# Appendices

# Appendix ADesigning for Surge and Fatigue

## A1 Introduction

All pipelines are subjected to pressure variations during their lifetimes. Some of these pipelines, e.g. rising mains, will experience significant and regular pressure surges, while others may be subjected only to minor diurnal pressure variations.

Rapid pressure fluctuations and surges generally result from events such as pump start-up and shutdown, or rapid closing or opening of valves, including 'slamming' of air valves as can happen during venting of bulk air from pipelines.

For the purposes of the WDC EES, a pressure surge is defined as a rapid, short-term pressure variation. Surges are characterised by rapid, high-pressure rise rates, with minimal time spent at the peak pressure. Surge events usually consist of a number of diminishing pressure waves that cease within a few minutes.

The frequency and magnitude of the pressure transients affects the choice of pipe pressure class. Ensure that the following aspects are considered when designing for surges and fatigue:

- That the maximum and minimum pressures are within acceptable limits for the pipe and fittings for all surge events (including infrequent events such as power failure, emergency shut-down, rapid closure of fire hydrants)
- Consider the potential for fatigue and select the pipe pressure class accordingly, to allow for frequent repetitive pressure variations
- The pipe and the quality of installation and their influence on the fatigue resistance of the pipe.

The following sections provide a methodology for dealing with surge and fatigue, so that pipes are adequately designed to provide the 100 year design life that is required.

The PIPA Guidelines may also be used, specifically the following:

- POP010A – Polyethylene Pressure Pipes Design for Dynamic Stresses
- POP101 – PVC Pressure Pipes Design for Dynamic Stresses.

These may be found at http://www.pipa.com.au/Guidelines.html.

## A2 Pressure Surge Events

A surge analysis is required to check whether damaging pressure surges (or surges that could cause customer complaint) could occur in a system. The level of detail of the surge analysis should be appropriate to the pipeline. For example, a reticulation pipeline may require only consideration of rapid closure of fire hydrants and conservative selection of pipe pressure rating.

Pipelines that may be subjected to more severe surge effects e.g. rising mains, areas close to control valves (reservoir inlet valves and pressure reducing valves) and where specified by Council, require a more detailed level of analysis, or the selection of pipe materials that are highly resistant to surge and fatigue issues.

The source(s) of significant pressure surges in a water system should be identified and included in any surge analysis. Mitigating measures may be needed to minimise any surges generated, and any surge control devices must be designed accordingly. As a minimum, such a surge analysis should consider:

- Identified causative scenarios (e.g. power failure, pump trip, component failure, air valve operation, rapid closure of valves)
- The highest pressure along the pipeline
- The lowest pressure along the pipeline
- Vacuum and air relief requirements along the pipeline under all conditions.

Note that non-slam air valves may be required on plastic pipelines, to minimise the risk of severe surges being generated by the movement of trapped air, and to minimise the potential for instantaneous 'slamming' shut of a conventional air valve.

If, during the design phase, it is found that the minimum pressure in the mains could fall below atmospheric pressure during pressure surge events or drain down, mitigating measures must be designed to eliminate or minimise these effects. If negative pressures are a possibility, buckling of the pipe must be considered and a safety factor of at least 2.0 applied.

### A3 Fatigue

Consideration of the effect of fatigue is particularly relevant to plastic pipes that are subjected to a large number of pressure cycles. Fatigue considerations can generally be ignored for ferrous pipe materials, e.g. ductile iron and concrete-lined steel. The important factors are the magnitude and frequency of the pressure fluctuations.

For fatigue loading situations, the maximum pressure reached in the pressure cycle must not exceed the nominal pressure rating of the pipe.

Fatigue does not need to be considered if the number of pressure cycles during the pipe's designed lifetime does not exceed the values below

**Table 1 Critical number of surges in pipe lifetime**

| Pipe Material | Critical Number of Cycles in Lifetime |
|---|---|
| PVC-U, PVC-O | 100,000 |
| PE 80B, PE 100 | 300,000 |

The procedure for fatigue design is:

- Confirm the design lifetime of pipeline. (The pipeline design life must be taken as 100 years unless specified otherwise by Council)
- Estimate the likely number of pressure cycles during design life
- Calculate the range of pressure surges
- Calculate the fatigue load factor
- Determine the equivalent operating pressure
- Select the pipe PN rating.

### A4 Number of Pressure Cycles

Calculate the expected number of cycles during the pipe's lifetime, based on realistic estimates of the number of pressure cycles per day or per hour. If the primary pressure variation is followed by a smaller number of pressure fluctuations on each cycle, as shown in Figure 1, the calculated number of cycles should be doubled.

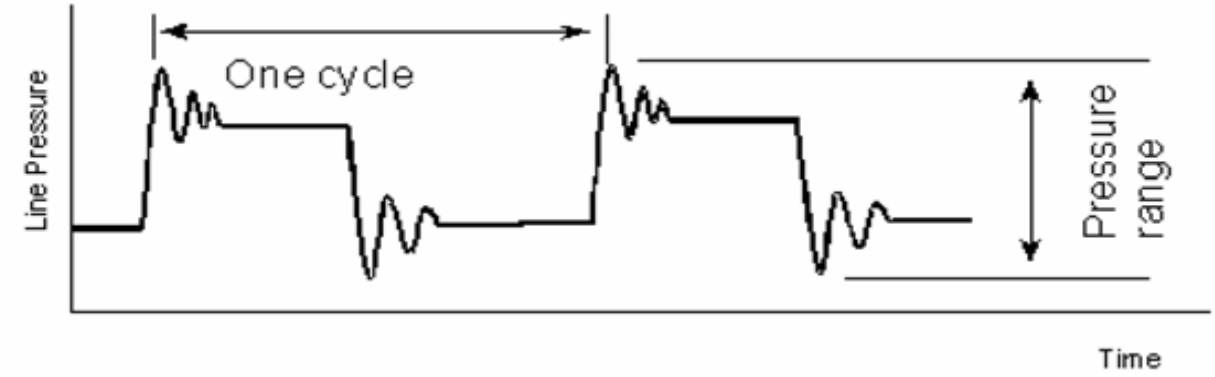



**Figure 1 Pressure cycle and pressure range (from POP101 Figure 1)**

The table below shows the number of pressure cycles over 100 years for various numbers of cycles per day and hour

**Table 2 Pressure Cycles in 100 Years for Various Numbers per Hour and per Day**

| Cycles Per Hour | Cycles Per Day | Total Number of Cycles in 100 Years |
|---|---|---|
| 0.04 | 1 | 36,000 |
| 0.5 | 12 | 440,000 |
| 1 | 24 | 880,000 |
| 10 | 240 | 8,800,000 |
| 60 | 1440 | 52,500,000 |
| 120 | 2880 | 105,000,000 |

## A5 Range of Pressure Surges

Calculate the pressure range of the regular pressure variations by surge analysis. Figure 1 shows a typical cyclic pressure pattern. Where pumps are controlled by variable speed drives, select a pressure cycle that is most representative of the expected pipeline operation over its design life.

The effects of infrequent or accidental conditions, e.g. power or surge protection device failures may be ignored, provided the peak surge pressure does not exceed the values derived from Table 19.

Note that the pressure range will vary along the pipeline. Economies may be possible on some pipelines by dividing the pipeline into sections and evaluating the fatigue design for each, subject to the approval of Council.

