage systems generally become less effective over time, where the stormwater system includes soakage systems, the overland flow paths shall be designed to take both primary and secondary flows with the freeboards specified in clause 6.2.3.

6.3.13 Domestic Connections

(a) Stormwater connections shall be located so that each property is serviced by gravity from ground level. All lots shall be provided with one stormwater connection.

(b) Residential service connections to a reticulated stormwater system shall be at least 150 mm diameter provided a grade of 1 in 100 (1%) can be achieved for a lot size of 800 to 1,000m^2. A 100 mm diameter connection may be used if the lot size is less than 800m^2. Specific design shall be carried out for lots larger than 1,000m^2.

(c) The connection provided for each residential lot shall be of a type capable of taking the spigot end of an Approved drainpipe of the appropriate size.

(d) The connection shall be positioned at sufficient depth to enable the entire buildable area of the property to be serviced, and to allow for the collection of surface run-off and the provision for field sumps and cut-off drains as required.

6.3.14 Commercial and Industrial Connections

(a) Connections for commercial and industrial lots shall not be less than 150 mm diameter discharging into a reticulated system and be designed to take the full design flow from the area served by the connection. All lots shall be provided with one stormwater connection.

(b) Service connections of diameter smaller than 300 mm (including leads 300 mm in diameter) may be saddled on to pipes 600 mm diameter and larger.

6.3.15 Testing

(c) The testing of stormwater mains or branch pipelines will not normally be required.

(d) Acceptance will be on the basis of the quality of materials and the standard and accuracy of construction. Pipelines shall be clean and free from debris.

6.4 Overland Flow Paths

6.4.1 Overland Flow Paths

The following requirements shall be met:

(a) All overland flow paths shall be designed to safely convey stormwater while maintaining the freeboards specified in clause 6.2.3.

(b) Overland flow paths shall be designed for an AEP storm of 1% (100 year ARI) as specified in clause 6.2.2(c).

Guidance Notes:

1. Overland flow paths include:

- *Drains and flood paths designed for primary and secondary stormwater flows in Rural areas.*
- *Swale drains designed for primary and secondary stormwater flows in Urban areas.*
- *A secondary stormwater system designed to carry stormwater flows in excess of the capacity of the primary system;*

2. Acceptable solutions include:

- *Temporary ponding on local and Collector Roads. Height and velocity should be such that the carriageway is still passable.*
- *Temporary flow along local and Collector Roads. Height and velocity should be such that the carriageway is still passable.*
- *All temporary ponding should drain away within 24 hours of the peak rainfall intensity.*
- *Flows across Council owned land such as Road reserves and recreational reserves.*

- *Flow across private property. Flow must be in a defined channel or swale, clear of existing or future building sites, and protected by easements or vesting in accordance with clause 6.1.2.*
- *Fencing should not be permitted across overland flow paths unless it is specifically designed to allow the passage of water.*

3. *Lots should generally be shaped such that they fall towards roadways which may be used as secondary flow paths. Where secondary flow paths cannot, with good design, be kept on roads, they should be kept on public land such as access ways, parks and reserves or designated by legal easements over private land. This design principle allows residential land to be used for its intended purpose free from the risk of flooding from overland flow paths.*
4. *Secondary flow paths should be designed so that erosion or land instability caused by the secondary flows will not occur. Where necessary the design should incorporate special measures to protect the land against such events.*

6.4.2 Open Drains

Guidance Notes:

1. *Where open drains are constructed, they should be designed to be stable, not prone to scour and able to be maintained, with adequate access for maintenance machinery. Generally concrete lined open drains will not be permitted.*
2. *Designs should be suitable to support and facilitate the movement of aquatic life. Planting adjacent to the waterways must be suitable to stabilise the banks without causing a maintenance liability in the future by their presence.*

6.4.3 Swale Drains

Swales drains shall be designed using the following design parameters;

(a) Maximum side slope of 6H : 1V

(b) Subsoil drains shall be provided in areas with a high Watertable.

(c) Shall be well vegetated with hardy grass species such as Kikuyu

(d) Vehicle Crossings shall be formed with maximum side slopes of 10H : 1V and shall be shaped to provide vehicle clearance in accordance with drawing S17.

(e) The swale drains shall be level with the Vehicle Crossing on either side.

(f) Swale drains surfaces shall be formed and maintained in a manner suitable for maintenance by conventional mowers. Surface armouring with concrete, rock riprap, Gobi blocks or check dams or similar will not be accepted by Council in Urban areas.

(g) Stormwater flows in swale drains shall comply with the following standards;

- For the 20% AEP event water depths shall not exceed 100mm, velocities shall not exceed 0.5m/s and water shall not remain on the surface for more than 1 hour following the cessation of rainfall.
- For the 1% AEP event velocities shall not exceed 1.5m/s

Guidance Notes:

1. *In low density residential areas, swale drains with field cesspits will generally be appropriate as the means of collecting stormwater from roads and lawns.*
2. *A combination of swale and piped system may be required to convey the necessary of quantity of water while complying with the Swale Drain design criteria.*

6.5 Stormwater Control and Treatment Devices Guidelines

Guidance Notes:

