matamata piako district council





Matamata Piako District Council

Soakage Design Procedures and Guidelines

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1. What is soakage?

Soakage is the disposal of stormwater by infiltration to the ground. Instead of stormwater from the site being discharged to Matamata Piako District Council's (MPDC) stormwater network or overland it is discharged to specially designed soakage devices such as soakholes or soakage trenches. These devices can provide temporary storage to allow the stormwater time to soak away. Examples of such devices and design procedures to size them are given in the design sections of this document.

2. When is soakage required?

The majority of MPDC's piped stormwater systems were only intended to carry the runoff from streets during low intensity rain storm. The MPDC has adopted a bylaw requiring that, in general, all stormwater generated by developments within a premises boundary shall be disposed of on that site. Even in the rare situations where the MPDC permits stormwater to be discharged to its piped system, there are likely to be restrictions on the maximum daily and/or peak flow rate discharged.

Any new development is therefore likely to have to discharge stormwater to either:

i) Soakage, or
ii) To a formal designated approved overland flowpath

Soakage is not an appropriate method of stormwater disposal if the design soakage rate is less than 0.5 litres/min/m^2. (Refer to Section 5.1 for determining the design soakage rate.)

In parts of the District, and especially in Matamata, an overland flow path is not likely to be available or feasible.

In areas where the soils are not suitable for soakage (ie the design soakage rates is less than 0.5 l/min/m^2) and there is no overland flow path available, then an alternative to soakage must be used. A discussion of potential alternatives to soakage is given later in section 10 of this document.

It should be recognised that, in some situations, greenfield sites may not be able to be developed immediately despite the zoning, if there is no economical and practical method and system to dispose of stormwater. Development in this situation would be delayed until such time as appropriate stormwater disposal becomes feasible.

3. What size storm must soakage cater for?

The storm size for which soakage must cater is governed by the effects on downstream reticulation, flowpaths and properties in accordance with the statutory requirements. Where disposal is to ground soakage with no overland flood path or piped system available, the soakage must cater for a 1 in 50 year return period storm. However taking into account the forecast increase in the Building Code from 1 in 50 year protection to 1 in 100 year, it is recommended that, as best engineering practice, soakage must cater for a 1 in 100 year return period storm. The Building Code (E1) also requires that water from a 1 in 50 year event shall not enter buildings.

Where an overland flow path is available and there are no adverse downstream effects then the Building Code requires ground soakage to cater for the 1 in 10 year storm. The Environment Waikato Permitted Activity Rule requires a designated overland flow path for the exceedence of a 1 in 10 year storm in association with soakage disposal systems. However it should be noted that the overland flow paths must be able to cater for a minimum of a 1 in 50 year return period storm (and up to a 1 in 100 year event is strongly recommended as best engineering practice). Overland flow paths must be protected by an easement registered against the titles affected throughout their length.

Where discharge is to an overland flow path Environment Waikato requires that it does not increase peak discharge rates to, or flow volumes in, receiving waters above existing levels – unless it is demonstrated that there shall be no adverse effects on the environment or downstream properties as a result of such increase. Hence even where an overland flowpath is available it is likely that soakage catering for the 1 in 100 year event will be required to meet the requirement of not increasing either volumes or peak flows.

4. Indicative areas of soakage in the Matamata-Piako District

Different soils have different abilities to soak water away. For example generally sand has excellent soakage characteristics while clays and silts have very little soakage capacity and can reduce in capacity over time.

In general terms Te Aroha and Morrinsville have soil types and uniformity of soil structure better suited to soakage than found in Matamata and Waharoa. Limited information on soil types and their soakage capabilities in each of these townships is available from MPDC.

However as soil types can vary enormously over very short distances and also at different depths, detailed testing is **always** required to confirm soakage capabilities of the soils at the development site prior to development approval. The tests should be undertaken by someone with appropriate expertise such as an experienced registered drainlayer or geotechnical professional. As part of the soakage testing, bore logs are to be undertaken to verify the soil stratum and correlate the soakage characteristics at various depths. This information, as well as a comment on the groundwater table level and the antecedent weather conditions at time of testing, is to be provided to Council as part of the soakage report.

When considering soakage options it is of benefit to identify a continuous sand layer of up to 1m. Soakage within some friable silt layers has in the past been considered acceptable, however, with the occurrence of additional development and the stress placed on the existing reticulation, greater soakage requirements have become more necessary and care needs to be taken that a minimum design soakage rate of 0.5 litres/min/m2 can be met.

Details of the testing methods to be used and locations to be tested are given later in this document.

5. Testing to determine soakage rates

5.1 Testing method

The methodology to be used in Matamata Piako District is described below.[1]

- Borehole **location** and **depth** to be based on proposed design location and depth.
- Depth must target known or identified layers of high permeability soils.
- Hand augured borehole to be 100 to 150mm diameter
- Prior to filling the borehole with water it is necessary to scrape the sides of the hole to remove smearing caused by the auger.
- Prior to the test, the borehole is to be filled with water and kept topped up for 4 hours (unless hole drains completely in less than 5 minutes)
- If the hole drains completely in less than 5 minutes then borehole must be filled a minimum of 5 times prior to testing.
- The water level at start of test run is not to be more than 500mm below the existing ground surface
- The water level at end of test is to be between 200mm and 300mm from base of the auger hole
- Maximum depth interval for recordings is 200mm
- Maximum time interval for recordings is 20 minutes
- Minimum number of recordings per test is 10

[1] (Note: while the test method to be used is in accordance with the verification method E1/VM1 of the New Zealand Building Code extra details have been added to ensure consistency throughout the Matamata Piako District area.)

- Natural groundwater Level to be recorded at least one location per proposed lot unless it is more than 2 m below the target soakage depth
- Base of auger hole to be at least 500mm above groundwater table if winter (May to September)
- Base of auger hole to be at least 1m above groundwater table if not winter (October to April)

Worksheet 1 provided in Appendix A must be used to record the test results. An example of how this worksheet must be completed is also given in Appendix A. On completing Worksheet 1 a design soakage rate is obtained.

This design soakage rate is required for determining the number of soakholes required for each property. Details of this process are given in the following soakage sizing section of this document. Worksheet 1 is available online and can be downloaded as an Excel spreadsheet from Council's website www.mpdc.govt.nz

Soakage is not an appropriate method of stormwater disposal if the design soakage rate is less than 0.5 litres/min/m^2

5.2 Number of tests required

Due to the variability in soakage, even within local areas, a sufficient number of tests must be undertaken and located so as to be representative of the site. The minimum number of tests required is shown in Table 1 below.

The development type is divided into Brownfields (sites in existing built up areas including infill subdivisions)) and Greenfields (new undeveloped areas including multiple lot subdivision).

Table 1 – Minimum number of test locations

Development type	Proposed Lot / Site size	Number of tests required
Brownfield	< 400 m^2	1
Brownfield	400 – 1000 m^2	2
Brownfield	> 1000 m^2	2 per 1000 m^2
Greenfield	< 1000 m^2	1 per 4 lots, 2 Minimum
Greenfield	> 1000 m^2	1 per 4000 m^2, 2 Minimum

*If test results show a variability in design soakage rate of >2 litres / min / m^2 then the number of tests must be increased to twice the number shown above.

6. Soakage sizing

This document provides some generic designs for site soakage devices (drawings SK01 to SK06 in Appendix B). The size and number of devices required may be simply read off the graphs supplied in Appendix C. These sizes are based on completely containing run-off from either a 10 year event or a 100 year event.

(NB The graphs for the 10 year event are only applicable in places where a formal (designated) overland flowpath capable of taking the 100 year flow is available AND it can be shown that any increase in volume of discharge or peak flow from the development in the 100 year event will have no adverse effects on the environment or downstream properties. **Where an overland flow path is not available, mitigation shall be provided on site for all the runoff generated / created by the development for storms up to and including the 100 year 24 hour storm event.)**

Although it is recommended to use the standard designs and sizing procedures provided in this document, specific designs may also be considered where supported by appropriate calculations. These calculations must show in detail that there will be no increase in volume or peak discharge due to the development and that the development will have no adverse effects on the environment or downstream properties. These calculations must be based on the runoff generated in a 100 year 24 hr storm including an allowance for global warming. The intensity of rainfall in this 24 hour storm must be nested to include the peak bursts from all other durations (10 min, 20min, 30 min, 1 hr, 2 hr, 6 hr and 12 hr) embedded within it. Details on this storm are provided for reference purposes in Appendix E. Other design assumptions that must be used are also stated here.