## A6 Fatigue Load Factor

The fatigue load factors for plastic pipes are as shown below in Table 3 and Table 4

**Table 3 Fatigue Load Factors for PE80B and PE100 (from POP010A Table 1)**

| Total Cycles | Cycles per day for 100 year life | PE80B | PE100 |
|---|---|---|---|
| 36,500 | 1 | 1.00 | 1.00 |
| 100,000 | 3 | 1.00 | 1.00 |
| 300,000 | 8 | 1.00 | 1.00 |
| 500,000 | 14 | 0.95 | 0.95 |
| 1,000,000 | 27 | 0.88 | 0.88 |
| 5,000,000 | 137 | 0.74 | 0.74 |
| 10,000,000 | 274 | 0.68 | 0.68 |
| 50,000,000 | 1370 | 0.57 | 0.57 |

**Table 4 Fatigue Load Factors for PVC (from POP101 Table 1)**

| Total Cycles | Cycles per day for 100 year life | PVC-U | PVC-M | PVC-O |
|---|---|---|---|---|
| 26,400 | 1 | 1.00 | 1.00 | 1.00 |
| 100,000 | 3 | 1.00 | 0.67 | 0.75 |
| 200,000 | 5.5 | 0.81 | 0.54 | 0.66 |
| 500,000 | 14 | 0.62 | 0.41 | 0.56 |
| 1,000,000 | 27 | 0.50 | 0.33 | 0.49 |
| 2,500,000 | 82 | 0.38 | 0.25 | 0.41 |
| 5,000,000 | 137 | 0.38 | 0.25 | 0.41 |
| 10,000,000 | 274 | 0.38 | 0.25 | 0.41 |

## A7 Equivalent Operating Pressure

Calculate this using the following equation:

**Equation 1 - Equivalent operating pressure**

$$\text{Peo} = \frac{\Delta P}{FLF}$$

where:

Peo = Equivalent operating pressure (bar)
ΔP = Cyclic pressure range (bar). Refer Figure 5
FLF = Fatigue Load Factor. Refer Figure 6

## Appendix B Form EES-SEW1

**On-Site Wastewater Disposal Investigation/Site Evaluation Checklist for Resource Consent Application**

**WHANGAREI DISTRICT COUNCIL**
Forum North · Private Bag 9023 · Whangarei 0148 · New Zealand
Telephone (09) 430 4200 · 0800 WDC INFO · 0800 932 463 · Facsimile (09) 438 7632
Website http//www.wdc.govt.nz · E-mail mailroom@wdc.govt.nz



**Form EES-SEW1**

# On-Site Wastewater Disposal Investigation/Site Evaluation Checklist for Resource Consent Application

**This form is to be read in conjunction with AS/NZS 1547:2000 (or any amendments as applicable), and, in particular with Part 4: Means of Compliance**

## Part A - Contact Details

### 1 applicant

Name _____

_____

Property Address _____

_____

Lot/DP Number _____

### 2 Consultant/Site Evaluator

Site Evaluator Name _____

Company Name _____

Postal Address _____

_____

Business Phone _____ Fax _____

Mobile _____ Email _____

IQP Registered[25] *(See note 1 below)*

❑ Yes ❑ No If no, details of suitably registered IQP who will countersign the report are to be supplied below

Name of IQP who is Countersigning Report _____

Company Name _____

Postal Address _____

_____

Business Phone _____ Fax _____

Mobile _____ Email _____

[25] It is a requirement that the Evaluator be IQP registered to carry out on-site effluent investigations/designs. If not, then evaluation/design will need to be counter-signed by a suitably registered IQP

## Part B - Site and Soil Evaluation

### 1 Desk Study

Requirements (✓ appropriate box)

Please complete **all** options. *(If more than one option applies to land under consideration, please clarify with supporting information)*

| WDC Requirement | | Applies to Lot(s) | Comments |
|---|---|---|---|
| **1 Hazard maps/GIS hazard layer - stability** | | | |
| ❑ Low instability risk | | | |
| ❑ Medium instability risk | | | |
| ❑ High instability risk | | | |
| **2 GIS hazard layer – effluent on slope stability** | | | |
| ❑ Low disposal potential | | | |
| ❑ Moderate disposal potential | | | |
| ❑ High disposal potential | | | |
| **3 GIS hazard layer – effluent suitability** | | | |
| ❑ Medium unsuitability | | | |
| ❑ High unsuitability | | | |
| **4 GIS hazard layer – flood susceptibility** | | | |
| ❑ Is flood susceptible | | | |
| ❑ Is partially flood susceptible | | | |
| ❑ Is not flood susceptible | | | |
| **5 GIS land resources layer - streams** | | | |
| Are there streams on or adjacent to land under investigation? | ❑ Yes | | |
| | ❑ No | | |
| **6 GIS land resources layer – aquifers at risk** | | | |
| Is land situated over or adjacent to aquifer? | ❑ Yes | | |
| | ❑ No | | |
| **7 Annual rainfall (HIRDS)** | | | |

**Important Note**

It is to be noted that **all** information obtained off WDC GIS/Hazard Maps is to be taken as a guide **only**.

All information obtained from the above sites is to be confirmed by a specific site investigation as localised conditions could vary substantially. However, should the above data checks indicate the potential for a hazard/non-complying activity etc, this **must** be further investigated to confirm/deny the indicated situation.

## 2 On-Site Evaluation

**a Determination of Soil Category** *(refer table 4.1.1 AS/NZS 1547:2000)* ( ✓ appropriate box)

| Soil Category | Structure | Applies to lot(s) | Comments |
|---|---|---|---|
| 1 Gravels & Sands | ❑ Structureless (massive) | | |
| 2 Sandy loams | ❑ Weakly Structured | | |
| | ❑ Massive | | |
| 3 Loams | ❑ High/Moderate structured | | |
| | ❑ Weakly structured or Massive | | |
| 4 Clay loams | ❑ High/moderate structured | | |
| | ❑ Weakly structured | | |
| | ❑ Massive | | |
| 5 Light clays | ❑ Strongly structured | | |
| | ❑ Moderately structured | | |
| | ❑ Weakly structured or massive | | |
| 6 Medium to heavy clays | ❑ Strongly structured | | |
| | ❑ Moderately structured | | |
| | ❑ Weakly structured or massive | | |

**Notes**

Refer 4.1 A4 – Soil Assessment AS/NZS 1547:2000 for assessment criteria.

Details of the method used to determine soil type etc are to be clearly stated, along with positions of boreholes/test pits etc clearly marked on a site plan. Bore logs are to be provided. Photos should be included.

The site plan should also clearly show the intended area for effluent disposal, along with any site features such as drains, water bores, overland flows etc, along with separation distance achieved.