1. *In Urban areas, clause 6.1.1(a)(iv) will normally require the provision of on-site stormwater detention to attenuate post-development peak stormwater flows to no more than pre-development peak flows for storm events of up to 100 year ARI (1%AEP).*
2. *Where stormwater attenuation is required, stormwater detention ponds or basins should be provided to serve the entire site catchment. A proliferation of small stormwater ponds or individual detention tanks will not generally be accepted because they are not as reliable or efficient as larger detention ponds or basins.*
3. *When the final outlet from the new stormwater system is into natural waterways, stormwater treatment devices which provide water quality in accordance with the requirements of the NRC should be provided. These may include vegetative filter strips, coarse sediment traps or oil separators. Design should be in accordance with the Auckland Regional Council's Technical Publication 10 or other approved guideline.*
4. *When the discharge is into a Council-managed system, Council should be consulted as to water quality requirements and existing or planned treatment devices which the discharge may flow through. If no suitable Council-managed treatment devices exist or are planned, then the discharge should be treated as if it is being made into a natural water body (refer to the previous paragraph).*

6.5.1 Stormwater Detention / Treatment Ponds

Stormwater ponds are an accepted method of improving stormwater quality and reducing peak downstream flow rates.

Stormwater treatment ponds can be of two types:

- *Wet Pond – a permanent pond or wetland that has a standing pool of water. These ponds, through their normal storage of water, or in conjunction with extended detention, provide water quality treatment. They can, also in conjunction with extended detention, provide protection of downstream channels by attenuating peak stormwater flows.*
- *Detention Basin – a designed basin that temporarily stores stormwater runoff to control the peak rate of discharges and provide some water quality treatment, primarily through the incorporation of extended detention. These basins are normally dry between storm events and can be used for recreational purposes.*

Unless otherwise specified in the conditions of consent, stormwater treatment/detention ponds should be designed for:

- *A water quality volume of 1/3 of the 2 year -24 hour rainfall event in accordance with TP10;*
- *The reduction of post-development discharge rates to no more than pre-development discharge rates for storm events of 20, 10 and 1% AEP (5, 10 and 100 year ARI).*

All pond surrounds should be earth bunded, landscaped and grassed; the pond may need to be fully lined subject to soil permeability testing.

Ponds may require consent from the Northland Regional Council.

Specific points to focus on are:

- *Side slopes with safety considerations (recommended maximum 1:4 slope)*
- *Ease of maintenance including mowing and silt clean-out and access to public roads*
- *Shape and contour for amenity value*

- *An effective outlet structure*
- *Overflow Design*
- *Landscape planting and maintenance*
- *Pest Control.*

Stormwater treatment/detention ponds are required to be located on land owned by Council as specified in clause 6.1.2.

6.6 Stormwater from Industries Which Use Hazardous Substances

Guidance Notes:

1. *In industrial or commercial developments which deal with environmentally hazardous substances (e.g. service stations, electroplating factories, timber treatment yards), the stormwater system should be protected from the entry of any of the hazardous substances and comply with the Rules for Industrial or Trade Discharges in the Regional Water and Soil Plan for Northland.*
2. *If necessary, the development should be surrounded with a bund that will contain any spills, and from which the storm runoff can be treated separately before discharge to the trunk system. The water quality in all such discharges should be the same or better than the water quality requirements of Council's resource consent for the ultimate stormwater discharge.*

6.7 Building Over Pipelines

Guidance Notes:

1. *Buildings should not be constructed over pipelines. Alternative options such as relocating the building or diverting the pipeline around the building are required for new pipelines.*
2. *Buildings and other structures are not permitted within drainage easements or reserves vested with Council.*

6.8 Construction Requirements

The following requirements shall be met:

(a) All pipeline construction shall conform to the requirements set out in NZTA specification F/3, AS/NZS 3725:2007, AS / NZS 2566.2 or AS/NZS 2033:2008 as appropriate.

(b) Culvert bedding and backfill shall be in accordance with drawing S25. Scour blocks and pipe protection shall be provided as required in accordance with drawing S26.

(c) All excavations shall be kept dry. If subsoil or trench water is discharged to existing stormwater drains, it shall be free of sediment and other harmful contaminants. No water may be discharged into existing sewerage systems from the operation.

(d) Wherever possible, pipes shall be laid in straight lines between start and finish points, junctions, valves, changes of direction or changes of grade. Any curvature shall be gradual and even.

(e) In the case of pressure pipes, any horizontal or vertical curvature to minimise pipe depths shall be gradual and even, and shall not result in crests in the pipe where air could accumulate.

(f) Unsatisfactory foundation material shall be undercut and replaced with compacted granular material such that a suitable foundation is achieved.

(g) All pipes shall be laid on granular bedding material of clean, evenly graded GAP 5 aggregate. The depth of bedding material beneath the pipe shall not be less than

100 mm and in rock or rocky soils, the depth shall be increased to 200 mm. The granular bedding material shall be thoroughly compacted by hand tamper around and over the pipe to a height of at least 100 mm above the crown of the pipe.

(h) All pipes and fittings shall be thoroughly cleaned inside before use. Temporary open ends of laid pipes shall be closed with plates or flanges whenever work is discontinued to prevent foreign matter from entering the pipe.

(i) The ordinary backfill shall be placed in layers not exceeding 300 mm compacted depth, each layer thoroughly compacted to a firm, unyielding surface. Suitable material excavated to form the trench can be used, and sufficient additional material shall be imported.

(j) Where a pipe changes direction and a manhole is not installed, thrust blocks shall be installed. The blocks shall be sized to immobilise passive resistance. The soil at the bearing surface (whether pipe or block) shall be free of organic matter and thoroughly compacted against the bearing surface. Drawing S39 gives details of thrust blocks.