The recovery period for all soakage systems shall be no more than 72 hours from the end of the storm event. The period refers to the time taken to drain the maximum live storage until it is empty via ground soakage. Refer to Section 9 re monitoring soakholes / wells.

6.1 Sizing soakage for lot (roof & driveway) runoff

The generic design for roof and drive runoff is to discharge to a soakhole (drawing SK03). Pre-treatments devices – Drawings SK04 and SK05 must be utilized to extend the working life of the soakhole.

The number and size of soakhole required depends on:

i) The design soakage rate measured at the site:
(As calculated on worksheet 1 in Appendix A)

ii) The area draining to the soakhole (and whether it is pervious or impervious):

The total effective area draining to a soakhole $A_t = A_i + 0.3 \times A_p + 0.3 \times A_{pp}$

Where A_i is the impervious area (roof and driveway)
A_p is any pervious surface such as lawns or gardens that is draining to the drive and hence contributing to the soakhole[2].
A_{pp} is porous or pervious paving

iii) The diameter and depth of the soakhole: the depth will depend on the proximity of the groundwater table (at least 0.5m above the winter water table or 1m above the summer water table) and also the depths of layers of well draining soils. The diameter will depend how they fit on site and relative costs. Standard recommended diameter sizes are 750mm (minimum), 900mm and 1200mm

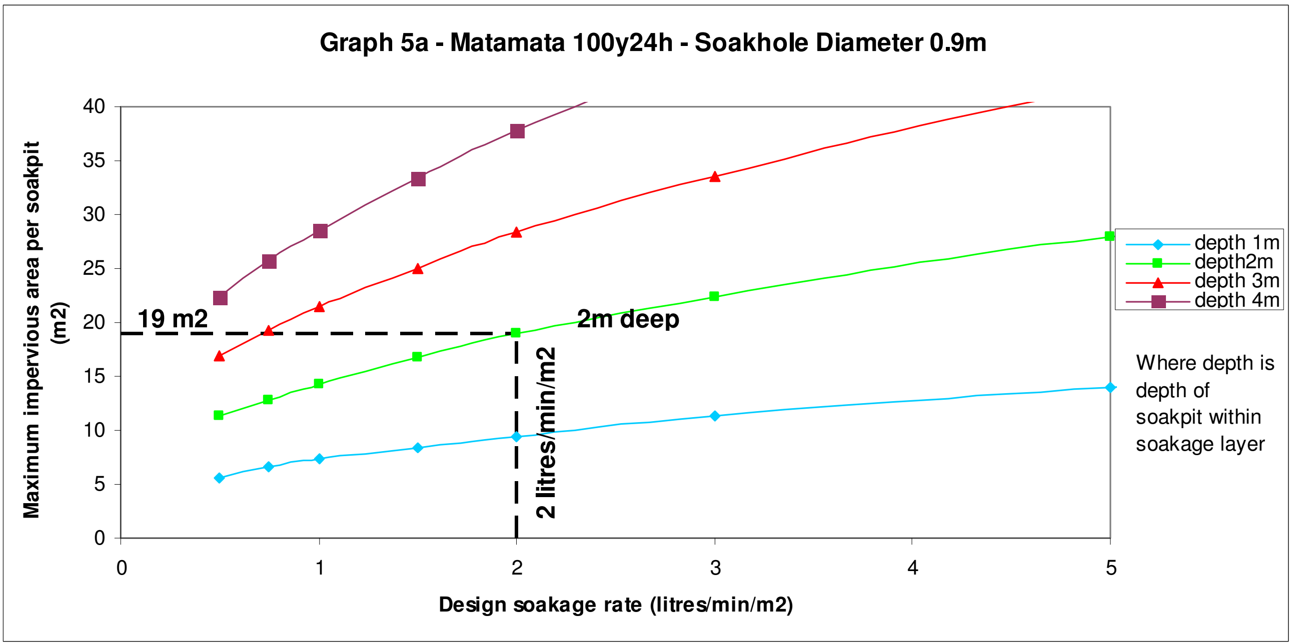
Using the graphs

Once the design soakage rate has been determined for a site using worksheet 1, the depth and diameter of the soakhole can then be chosen. The maximum total effective area that can drain to that soakhole A_t can then be determined from the appropriate graph in Appendix C.

Example
By undertaking an on-site percolation test and completing Worksheet 1, a design soakage rate of 2 litres / min / m^2 was found at this site. The summer water table was found to be approximately 3 m below ground level. A soakhole to 2 m maximum depth is therefore to be used. The standard 900mm diameter size has been chosen. There is no available overland flow path so the soakage must be designed to cater for the 1 in 100 year event. As the site is in the Matamata township the appropriate graph to use is Graph 5a. Reading off Graph 5a the maximum total effective area A_t that may drain to the soakhole is around $19m^2$. As the driveway to be built is around $30m^2$ two soakholes will be required. If the driveway was larger than $38m^2$ (2 x 19) then either an extra (third) soakhole would be required or larger diameter soakhole need to be utilised.

[2] In greenfield sites development is likely to focus overland flow to a distinct location on the property boundary (compared to being spread over the entire length of the property boundary in the pre development situation – hence mitigation is also required for pervious surfaces. In brownfield sites this factor may be excluded from the calculation of A_t

Diagram 1



6.2 Sizing soakage for roads

The generic design for road runoff is to discharge to a soakage trench (Drawing SK03 in Appendix B).

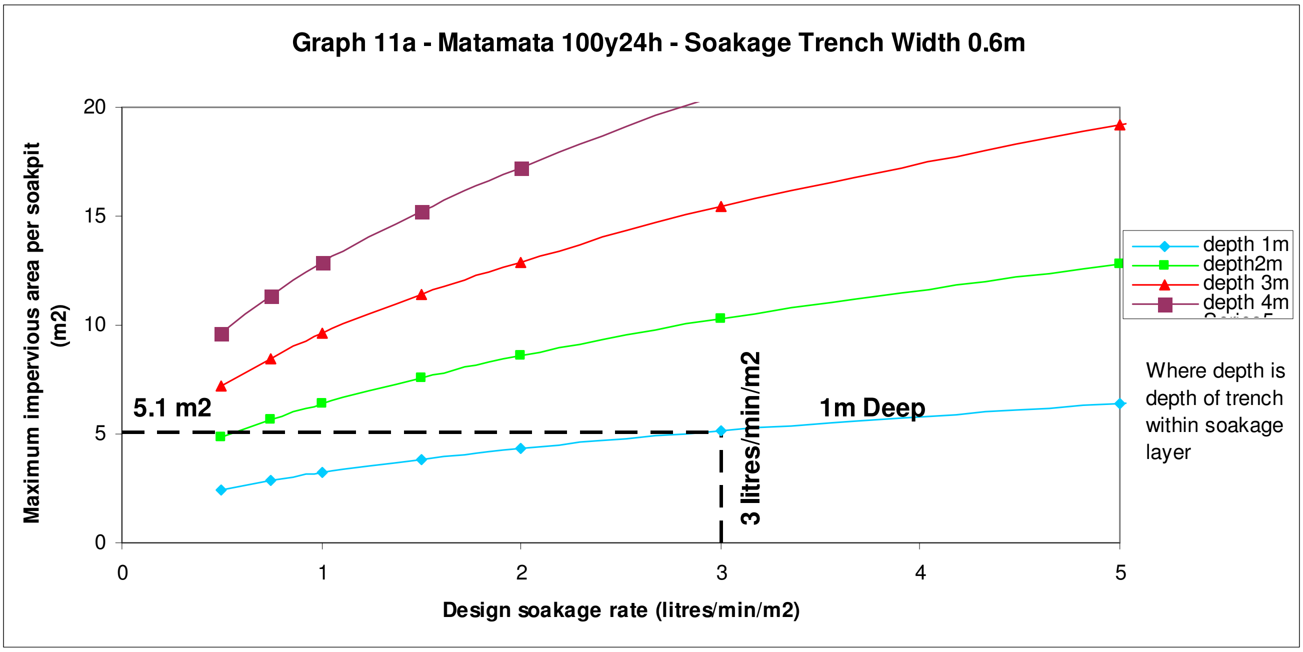
The total effective area draining to the soakage trench $A_t = A_i + 0.3 \times A_p$
Where A_i is the impervious area of the road seal and pedestrian pavement.
And A_p is any pervious surface such as berms or other pervious surfaces not captured in individual Lot drainage[2].