**On-Site Evaluation Continued**

b Site Characteristics for Proposed Disposal Area: *(if there is a marked difference between sites, please fill in a separate form for each site and clearly note which site the assessment applies to)* ( ✓ appropriate box)

| **Details** | **Applies to Site/s** |
|---|---|
| **1 Flooding potential to proposed field and reserve field** *(refer note 1 below)* | |
| ❑ Fields will not flood, or | |
| **Fields will flood in:** | |
| ❑ 20% AEP event | |
| ❑ 5% AEP event | |
| ❑ 1% AEP event | |
| **2 Surface water separation to proposed field and reserve field** *(refer note 2 below)* | |
| ❑ Main/reserve disposal field comply with NRC rules | |
| ❑ Main/reserve disposal field do **not** comply with NRC rules | |
| **3 Winter ground water separation to proposed field and reserve field** *(refer note 3 below)* | |
| ❑ Main and reserve disposal field comply with NRC rules | |
| v Main and reserve disposal field do NOT comply with NRC rules | |

**4 Slope of ground of proposed field and reserve field** *(refer note 4 below)*

**Description**

**5 Shape of ground of proposed field and reserve field** *(refer note 5 below)*

| | | |
|---|---|---|
| ❑ Waxing divergent | ❑ Linear divergent | ❑ Waning divergent |
| ❑ Waxing planar | ❑ Linear planar | ❑ Waning planar |
| ❑ Waxing convergent | ❑ Linear convergent | ❑ Waning convergent |

**Comments**

| **6 Intended water supply source** | **Applies to Site/s** |
|---|---|
| ❑ Public supply | |
| ❑ Rainwater | |
| ❑ Bore | |

**7 Proposed method of disposal and recommended Daily Loading rate (DLR)** *(refer note 6 below)*

**Description**

**Peak Loading factored in?** *(refer note 6 below)* ❑ **Yes** ❑ **No** **Comments**

| **8 Site Exposure** *(refer note 7 below)* | **Description** | **Applies to Site/s** |
|---|---|---|
| Site/s aspect | | |

| | | |
|---|---|---|
| Pre-dominant wind direction | | |
| Presence of shelter belts | | |
| Presence of topographical features or structures | | |

**9 Proximity of water bores. (include adjacent properties).** *(refer note 9 below)*

**10 Visible evidence of slips/instability** *(refer note 8 below)*

**11 Total suitable area available for type of effluent disposal proposed** *(including reserve area)*

**12 Setback areas proposed** (if any) *(refer note 10 below)*

**Notes**

1 If the WDC hazard maps/GIS indicate a flooding susceptibility on the site being evaluated, an on-site evaluation is to be carried out to determine the effects from 20%, 5% and 1% AEP storm events. This evaluation is to include all calculations to substantiate conclusions drawn. If necessary, include a detailed contour plan and photos.

2 NRC Water & Soil plan defines surface water as 'All water, flowing or not, above the ground. It includes water in continually or intermittently flowing rivers, artificial watercourses, lakes and wetlands, and water impounded by structures such as dams or weirs but does not include water while in pipes, tanks, cisterns, nor water within the Coastal Marine Area'. By this definition, separation (complying with NRC rules) is to be maintained by both the proposed disposal and reserve areas from any overland flowpaths and/or swale drains etc or R/C will be required from NRC. Surface water is to be clearly marked on each site plan, showing the extent of a 1% AEP storm event, and detailing separation distances to main/reserve disposal areas.

3 Positions of test borehole/s to be shown, and bore logs to be provided. Separation (complying with NRC rules) is to be maintained by both the proposed disposal and reserve areas from winter ground water level or R/C will be required from NRC. If the investigation is done outside of the winter period, allowance is to be made in determining the likely winter level.

4 Slopes of ground are to be compared with those recommended maximums for type of system proposed (refer Appendix 4.2B AS/NZS 1547:2000). Designs exceeding those maximums will require specific design to justify the proposal, and may also need Resource Consent from NRC.

5 Shape of ground is important as it will determine whether there is potential for concentrated overland flows from the upper slopes and also if effluent might be concentrated at base of slope if leeching occurs. Refer Figure 4.1B2 AS/NZS 1547:2000.

6 The proposed system (for residential developments) should be sized to accommodate an average 3 bedroom house with 5 people. Sites in holiday areas need to take peak loading into effect in determining daily volumes. The design must state what DLR was used to determine area necessary (including reserve area). If ground conditions are marginal for type of disposal proposed, then a soil permeability test utilising the constant head method is to be carried out across the proposed disposal area. Refer Appendix 4.1F AS/NZS 1547:2000.

7 The site aspect is important as a north-facing site that is not sheltered from wind and sun by shelterbelts or other topographical features or structures will perform far better than a south-facing site on the lee of a hill that is shaded from wind and sun etc

8 If any effluent disposal area (including any reserve area) proposed has or is adjacent to areas that show signs of instability, then a full report from a CPEng (Geotech) will be required to justify the viability of the area for effluent disposal.

9 If there are any water bores on the subject property or adjacent properties then a site plan will be required showing bore positions in relation to any proposed effluent field(s).

10 If setback areas are proposed to mitigate effects, the extent and position/s need to be shown on a site plan.

## Appendix CForm EES-PS1

### Producer Statement – Design

### Design Works to be carried out under Resource Consent Conditions

**WHANGAREI DISTRICT COUNCIL**
Forum North · Private Bag 9023 · Whangarei 0148 · New Zealand
Telephone (09) 430 4200 · 0800 WDC INFO · 0800 932 463 · Facsimile (09) 438 7632
Website http//www.wdc.govt.nz · E-mail mailroom@wdc.govt.nz



# Form EES-PS1
# Producer Statement – Design
# Design Works to be carried out under Resource Consent Conditions

Issued By *(print)* _____
*(Suitably qualified professional/IQP)*

To **Whangarei District Council**

In respect of _____
*(Description of sub divisional/development work)*

at _____
*(Address)*

Lot _____ DP _____ SO _____

_____ has been engaged by _____
*(Consultants Firm)* *(Developer/Owner)*

to provide engineering calculations/report/drawings for construction of the above sub divisional/ development work.

The work is described on drawings titled _____

and numbered _____ and dated _____

and the specification and other documents according to which the works are proposed to be constructed. The design has been prepared in accordance with WDC's Environmental Engineering Standards (2009) (or subject to any variations thereto as listed below:

_____

_____

I am familiar with the conditions of consent to the works as described by Resource Consent No _____

granted and approved by WDC on *(date)* _____

As an independent design professional I believe on reasonable grounds that the drawings, specifications and other documents according to which the subdivision works are proposed to be constructed adequately illustrate the design

services provided by _____

and that the design services provided by _____

have been prepared in accordance with WDC Environmental Engineering Standards (2009), or any variation thereto listed above.

_____ _____
*Signature Suitably Qualified Professional* *Date*

_____
*Professional Qualifications*

_____
*Address*

Member of ❑ ACENZ ❑ IPENZ ❑ NZIS IQP Registered ❑ Yes ❑ No

**Note**
This statement is to be accompanied by proof of current Professional Indemnity Insurance to a value of not less than that stated in the WDC Environmental Engineering Standards (2009)

## Appendix D Form EES-PS4

**Producer Statement – Construction**

**Certification of Works Carried out under Resource Consent**

**WHANGAREI DISTRICT COUNCIL**
Forum North · Private Bag 9023 · Whangarei 0148 · New Zealand
Telephone (09) 430 4200 · 0800 WDC INFO · 0800 932 463 · Facsimile (09) 438 7632
Website http//www.wdc.govt.nz · E-mail mailroom@wdc.govt.nz



# Form EES-PS4
# Producer Statement – Construction
# Certificate of Works carried out under Resource Consent

Issued By *(print)* _____
*(Suitably Qualified Professional/IQP)*

To **Whangarei District Council**

In respect of _____
*(Description of sub divisional/Development work)*

at _____
*(Address)*

Lot _____ DP _____ SO _____

_____ has been engaged by _____
*(Consultants Firm)* *(Developer/Owner)*

to provide certification for the following works approved under Resource Consent number _____

Issued on _____ and described on drawings titled _____

and numbered _____ and dated _____

Works subject to *(provide description of work/extent of certification)*

i _____

ii _____

iii _____

iv _____

v _____

We have sighted the Resource Consent issued and the conditions attached to it

On the basis of review(s), supervision and information supplied by the contractor(s) during the course of the works, as an independent professional **I believe on reasonable grounds** that the construction works as specified above have been completed in terms of the approved drawings, specifications and other documents approved under the Resource Consent process