Using the graphs

Once the design soakage rate has been determined for a site using worksheet 1, the depth and width of the soakage trench can then be chosen. The maximum total effective area that can drain to that soakage trench A_t can then be determined from the appropriate graph in Appendix D.

Example
By undertaking an on-site percolation test and completing Worksheet 1 a design soakage rate of 3 litres/min/ m^2 was found at this site. The summer groundwater table was found to be approximately 2.5m below ground level. A 1000mm deep soakage trench is therefore to be used. Services in the berm mean the width of the soakage trench must be limited to 600mm. There is no available overland flow path so the soakage must be designed to cater for the 1 in 100 year event. The road width is 8m, and the berm width is 3m on each side. Per metre length of road the total effective area A_t is 8 + 0.3 x (3+3) which is 9.8 m^2. For a 600mm wide trench catering for a 1 in 100 year event in the Matamata township - Graph 11a in Appendix D must be used. For a design soakage rate of 3 litres/min/ m^2 and a drainage metal depth of 1000mm a maximum effective area of 5.1 m^2 per lineal metre of soakage trench is required. Hence 2 metres of trench is required for every lineal metre of road (i.e. 2 x 5.1 = 10.2 m^2 of soakage capacity is greater than the total effective area of 9.8m^2 per lineal metre of road)

Diagram 2



7. Suitable locations for soakage devices

Soakage devices shall be positioned on site where:

i) They can collect **all** runoff from the site (e.g. if placed at the top of a driveway will the soakage device still be low enough to collect water from lower points of the driveway)
ii) They can be easily accessed and maintained on a long term basis (there should be at least 2m wide accessway to and around the device)
iii) They are above the winter water table (this must be measured when doing the percolation test – if the tests are done in the summer months October to April then the winter water table is estimated as that measured plus 0.5m
iv) They are at least 1.5 m away from buildings, property boundaries and sewers and public mains unless consented by affected parties.
v) They are placed away from retaining walls and unstable banks. Without specialist geotechnical advice to the contrary the minimum horizontal distance to be placed away from a wall or bank is to be twice the height of the wall or bank.
vi) They are outside of the 1 in 100 year floodplain

8. Soakage device design notes

This document provides some generic designs for site soakage devices (drawings SK01 to SK06 in Appendix C). Alternative designs will be considered but will need to be supported by relevant calculations or technical specifications where appropriate. The general principles shown in the generic designs should be retained.

8.1 Pre-treatment devices

To prolong the life of soakage devices it is crucial to incorporate pre-treatment devices which can be readily and practically maintained to ensure silt and sediment does not enter the soakage device. If less pre-treatment is proposed than shown in the generic designs then the applicant will be required to prove to Council that the proposal can be adequately maintained for the design life and provide a maintenance (and funding for maintenance) regime and propose how Council can enforce adherence to this regime.

8.2 Impacts on house design

It is common practice in New Zealand for soakage to cater for the 1 in 10 year storm event with overflow going to piped or overland flow paths. However in the MPDC, and especially in Matamata and Waharoa, there is often no piped system nor overland flow path available (or it has no surplus capacity). Hence soakage must cater for the 1 in 100 year storm event. This has some potential impacts on house design that should be noted:

vii) Increased lot size

The number and size of soakholes required will be significantly greater than where only the 1 in 10 year storm event is catered for. To provide enough room for the increased number of soakholes may require positioning the house further from the lot boundary than normal (especially to provide access for maintenance). Larger lot sizes may therefore be required.

viii) Increased gutter and downpipe sizes

For soakage to be effective in the 1 in 100 year storm event requires that all the stormwater is able to enter the soakholes. This requires that the gutter and downpipes are able to convey the 1 in 100 year flow without overflowing.

For gutter sizing Figures 15 and 16 from clause E1 of the New Zealand Building Code as adjusted in Appendix F of this document must be used. The numbers obtained from original Figures 15 and 16 have been multiplied by I/100 where "I" is the 1 in 100 year peak rainfall intensity. (For the MPDC area "I" including climate change should be taken as 180 mm/h.)

Where capacity for the 1 in 100 year event is required the number of down pipes obtained from Table 5 of clause E1 must be doubled unless specific design calculations are provided (refer to the anotatated Table 5 in Appendix F1). Specific design must be based on a peak 1 in 100 year flow of 0.5 litres/s per $10m^2$ of roof.

(*Where the development or subdivision has an available overland flowpath or has been provided with a centralised common mitigation for the 1 in 100 year storm event associated buildings utilising soakage can use the standard E1 solutions.*)

8.3 Porous paving

No specific design is given in this document for porous paving. This should be laid to the manufacturers specifications. Another useful guide on this can be found in the Auckland City Soakage design manual.

8.4 Driveway and road sump capacity

For soakage to be effective in the 1 in 100 year storm event requires that all the stormwater is able to enter the soakpits or soak trenches. For the MPDC area the 1 in 100 year 10 minute peak flow including climate change is 0.5 litres/s per $10m^2$ of impervious surface. The number and size of sumps and or slot drains must have sufficient capacity for this 1 in 100 year peak flow. The capacity of a particular sump or slot drain should be obtained from the manufacturers technical specifications.

Where specific design is used rather than the standard generic designs and sizing procedures provided in this document there may be scope to allow some for ponding in roads. The specific design calculations need as a minimum to show:

i) There is no overflow from roads in a new development to existing roads in events up to the 1 in 100 year event

And

ii) In a 1 in 20 year rainfall event ponding is to a maximum height of 100mm above the crown of the road.

And

iii) In a 1 in 50 year rainfall event the maximum ponding level is at least below 500mm below adjacent building floor levels

And

iv) In 1 in 100 year rainfall event the maximum ponding level is below any adjacent building floor levels.

9. Operation, Maintenance and access

9.1 Lot soakage

Soakage devices on individual lots are to be maintained by the owners of that lot. Soakage systems require periodic maintenance to ensure they continue to operate effectively as designed. Pre-treatment devices such as roof runoff settling chambers and driveway sumps linked to a monitoring soakhole/well/silt trap all need to cleaned out at least once a year - or more often if blockage or rapid silt/sediment build up occur. These then connect to soakpits which need to be accessible, inspected and cleaned out at least once every 10 years by a registered drain-layer. Maintenance is likely to include scraping or scouring the sides of the soakhole(s) ie with a water blaster to maintain the required soakage. Records of such maintenance must be kept and provided to Council if requested. If any flooding or surface inundation is apparent at any stage then the soakage system must be inspected and rectified within one month.

If Council has any concerns about the soakage system on a particular lot then they may apply to obtain access to undertake their own inspection.

9.2 Road soakage

Where roads are vested in Council it is expected that the drainage/soakage system will also be taken over by Council. For private roads the drainage/soakage system must be maintained by the owner.

The initial discharge point of the roadway is via the sump. To maintain their effectiveness sumps must be cleaned out at least once every 6 months. This will likely be by way of a ‘vacuum truck’. For vesting roads the Council may request the installation of gross contamination filters such as Enviropods with 100um filters or similar to assist in preventing floatables from clogging the soakage system. These require 3 to 6 monthly cycle cleaning.

Where sumps discharge to a soakage system, in-line monitoring soakholes/wells are to be installed between the sumps and the soakage trenches. Soakage trenches should also terminate with a monitoring soakhole to enable flushing of the trenches). These soakholes operate as silt traps and must be initially checked after the first 6 months of operation and then after a12 month period. If no problems are encountered maintenance can be extended to a 5 yearly cycle. Maintenance is likely to include scraping, scouring or jetting the sides of the soakholes/trenches (ie with a water blaster and vacuuming) to remove silting and maintain the required soakage. Soakage trenches will need to be inspected and maintained by water jetting or similar initially after the first 5 years of operation and then every 10 years thereafter.

10. Alternatives to soakage

Where the soakage percolation test outlined on Worksheet 1 provides a design soakage rate of less than 0.5 litres/min/m^2 soakage is not an appropriate method of stormwater disposal. The main alternatives to soakage are a piped system or an overland flow path. Where these options are not available either, then development may not be a practical option. However specific design may be able to overcome these issues and applications will be considered on a case by case basis[3]. Specific design is most likely to be successful where development is low density and there is plenty of room for stormwater mitigation.

3 Rainfall and other assumptions to use in specific design are listed in Appendix E

In preparing a specific design the following principle needs to be demonstrated:

"Development must not increase peak discharge rates to, or flow volumes above existing levels – unless it is demonstrated that there shall be no adverse effects on the environment or downstream properties as a result of such increase"

These criteria apply both for small regular storms AND to larger storms right up to the 1 in 100 year event.

i) Attenuation of peak flows:
Peak flows can be attenuated to pre-development flows by a number of means. On a lot-by-lot basis this is usually by rainwater tanks for roof water with a small diameter orifice outlet. Runoff from driveways can be attenuated by underground tanks. On a development-wide basis attenuation is typically via stormwater ponds although with no overland flow path available there is a problem as to where the pond can discharge to. Peak flows from roads can be attenuated via swale drains and / or underground attenuation storage. There are a number of proprietary products typically of a cellular/modular plastic nature for storage under trafficked areas. Again however there would be issues where this storage could discharge to (especially considering the discharge point would have to be at the base of the storage which would necessarily be below road level)

Details on such methods can be found in Auckland City's Soakage Design Manual and Auckland Regional Council's Technical Publications TP 10 and TP 124

ii) Reduction of Runoff Volumes
A number of low impact design measures can be utilised to reduce the volume of runoff, these include rainwater harvesting, porous or pervious paving and 'green' roofs.

Again details on such methods can be found in Auckland City's Soakage Design manual and Auckland Regional Council's Technical Publications TP 10 and TP 124

iii) Avoiding adverse effects on the environment or downstream properties
Detailed calculations or modelling will be required to shows that there are no adverse effects on the environment or downstream properties. As a guide Auckland Regional Council's TP10 lists criteria for avoiding adverse effects on the environment and downstream properties. These include attenuating the first 34.5mm of rainfall to discharge in not less than 24 hours, attenuating the 2 and 10 years flows to pre-existing levels and to attenuating the 100 year flow to 80% of the pre-existing flow. However it should be noted these criteria are for discharging to a stream or overland flow path. In situations where there is no stream or overland flow path to discharge to then another crucial factor is to ensure that post-development discharges from the site are similar in nature and location to that in the existing case. If in the existing situation discharge is along the length of a boundary, then if the development concentrates discharge to just one or two locations on the boundary this will most likely cause erosion at these locations and hence have an adverse effect on the environment and downstream properties.

Appendix A

Worksheet 1 – Soakage percolation test

Worksheet 1 - Soakage Percolation Test

Notes

Borehole diameter to be 100 to 150mm diameter
Borehole location and depth to be based on design location and depth
One borehole test required at each design soakhole loaction
Prior to the test the borehole is to be filled with water and kept topped up for 4 hours (unless hole drains completely in less than 5 minutes)
If the hole drains completely in less than 5 minutes then borehole must be filled a minimum of 5 times prior to testing
Mimimum depth interval for recordings is 200mm
Minimum time interval for recordings is 20 minutes
Minimum number of recordings per test is 10

Maximum water level at start of test run not to be less than 500mm from existing ground surface
Minimum water level at end of test to be between 200mm and 300mm from base of pit

Groundwater Level to be recorded at least one location per proposed lot
Base of pit to be at least 500mm above groundwater table if winter (May to September)
Base of test pit to be at least 1m above groundwater table if not winter (October to April)

Test Location	
Groundwater Table (m RL)	
Date	
Time pre-soak commenced	
Time pre-soak completed	
Time test commneced	
Time test finished	

Diameter of borehole 'D' (metres)	
plan area of borehole (m2)	
circumference of borehole (metres)	

Water Depth in borehole 'WD' (metres)	Time from start of test 't' (seconds)	Time between readings 'dt' (seconds)	Volume soaked between readings 'V' (litres)	Surface Soakage Area 'SA' (m2)	Soakage Rate 'SR' (litres/min/m2)
	0	-	-	-	-

Average soakage rate 'Ave'		litres/min/m2
Design soakage rate 'DSR'		litres/min/m2

	Name	Signature	Date
Test undertaken by			
Test results checked by			

Worksheet 1 - Soakage Percolation Test - Example

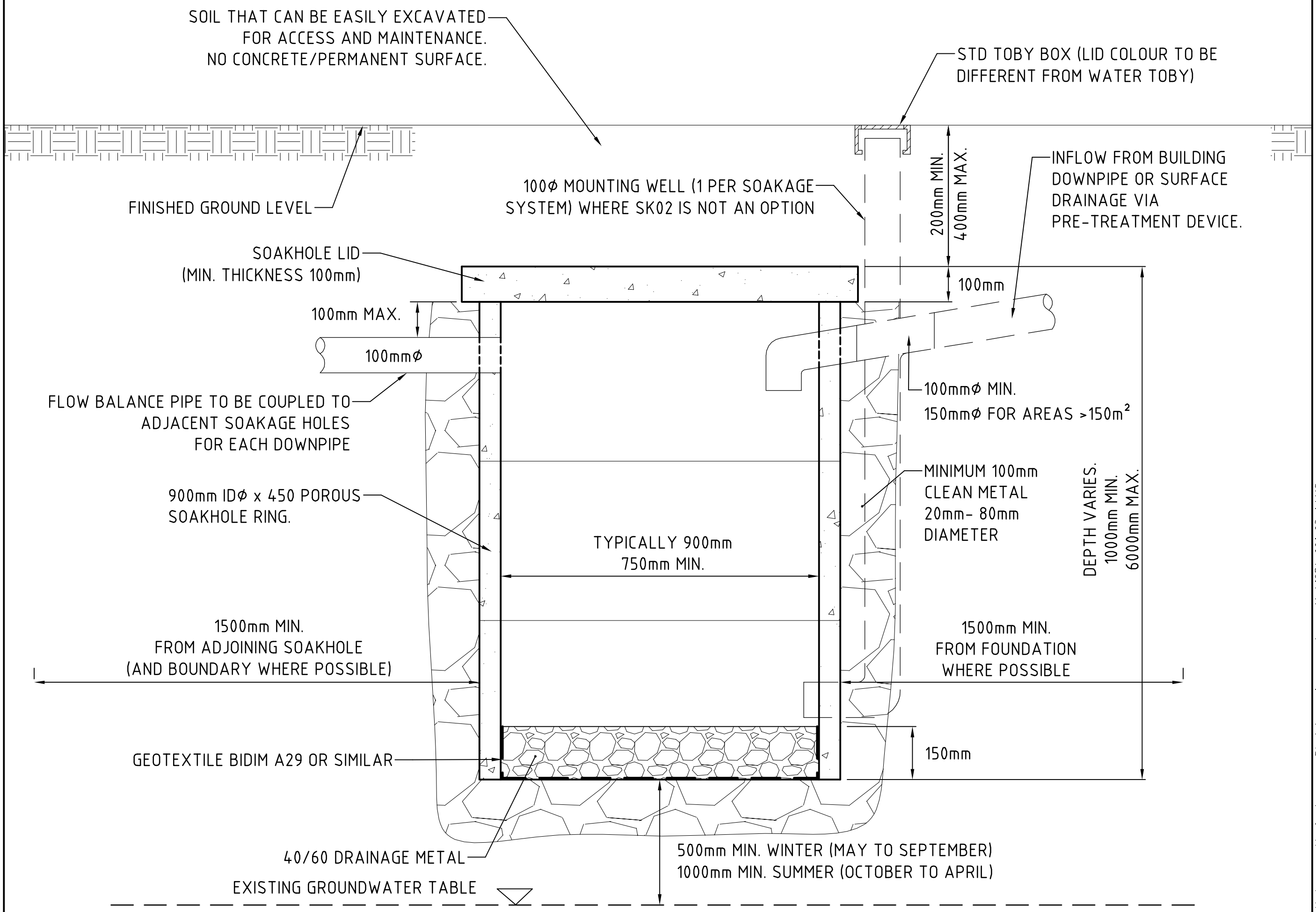
Diameter of borehole 'D' (metres)	D
plan area of borehole (m2)	a = pi /4 * D * D
circumference of borehole (metres)	c = pi * D