_____ _____
*Signature Suitably Qualified Professional* *Date*

_____
*Professional Qualifications*

_____
*Address*

Member of ❑ ACENZ ❑ IPENZ ❑ NZIS IQP Registered ❑ Yes ❑ No

**Note**
This statement is to be accompanied by proof of current Professional Indemnity Insurance to a value of not less than that stated in Council's Environmental Engineering Standards (2009)

## Appendix E Form EES-PO1

**Statement of Professional Opinion on Suitability of Land for Building Construction**

**WHANGAREI DISTRICT COUNCIL**
Forum North · Private Bag 9023 · Whangarei 0148 · New Zealand
Telephone (09) 430 4200 · 0800 WDC INFO · 0800 932 463 · Facsimile (09) 438 7632
Website http//www.wdc.govt.nz · E-mail mailroom@wdc.govt.nz



# Statement of Professional Opinion on Suitability of Land for Building Construction
## Form EES-PO1

Development _____

Developer _____

Location _____

I *(full name)* _____

of *(Name and address of firm)* _____

_____

Hereby confirm that _____

1 I am a geo-professional as defined in **Section 1.2** of the WDC EES and was retained by the developer as the geo-professional on the above development

2 The extent of my preliminary investigations are described in my Report(s) number _____ dated _____ & the conclusions and recommendations of that/those document(s) have been re-evaluated in the preparation of this report. The extent of my inspections during construction, & the results of all tests and/or re-evaluations carried out are as described in my geotechnical completion report dated _____

3 In my professional opinion, not to be construed as a guarantee, I consider that *(delete as appropriate):*

a The earth fills shown on the attached Plan No _____ have been placed in compliance with the requirements of the _____ Council & my specification (However, lots _____ & _____ did not pass final fill specification testing & as a result, specific site investigations & foundation designs will be required here at the time of building consent application)

b The completed works take into account land slope & foundation stability considerations, subject to the appended foundation recommendations and earthworks restrictions, *(which should be read in conjunction with the appended final site contour plan)*

c Subject to 3(a) and 3(b) above, the original ground not affected by filling satisfies the description of 'good ground' as described in NZS3604/NZS4229 ❒ Yes ❒ No

(If **no**, a specific foundation investigation/design will be required at the time of Building Consent)

d Subject to 3(a) & 3(b) above, the filled ground satisfies the description of 'good ground' as described in NZS3604/NZS4229 ❒ Yes ❒ No

(If **no**, a specific foundation investigation/design will be required at the time of Building Consent)

e The original ground not affected by filling & the filled ground are not subject to erosion, subsidence, or slippage in accordance with the provisions of section 106 of the Resource Management Act 1991provided that:

i _____

ii _____

4 This professional opinion is furnished to the TA & the developer for their purposes alone on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any building

5 This certificate shall be read in conjunction with my geotechnical report referred to in clause 2 above & shall not be copied or reproduced except in conjunction with the full geotechnical completion report

| *Signature* | *Professional Qualifications* | *Date* |
|---|---|---|

## Appendix F Form EES-W1

### Application to Connect Water Reticulation to WDC Mains

**WHANGAREI DISTRICT COUNCIL**
Forum North · Private Bag 9023 · Whangarei 0148 · New Zealand
Telephone (09) 430 4200 · 0800 WDC INFO · 0800 932 463 · Facsimile (09) 438 7632
Website http//www.wdc.govt.nz · E-mail mailroom@wdc.govt.nz



# Application to Connect Water Reticulation to WDC Mains
# Form EES-W1

Subdivision/Development Name _____

Subdivision/Development No _____ Application No _____

Building Consent _____ PID _____

Surveyor _____ Approved contractor _____

Developer _____

**Document Information**

Drawing Numbers _____

Other Documents _____

| **1 Approval of Works** | **Yes** | **No** |
|---|---|---|
| The works have been built in full accordance with the approved drawings and have been inspected against the SEEO checklist and passed all inspections. | ❑ | ❑ |

| **2 Pressure Testing** | | | | **Pass** | **Fail** |
|---|---|---|---|---|---|
| Pressure taken to | _____ kPa | | | ❑ | ❑ |
| For | _____ hours | $N_1$ | _____ | | |
| Pressure drop | _____ % | $N_2$ | _____ | | |

| **3 Disinfection** | | **Pass** | **Fail** |
|---|---|---|---|
| Initial Chlorine Residual | _____ | ❑ | ❑ |
| 24hr Chlorine Residual | _____ ppm | | |
| Final Chlorine Residual | _____ ppm | | |

**4** The above inspection/testing is for the ❑ complete works ❑ part of the works

If for part of the works, please give specific details _____

**Approved by** _____ _____
*(SEEO or Delegated Representative)* *Date*

**Office Use Only**

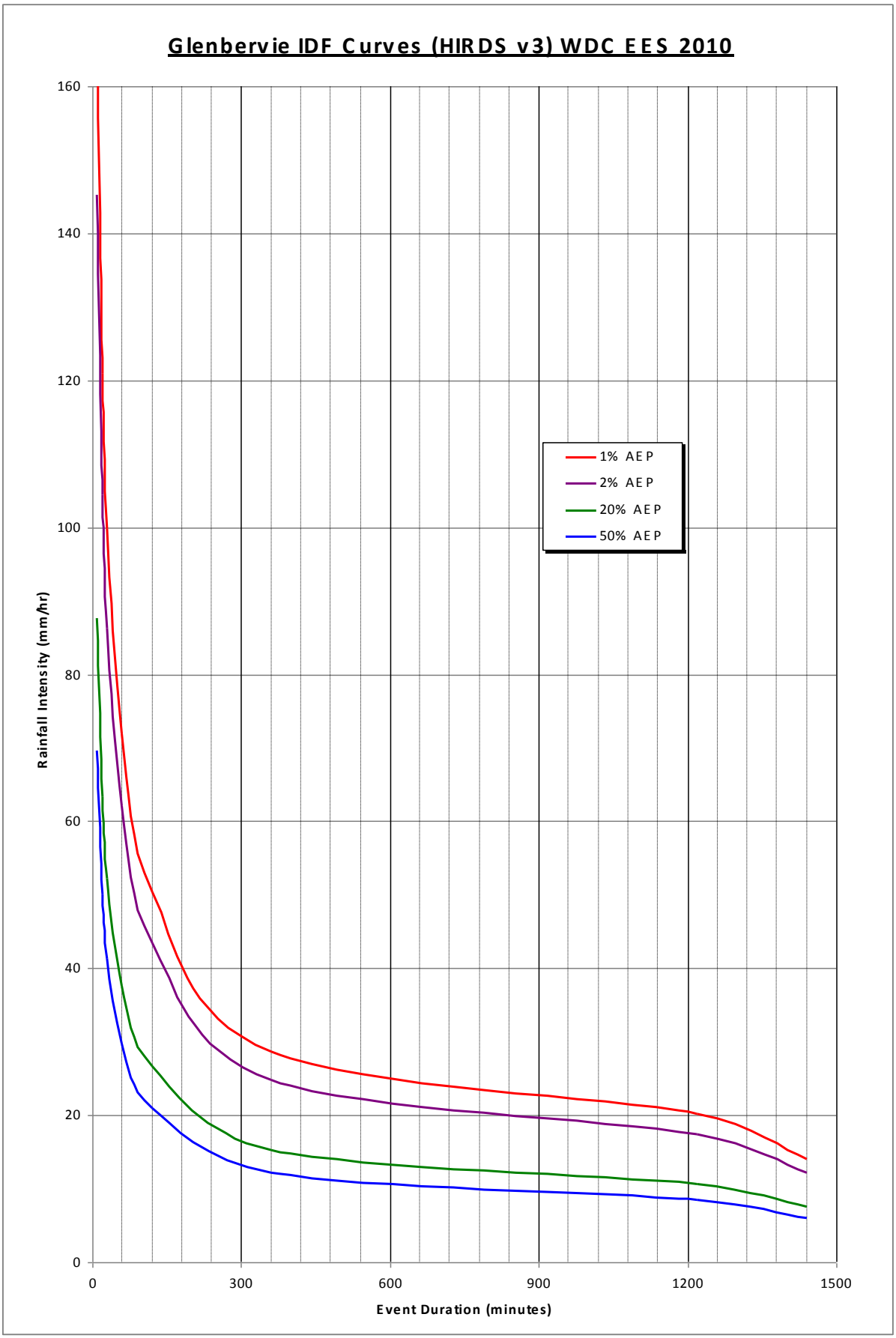
| **Approved to connect into Public Water Supply** | **Yes** | **No** |
|---|---|---|
| | ❑ | ❑ |

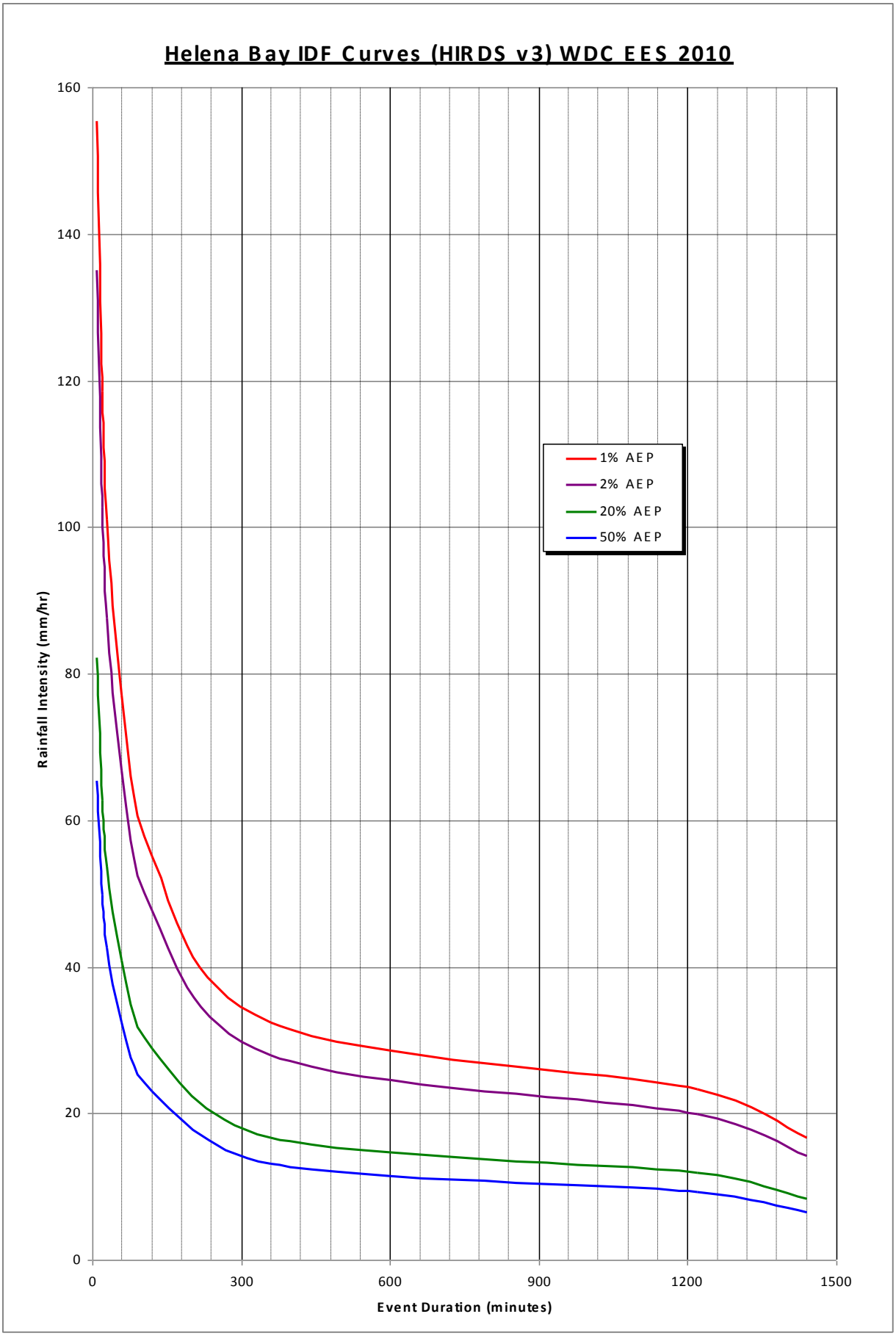
_____ _____ _____
*Name of Approving Officer (print)* *Signature* *Date*