Water Depth in borehole 'WD' (metres)	Time from start of test 't' (seconds)	Time between readings 'dt' (seconds)	Volume soaked between readings 'V' (litres)	Surface Soakage Area 'SA' (m2)	Soakage Rate 'SR' (litres/min/m2)	
WD 0	t 0					
WD 1	t 1	dt1 = t1 - t0	V1 = (WD0 - WD1) * a * 1000	SA1 = a + (W1 +W0)/2 * c	SR1 = V1 / dt1 * 60 / SA1	
WD2	t 2	dt2 = t2- t1	V2 = (WD1 - WD2) * a * 1000	SA2 = a + (W2 +W1)/2 * c	SR2 = V2 / dt2 * 60 / SA2	
WD 3	t 3	dt3 = t3 - t2	V3 = (WD2 - WD3) * a * 1000	SA3 = a + (W3 +W2)/2 * c	SR3 = V3 / dt3 * 60 / SA3	
WD 4	t 4	dt4 =t4- t3	V4 = (WD3 - WD4) * a * 1000	SA4 = a + (W4 +W3)/2 * c	SR4 = V4 / dt4 * 60 / SA4	
WD 5	t 5	dt5 =t5 - t4	V5 = (WD - WD5) * a * 1000	SA5 = a + (W5 +W4)/2 * c	SR5 = V5 / dt5 * 60 / SA5	
WD 6	t 6	dt6 = t6 - t5	V6 = (WD5 - WD6) * a * 1000	SA6 = a + (W6 +W5)/2 * c	SR6 = V6 / dt6 * 60 / SA6	
WD 7	t 7	dt7= t7 - t6	V7 = (WD6 - WD7) * a * 1000	SA7 = a + (W7 +W6)/2 * c	SR7 = V7 / dt7 * 60 / SA7	
WD 8	t 8	dt8= t8 - t7	V8 = (WD7 - WD8) * a * 1000	SA8 = a + (W8 +W7)/2 * c	SR8 = V8 / dt8 * 60 / SA8	
WD 9	t 9	dt9= t9 - t8	V9 = (WD8 - WD9) * a * 1000	SA9 = a + (W9 +W8)/2 * c	SR9 = V9 / dt9 * 60 / SA9	
WD 10	t 10	dt10 = t10- t9	V10 = (WD9 - WD10) * a * 1000	SA10 = a + (W10 +W9)/2 * c	SR10 = V10 / dt10 * 60 / SA10	
				Average soakage rate 'Ave'	Ave = (SA1 +SA2 + SA3 ... + SA10)/10	litres/min/m2
				Design soakage rate 'DSR'	DSR = 0.5 * Ave	litres/min/m2

Diameter of borehole 'D' (metres)	0.150
plan area of borehole (m2)	0.018
circumference of borehole (metres)	0.471

Water Depth in borehole 'WD' (metres)	Time from start of test 't' (seconds)	Time between readings 'dt' (seconds)	Volume soaked between readings 'V' (litres)	Surface Soakage Area 'SA' (m2)	Soakage Rate 'SR' litres/min/m2)	
1.2	0					
1.1	40	40	1.8	0.56	4.7	
1.0	85	45	1.8	0.51	4.6	
0.9	140	55	1.8	0.47	4.1	
0.8	200	60	1.8	0.42	4.2	
0.7	270	70	1.8	0.37	4.1	
0.6	350	80	1.8	0.32	4.1	
0.5	450	100	1.8	0.28	3.8	
0.4	570	120	1.8	0.23	3.8	
0.3	740	170	1.8	0.18	3.4	
0.2	960	220	1.8	0.14	3.6	
				Average soakage rate 'Ave'	4.1	litres/min/m2
				Design soakage rate 'DSR'	2.0	litres/min/m2

Appendix B
Soakage Device Design Drawings



NOTES:

1. WHERE PRACTICAL, ALL SOAKHOLES SHOULD BE LINKED FOR LOAD BALANCING.
2. WORKS TO BE UNDERTAKEN IN ACCORDANCE WITH MPDC SPECIFICATION AND CODE OF PRACTICE
3. AREA OF ROOF/ DRIVEWAY ALLOWED PER SOAKHOLE TO BE CALCULATED AS PER GRAPH 1 OF MPDC SOAKAGE POLICY.
4. SOAKAGE DEVICES SHALL BE POSITIONED ON SITE WHERE:
   a. THEY CAN COLLECT ALL RUNOFF FROM THE SITE (E.G. IF PLACED AT THE TOP OF A DRIVEWAY WILL THE SOAKAGE DEVICE STILL BE LOW ENOUGH TO COLLECT WATER FROM LOWER POINTS OF THE DRIVEWAY)
   b. THEY CAN BE EASILY ACCESSED AND MAINTAINED ON A LONG TERM BASIS (THERE SHOULD BE AT LEAST 2M WIDE ACCESSWAY TO AND AROUND THE DEVICE)
   c. THEY ARE ABOVE THE WINTER WATER TABLE (THIS MUST BE MEASURED WHEN DOING THE PERCOLATION TEST - IF THE TESTS ARE DONE IN THE SUMMER MONTHS OCTOBER TO APRIL THEN THE WINTER WATER TABLE IS ESTIMATED AS THAT MEASURED PLUS 1M
   d. THEY ARE AT LEAST 1.5 M AWAY FROM BUILDINGS, PROPERTY BOUNDARIES AND SEWERS AND PUBLIC MAINS UNLESS CONSENTED BY AFFECTED PARTIES.
   e. THEY ARE PLACED AWAY FROM RETAINING WALLS AND UNSTABLE BANKS. WITHOUT SPECIALIST GEOTECHNICAL ADVICE TO THE CONTRARY THE MINIMUM HORIZONTAL DISTANCE TO BE PLACED AWAY FROM A WALL OR BANK IS TO BE TWICE THE HEIGHT OF THE WALL OR BANK.
   f. THEY ARE OUTSIDE OF THE 1 IN 100 YEAR FLOODPLAIN

400 200 0 400 800mm

SCALE 1:20

CONCEPT
FOR REPORT PURPOSES

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Project: STORMWATER SOAKAGE DESIGN MANUAL

Drawing Title: SOAKHOLE & MONITORING WELL DETAIL UNDER LAWN/ GARDEN PERMEABLE SURFACE

Client: MATAMATA PIAKO DISTRICT COUNCIL

No.	Date	Revision Details	Des
02	09.04.10	UPDATED TO INDEPENDENT PEER REVIEW	RK
01	20.05.09	PRELIMINARY ISSUE	RK

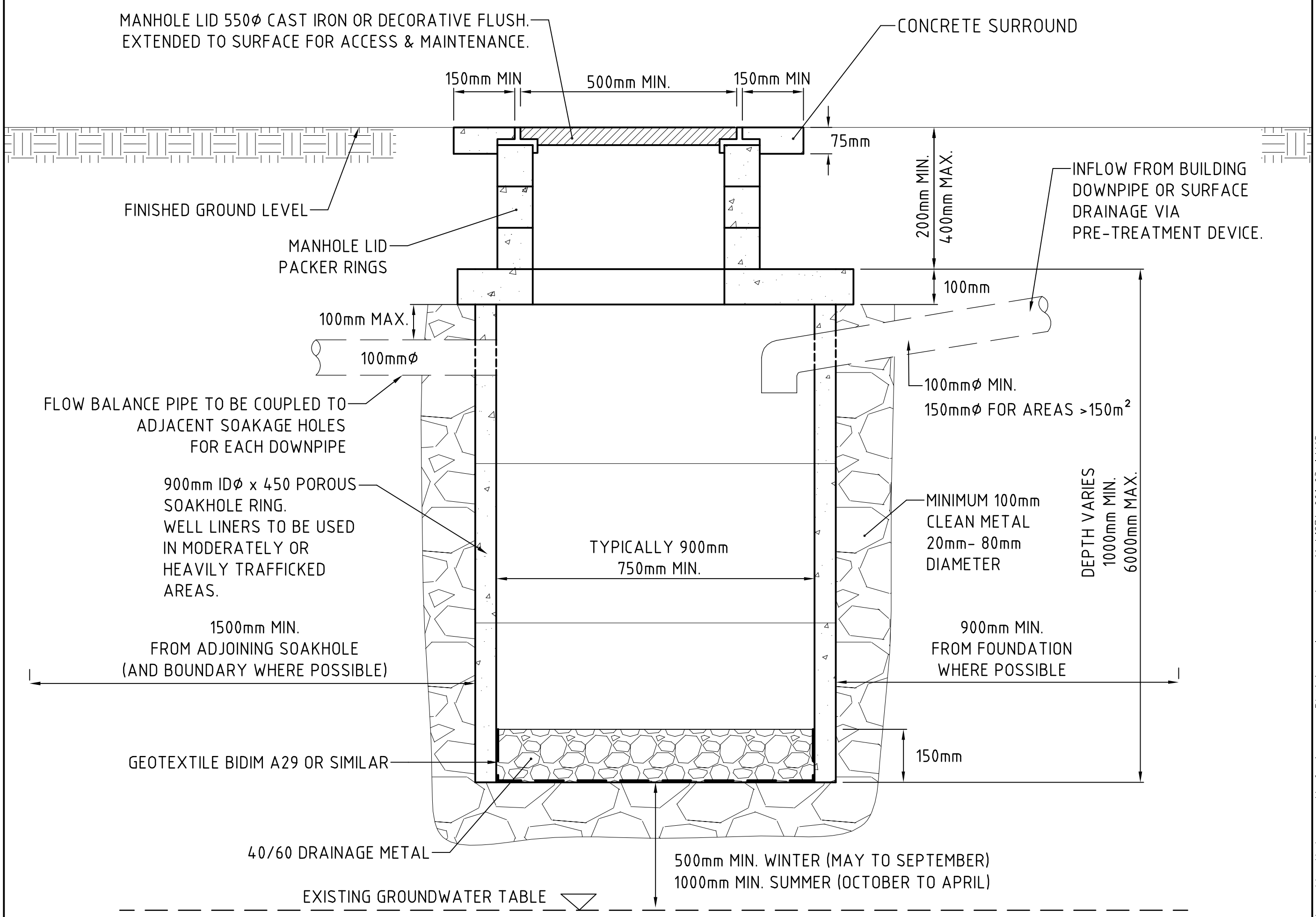
Drawn	pp WAH	Date	20.05.09
Designed	RK		
Verified	JVA	Scale 1:20	Sheet Size A4
Approved	NR		
Project No. 41874-001-03		Drawing No. SK01	Rev 02