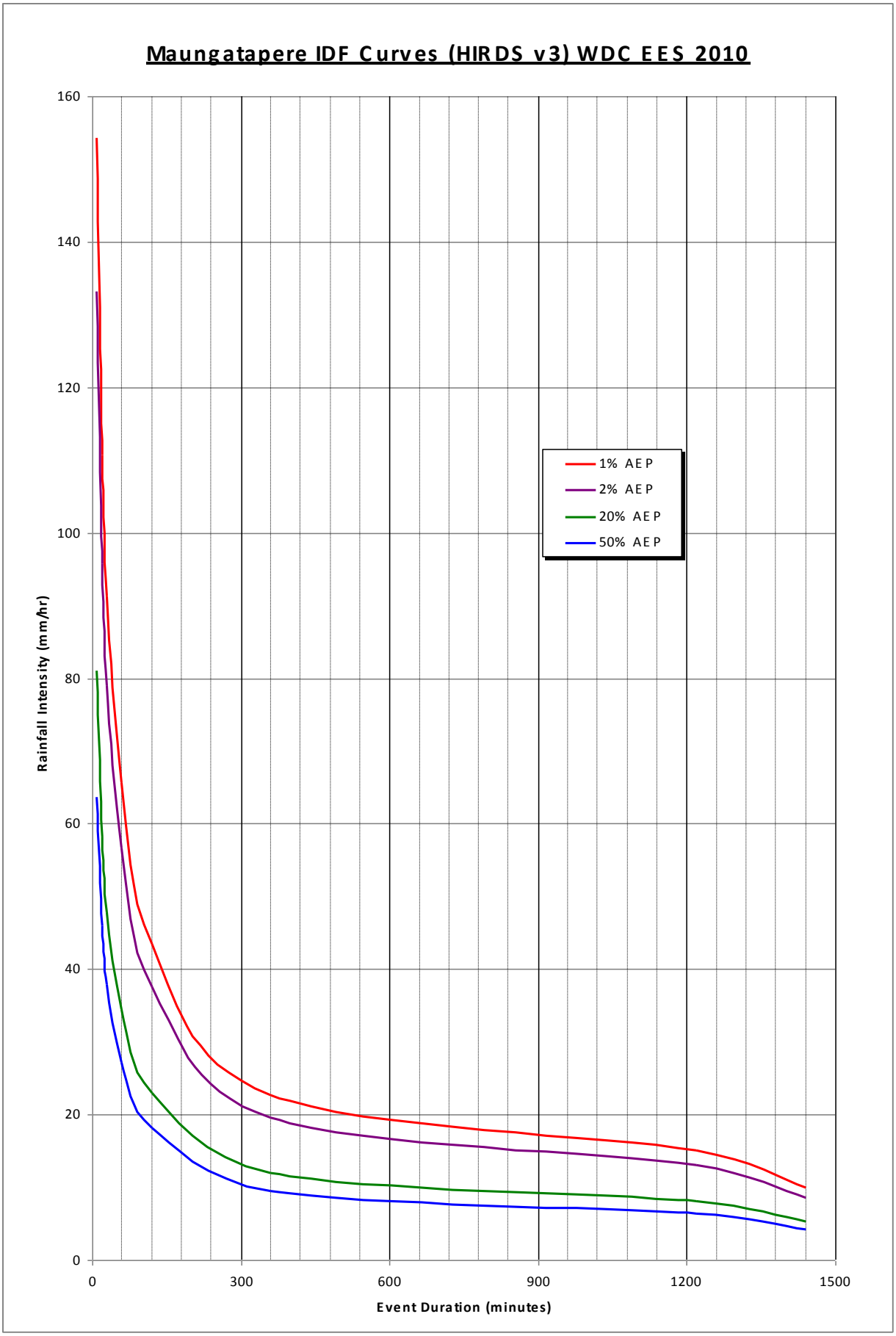
**Comments** _____

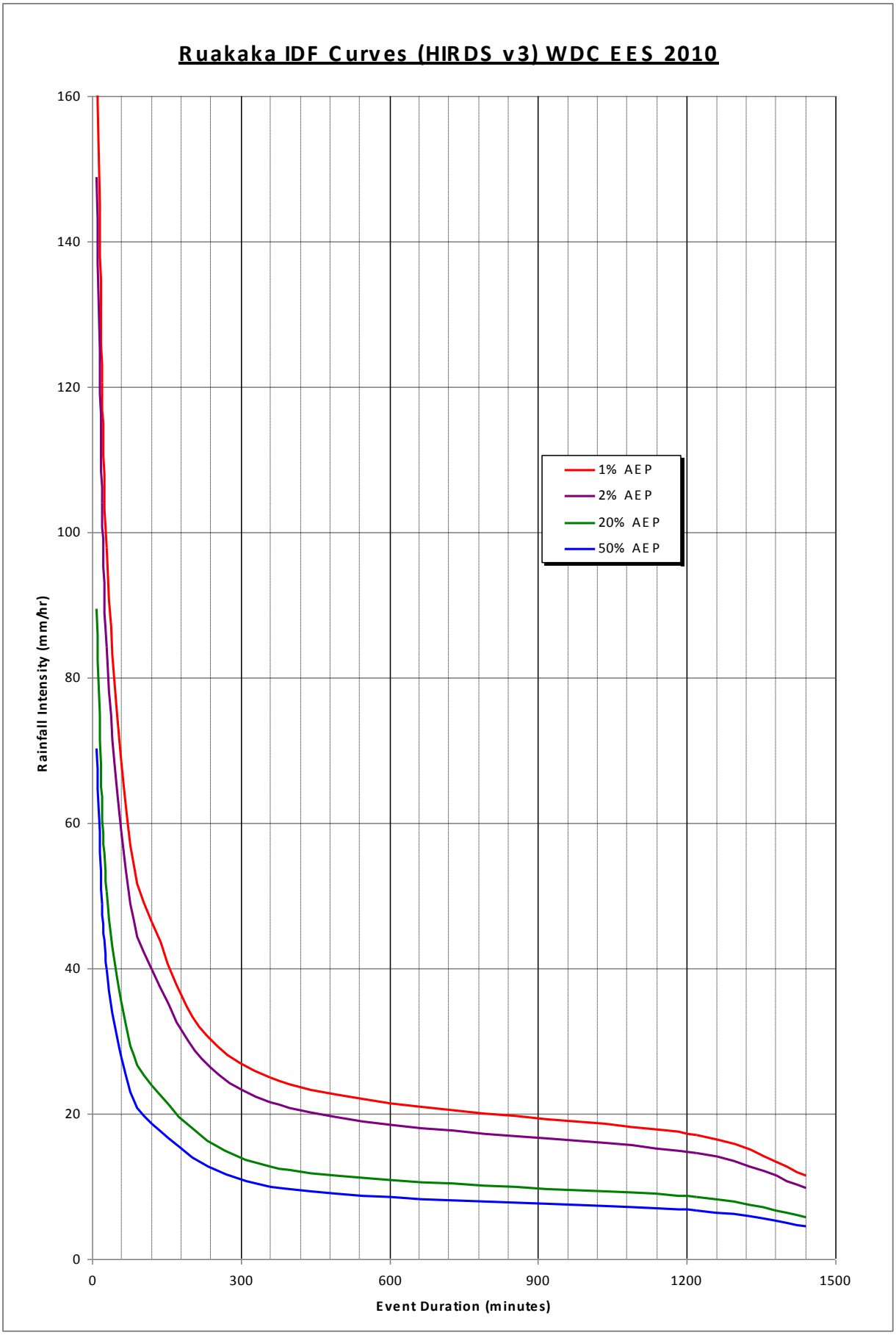
# Appendix G IDF Curves

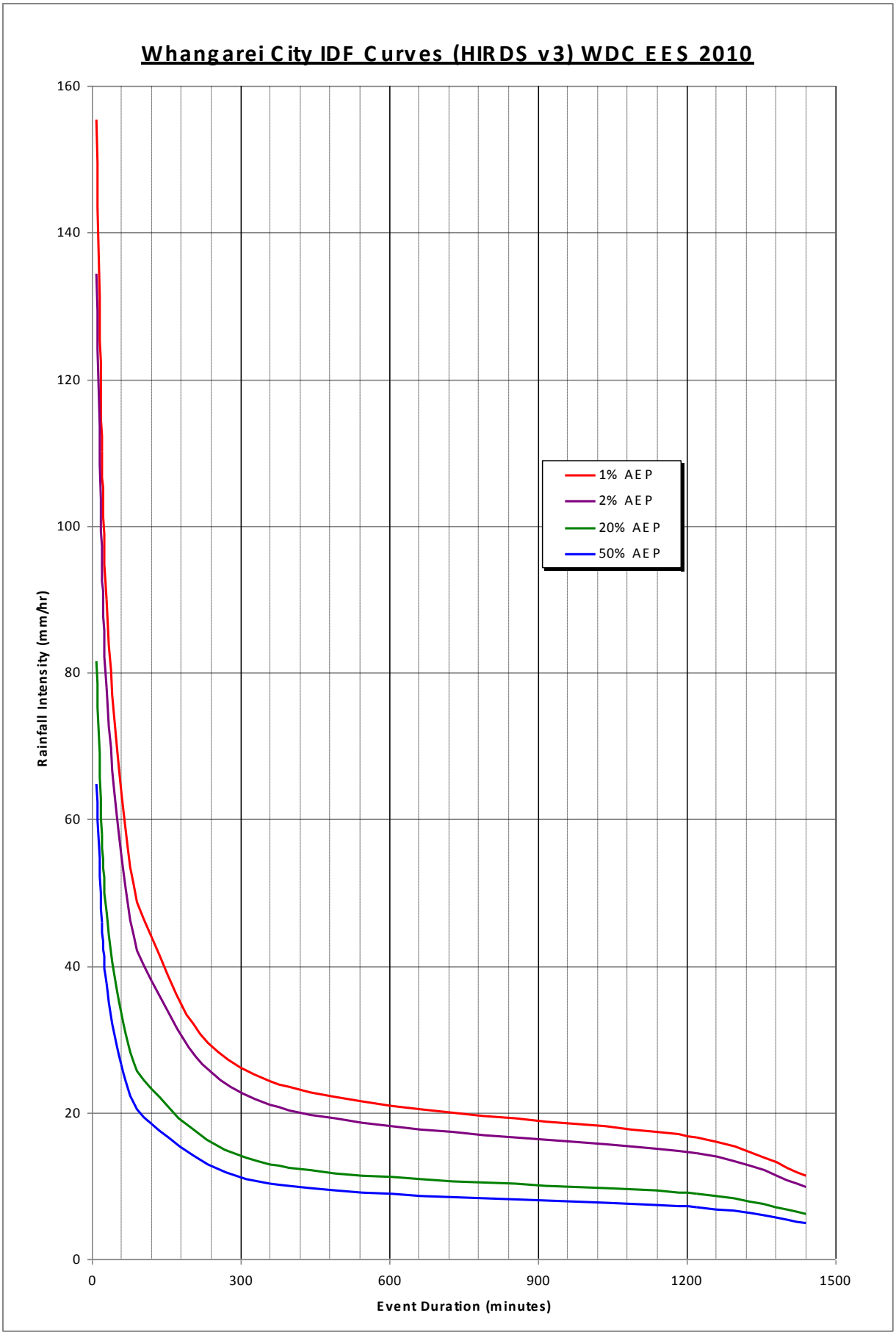
**IDF Curves for Glenbervie, Helena Bay, Maungatapere, Ruakaka, Whangarei City**