20 10 0 10 20 30 40 50mm

Appendix C

Graphs to determine required number of soakpits

Graph	Township	Soakhole diameter (mm)	Storm Event
1a	Matamata	0.6	10 y
1b	Morrinsville	0.6	10y
1c	Te Aroha	0.6	10y
2a	Matamata	0.9	10 y
2b	Morrinsville	0.9	10 y
2c	Te Aroha	0.9	10 y
3a	Matamata	1.2	10 y
3b	Morrinsville	1.2	10 y
3c	Te Aroha	1.2	10 y
4a	Matamata	0.6	100 y
4b	Morrinsville	0.6	100 y
4c	Te Aroha	0.6	100 y
5a	Matamata	0.9	100 y
5b	Morrinsville	0.9	100 y
5c	Te Aroha	0.9	100 y
6a	Matamata	1.2	100 y
6b	Morrinsville	1.2	100 y
6c	Te Aroha	1.2	100 y



NOTES:

1. WHERE PRACTICAL, ALL SOAKHOLES SHOULD BE LINKED FOR LOAD BALANCING.
2. WORKS TO BE UNDERTAKEN IN ACCORDANCE WITH MPDC SPECIFICATION AND CODE OF PRACTICE
3. AREA OF ROOF/ DRIVEWAY ALLOWED PER SOAKHOLE TO BE CALCULATED AS PER GRAPH 1 OF MPDC SOAKAGE POLICY.
4. SOAKAGE DEVICES SHALL BE POSITIONED ON SITE WHERE:
   a. THEY CAN COLLECT ALL RUNOFF FROM THE SITE (E.G. IF PLACED AT THE TOP OF A DRIVEWAY WILL THE SOAKAGE DEVICE STILL BE LOW ENOUGH TO COLLECT WATER FROM LOWER POINTS OF THE DRIVEWAY)
   b. THEY CAN BE EASILY ACCESSED AND MAINTAINED ON A LONG TERM BASIS (THERE SHOULD BE AT LEAST 2M WIDE ACCESSWAY TO AND AROUND THE DEVICE)
   c. THEY ARE ABOVE THE WINTER WATER TABLE (THIS MUST BE MEASURED WHEN DOING THE PERCOLATION TEST - IF THE TESTS ARE DONE IN THE SUMMER MONTHS OCTOBER TO APRIL THEN THE WINTER WATER TABLE IS ESTIMATED AS THAT MEASURED PLUS 1M
   d. THEY ARE AT LEAST 1.5 M AWAY FROM BUILDINGS, PROPERTY BOUNDARIES AND SEWERS AND PUBLIC MAINS UNLESS CONSENTED BY AFFECTED PARTIES.
   e. THEY ARE PLACED AWAY FROM RETAINING WALLS AND UNSTABLE BANKS. WITHOUT SPECIALIST GEOTECHNICAL ADVICE TO THE CONTRARY THE MINIMUM HORIZONTAL DISTANCE TO BE PLACED AWAY FROM A WALL OR BANK IS TO BE TWICE THE HEIGHT OF THE WALL OR BANK.
   f. THEY ARE OUTSIDE OF THE 1 IN 100 YEAR FLOODPLAIN

400 200 0 400 800mm

SCALE 1:20

CONCEPT
FOR REPORT PURPOSES

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Project: STORMWATER SOAKAGE DESIGN MANUAL

Drawing Title: SOAKHOLE & MONITORING WELL DETAIL UNDER CONCRETE/ IMPERMEABLE SURFACE

Client: MATAMATA PIAKO DISTRICT COUNCIL

No.	Date	Revision Details	Des
02	09.04.10	UPDATED TO INDEPENDENT PEER REVIEW	RK
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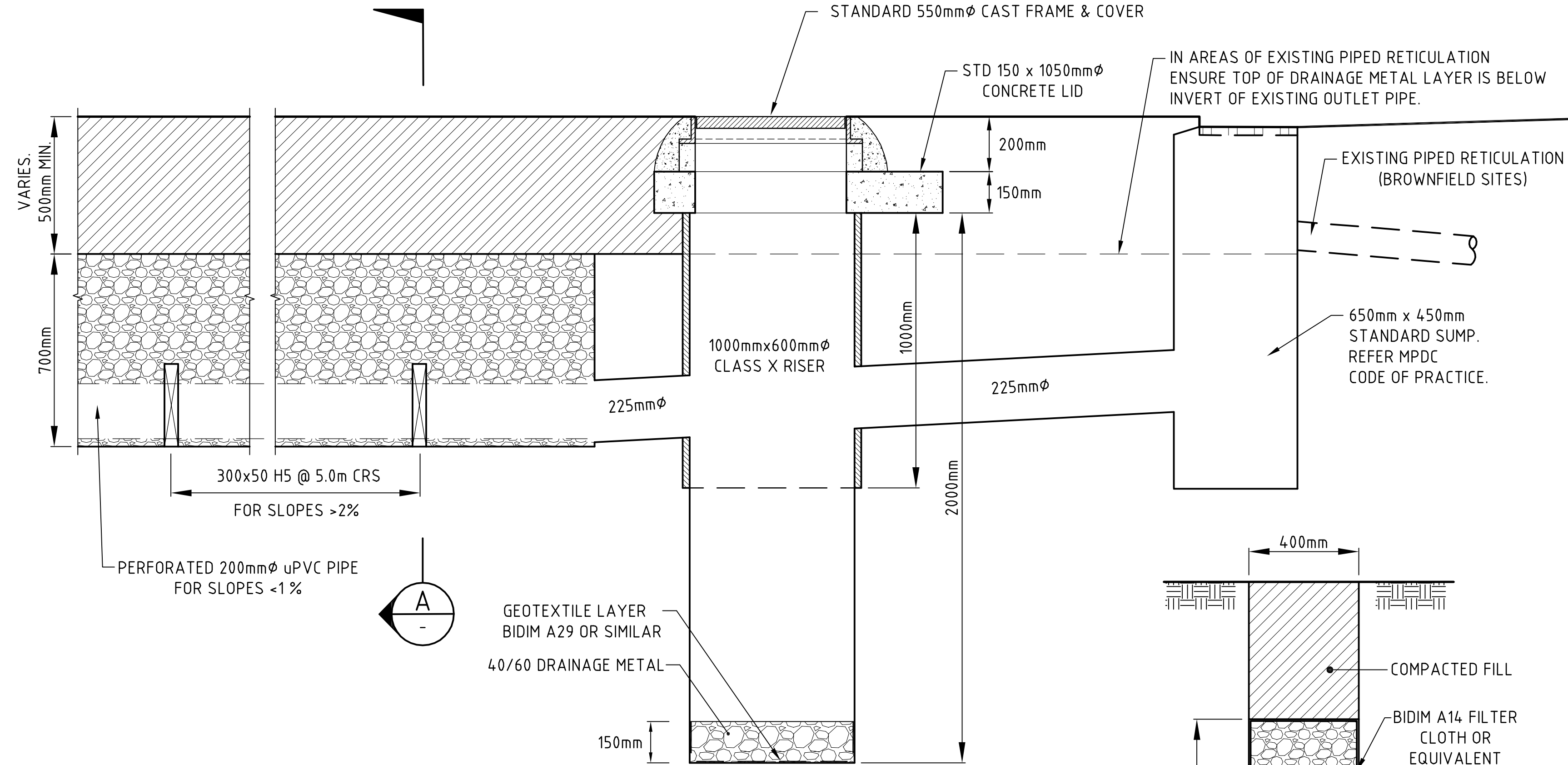
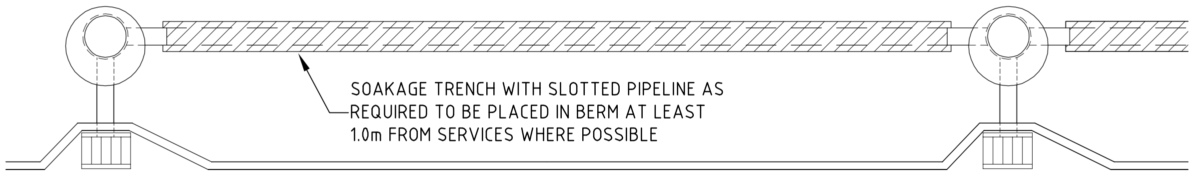
Drawn	pp WAH	Date	20.05.09
Designed	RK		
Verified	JVA	Scale 1:20	Sheet Size A4
Approved	NR		
Project No. 41874-001-03		Drawing No. SK02	Rev. 02

20 10 0 10 20 30 40 50mm



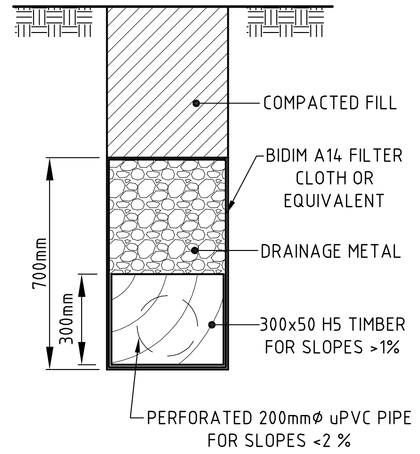
SOAKAGE TRENCH DETAIL

1:25



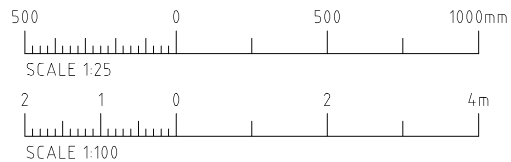
SOAKAGE TRENCH PLAN

1:100



TYPICAL CROSS SECTION (A / -)

1:25



CONCEPT
FOR REPORT PURPOSES

NOTES:

1. SLOPE DRAINAGE TRENCH INVERT GENTLY (1:100) DOWNWARDS FROM SOAKHOLES
2. REFER TO SOAKAGE DESIGN MANUAL FOR REQUIRED LENGTH OF SOAKAGE TRENCH PER m^2 OF ROAD SURFACE

No.	Date	Revision Details	Des
02	09.04.10	UPDATED TO INDEPENDENT PEER REVIEW	RK
01	20.05.09	PRELIMINARY ISSUE	RK

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Client:
MATAMATA PIAKO DISTRICT COUNCIL

Project:
STORMWATER SOAKAGE DESIGN MANUAL

Drawing Title:
SOAKAGE TRENCH DETAIL PLAN (ROADING / INDUSTRIAL)

Drawn	pp WAH	Date	20.05.09
Designed	RK		
Verified	JVA	Scale: AS SHOWN	Sheet Size: A4
Approved	NR		
Project No. 41874-001-03		Drawing No. SK03	Rev. 02

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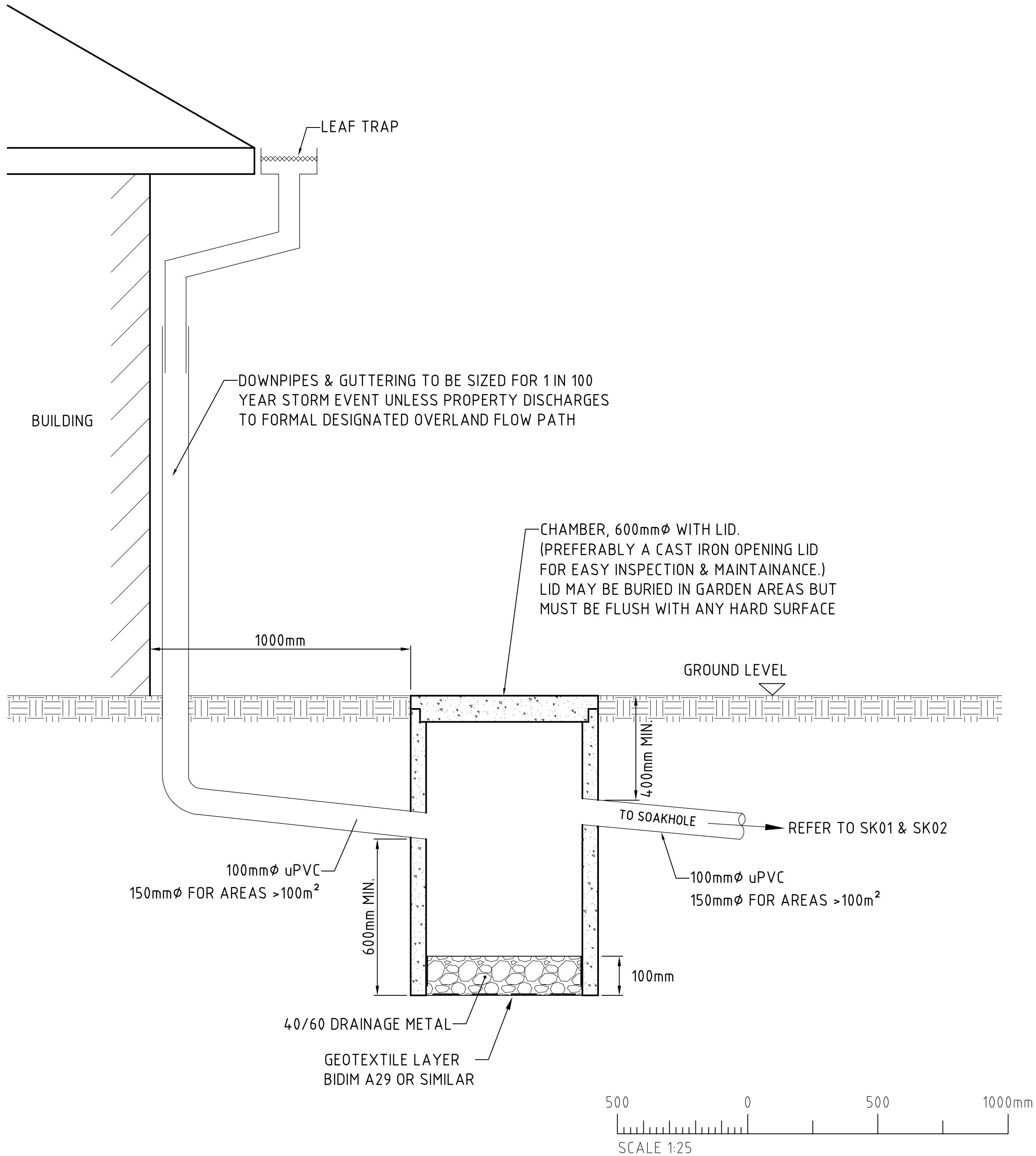
ad File: P:\41874 - Matamata Paiko DC\41874-001 - Stormwater Soakage\03 - Engineering\Dwgs\41874-001-03-SK03.dwg Plot Date: 12/04/2010 9:57:32 a.m. Name: Liam Hodgson Xrefs: X-41874-001-03-A4HS, Aurecon_Disclaimer, Aurecon_Logo