Glenbervie IDF Curves (HIRDS v3) WDC EES 2010
160
140
120
100
80
60
40
20
0
Rainfall Intensity (mm/hr)
0
300
600
900
1200
1500
Event Duration (minutes)
1% AEP
2% AEP
20% AEP
50% AEP

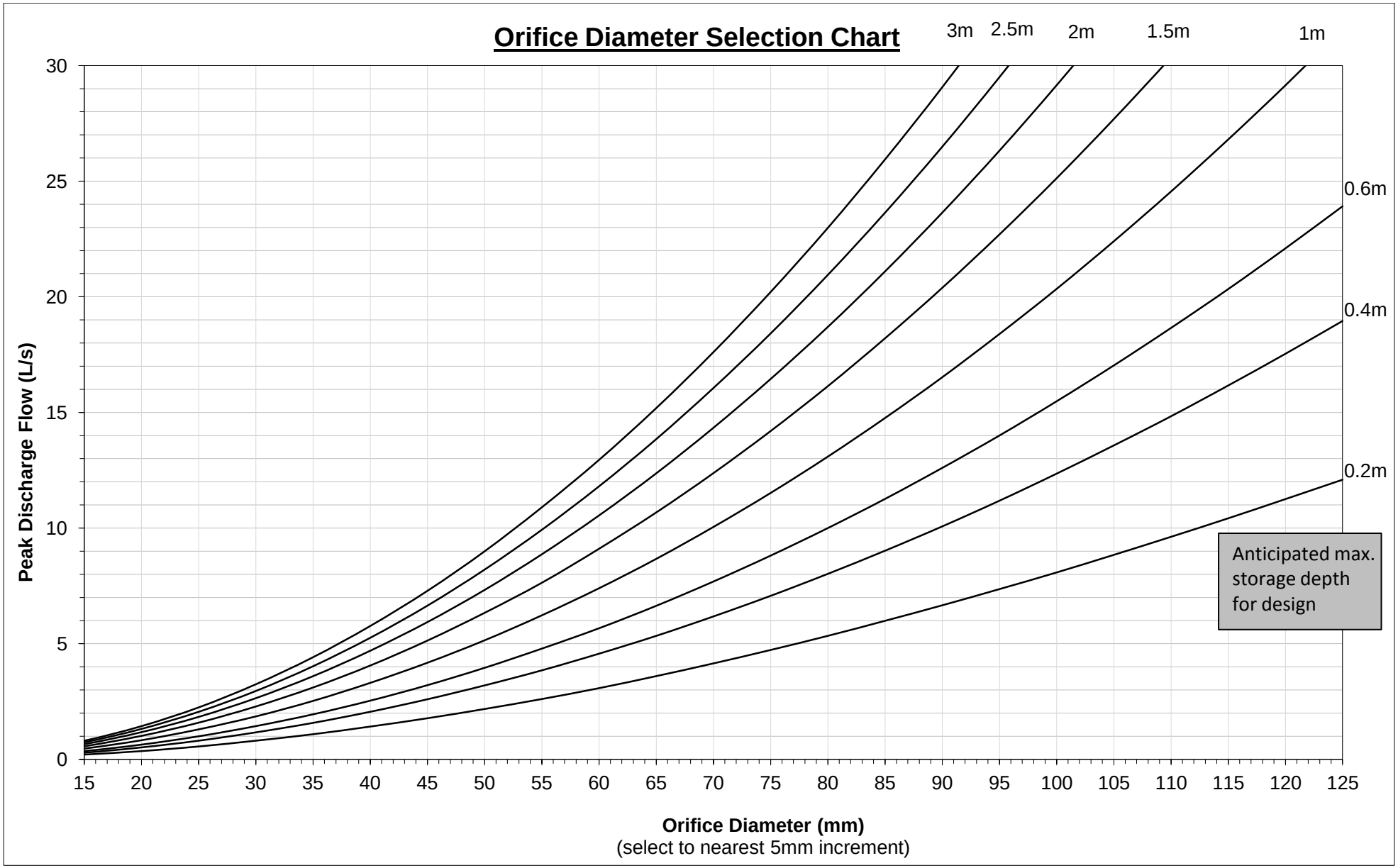

Helena Bay IDF Curves (HIRDS v3) WDC EES 2010
Rainfall Intensity (mm/hr)
Event Duration (minutes)
0
20
40
60
80
100
120
140
160
0
300
600
900
1200
1500
1% AEP
2% AEP
20% AEP
50% AEP


Maungatapere IDF Curves (HIRDS v3) WDC EES 2010
160
140
120
100
80
60
40
20
0
Rainfall Intensity (mm/hr)
0
300
600
900
1200
1500
Event Duration (minutes)
1% AEP
2% AEP
20% AEP
50% AEP


Ruakaka IDF Curves (HIRDS v3) WDC EES 2010
160
140
120
100
80
60
40
20
0
Rainfall Intensity (mm/hr)
0
300
600
900
1200
1500
Event Duration (minutes)
1% AEP
2% AEP
20% AEP
50% AEP


Whangarei City IDF Curves (HIRDS v3) WDC EES 2010
160
140
120
100
80
60
40
20
0
Rainfall Intensity (mm/hr)
0
300
600
900
1200
1500
Event Duration (minutes)
1% AEP
2% AEP
20% AEP
50% AEP

# Appendix H Orifice Diameter Selection Chart


Orifice Diameter Selection Chart
3m
2.5m
2m
1.5m
1m
0.6m
0.4m
0.2m
Anticipated max. storage depth for design
Peak Discharge Flow (L/s)
0
5
10
15
20
25
30
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
Orifice Diameter (mm)
(select to nearest 5mm increment)

# Appendix I Permeability Test Sheets

**WHANGAREI DISTRICT COUNCIL**
Forum North · Private Bag 9023 · Whangarei 0148 · New Zealand
Telephone (09) 430 4200 · 0800 WDC INFO · 0800 932 463 · Facsimile (09) 438 7632
Website http//www.wdc.govt.nz · E-mail mailroom@wdc.govt.nz



# Falling-Head Permeability Test (Borehole)

Site Address _____

Completed by _____

Date of test _____ Signature _____

**Ensure the following procedures are followed (✓ when complete)**

- ❒ Bore hole of minimum 150mm diameter and minimum 1.5m depth (or to groundwater level)
- ❒ Bore is filled to minimum 75% of total depth
- ❒ Drop in water level is recorded at intervals of 15 minutes or less
- ❒ Test is continued for 4 hours or until hole is to 25% of depth
- ❒ Three tests completed in bore

## 1 Details

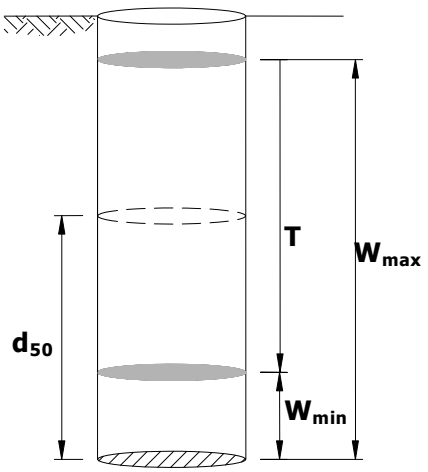
a diameter of bore = **D** = _____ m b total bore depth = _____ m

| Test 1 | |
|---|---|
| c Depth to water (m) | Time (min) |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

| Test 2 | |
|---|---|
| Depth to water (m) | Time (min) |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

| Test 3 | |
|---|---|
| Depth to water (m) | Time (min) |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

## 2 Calculate Permeability Rate: Note Base area disregarded




a maximum water depth = $\mathbf{W_{max}}$ = _____ m

b minimum water depth = $\mathbf{W_{min}}$ = _____ m

c $\mathbf{d_{50}} = (\mathbf{W_{max}} - \mathbf{W_{min}}) / 2 + \mathbf{W_{min}}$ = _____ m

d $\mathbf{A_{s50}} = (22 \times \mathbf{D} \times \mathbf{d_{50}}) / 7$ = _____ $m^2$

e $\mathbf{V_{ol}} = (22 \times \mathbf{D}^2) / 28$ = _____ $m^3$

f **T** (time between $\mathbf{W_{max}}$ and $\mathbf{W_{min}}$)(Test #3)= _____ min

g soil permeability = $\mathbf{P} = \mathbf{V_{ol}} / (\mathbf{A_{s50}} \times \mathbf{T} \times 60)$ = _____ m/sec

h safe soil permeability = $\mathbf{P_{safe}} = \mathbf{P} / 2$ = _____ m/sec

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# Falling-Head Permeability Test (Soak Pit)

Site Address _____

Completed by _____

Date of test _____ Signature _____

**Ensure the following procedures are followed**

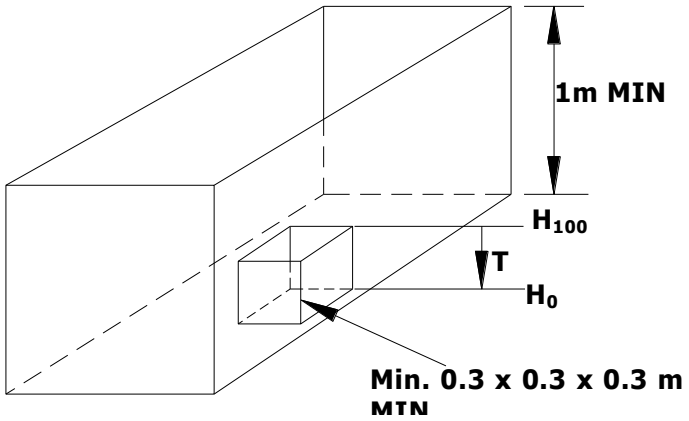
- ❒ Excavate 0.3 x 0.3 x 0.3m test pit at base of main excavation (minimum 1m deep)
- ❒ Refill test pit 3 times
- ❒ Use results from 3rd test

## 1 Test Pit Details

a Depth of pit = **H** = _____ m

b Length of pit = **L** = _____ m

c Width of pit = **W** = _____ m




| Test 1 - Time (min) | Test 2 - Time (min) | Test 3 - Time (min) |
|---|---|---|
| | | |

## 2 Calculate Permeability Rate

a Test pit volume = **V** = **W** x **L** x **D** = _____ $m^3$

b **A** = (**H** x **L** x 2) + (**W** x **H** x 2) = _____ $m^2$ (Base ignored)

c Time for pit to drain full to empty $\mathbf{H_{100}}$ to $\mathbf{H_0}$ = **T** = _____ minutes (Test #3 result)

d Permeability (Test) $\mathbf{P_T}$ = **V** / (**T** x 60 x **A**) = _____ m/sec

e Permeability (Final) $\mathbf{P_F}$ = $\mathbf{P_T}$ x 0.5 = _____ m/sec

Use $\mathbf{P_F}$ for soak pit designs

## Appendix J Worksheet - Simplified Storage Assessment (Rational)

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# Simplified Storage Assessment (Rational)
## (Single Lots / Small Developments Only)

Site Address _____

Completed by _____

Date of test _____ Signature _____

**1** Estimate pre-development run-off from proposed footprint to discharge point

**$Q_{PEAK}$ = (C x $I_{60}$ x A) / 3600** **(L/sec)**

Where:

**C** is from Table 4.1 for existing site condition and hydrological soil group = _____

**$I_{60}$** is intensity from IDF curves for relevant area of district/or site specific HIRDS data (60 min duration) = _____ mm/hr

**A** is the total development footprint routed to storage = _____ $m^2$

$Q_{PEAK}$ = (**C** x **I** x **A**) **/** 3600 = _____ L/sec

**2** Establish likely storage depth (**D**, m) and associated orifice size to give pre-development flow from Appendix H. (eg. 1.5m for pond, 2.5m for roofwater tank, etc)

**D** = _____ m

Orifice diameter = _____ mm (to nearest 5mm)

**3** Calculate average discharge flow rate for orifice from storage

$Q_D$ = $Q_{PEAK}$ x 0.4 = _____ L/sec

**4** Calculate stored volume

| Storm duration - **T** | | Storm Intensity, **I**, (mm/hr) | Volume in, ($m^3$) $V_{IN}$ = (**C** x $T_{HR}$ x **A**) **/ /** 1000, | Volume out, ($m^3$) $V_{OUT}$ =( $Q_D$ x 60 x x $T_{MINS}$ ) **/** 1000 | Volume stored, ($m^3$) $V_{STORED}$ = = $V_{IN}$ - $V_{OUT}$ |
|---|---|---|---|---|---|
| $T_{MINS}$, (mins) | $T_{HR}$, (hr) | | | | |
| 10 | 0.17 | | | | |
| 30 | 0.5 | | | | |
| 60 | 1 | | | | |
| 120 | 2 | | | | |
| 240 | 4 | | | | |

**5** Calculate pond area (land required) = ($V_{STORED\ MAX}$ **/ D** ) x 3 = _____ $m^2$

Where $V_{STORED\ MAX}$ is the maximum $V_{STORED}$ from table above

**Note** This worksheet provides a conservative estimation of storage requirements. Specific detailed design will yield improved accuracy and a lesser storage volume requirement