CONCEPT
FOR REPORT PURPOSES

No.	Date	Revision Details	Des
02	09.04.10	UPDATED TO INDEPENDENT PEER REVIEW	RK
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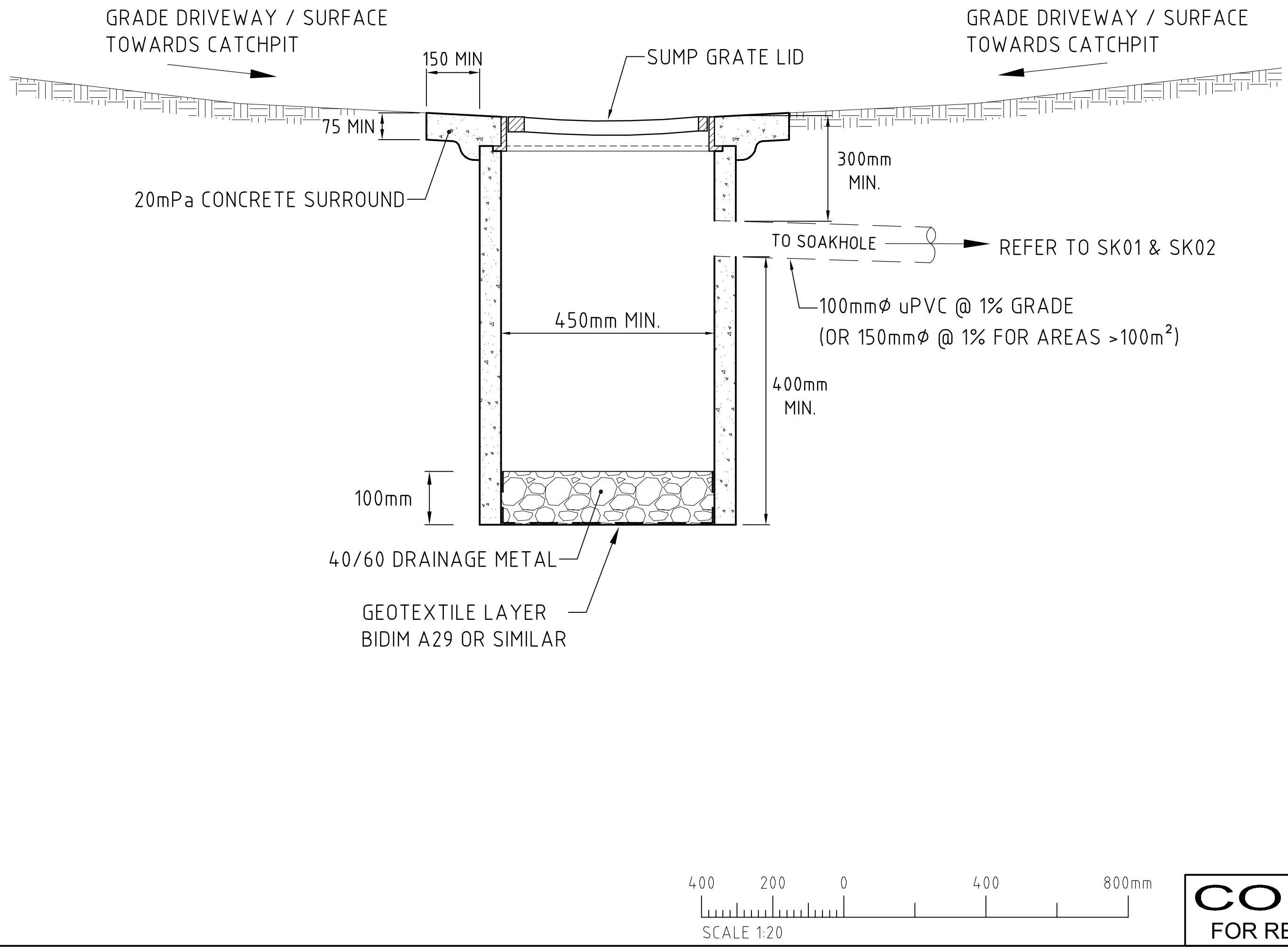
Client:
MATAMATA PIAKO DISTRICT COUNCIL

Project:
STORMWATER SOAKAGE DESIGN MANUAL

Drawing Title:
SETTLING CHAMBER (FOR ROOF RUNOFF)

Drawn	pp WAH	Date	22.05.09
Designed	RK		
Verified	JVA	Scale 1:25	Sheet Size A4
Approved	NR		
Project No. 41874-001-03		Drawing No. SK04	Rev. 02



NOTE:

1. WHERE SLOTTED DRAINS ARE USED INSTEAD OF CATCHPITS, THEY SHOULD DISCHARGE TO SUMP PRIOR TO SOAKPIT.
2. SUMP INLET MUST HAVE CAPACITY FOR 1 IN 100 YEAR FLOW OF 0.5 LITRES/s PER $10m^2$ OF DRIVEWAY (UNLESS PROPERTY DISCHARGES TO FORMAL DESIGNATED OVERLAND FLOW PATH).

No.	Date	Revision Details	Des
02	09.04.10	UPDATED TO INDEPENDENT PEER REVIEW	RK
01	22.05.09	PRELIMINARY ISSUE	RK

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Client: MATAMATA PIAKO DISTRICT COUNCIL

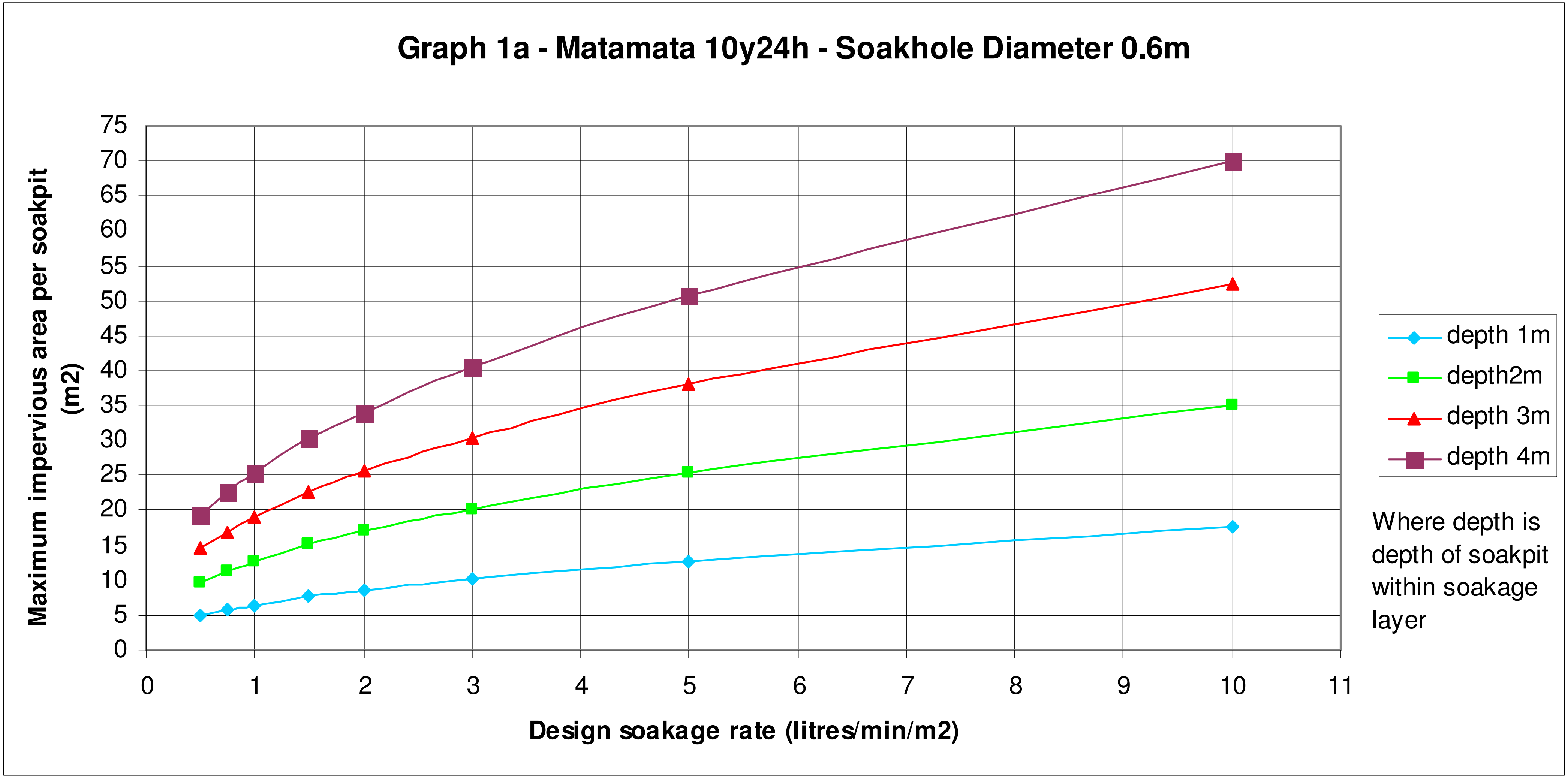
Project: STORMWATER SOAKAGE DESIGN MANUAL

Drawing Title: SUMP/ SETTLING CHAMBER (FOR DRIVEWAY OR YARD RUNOFF)

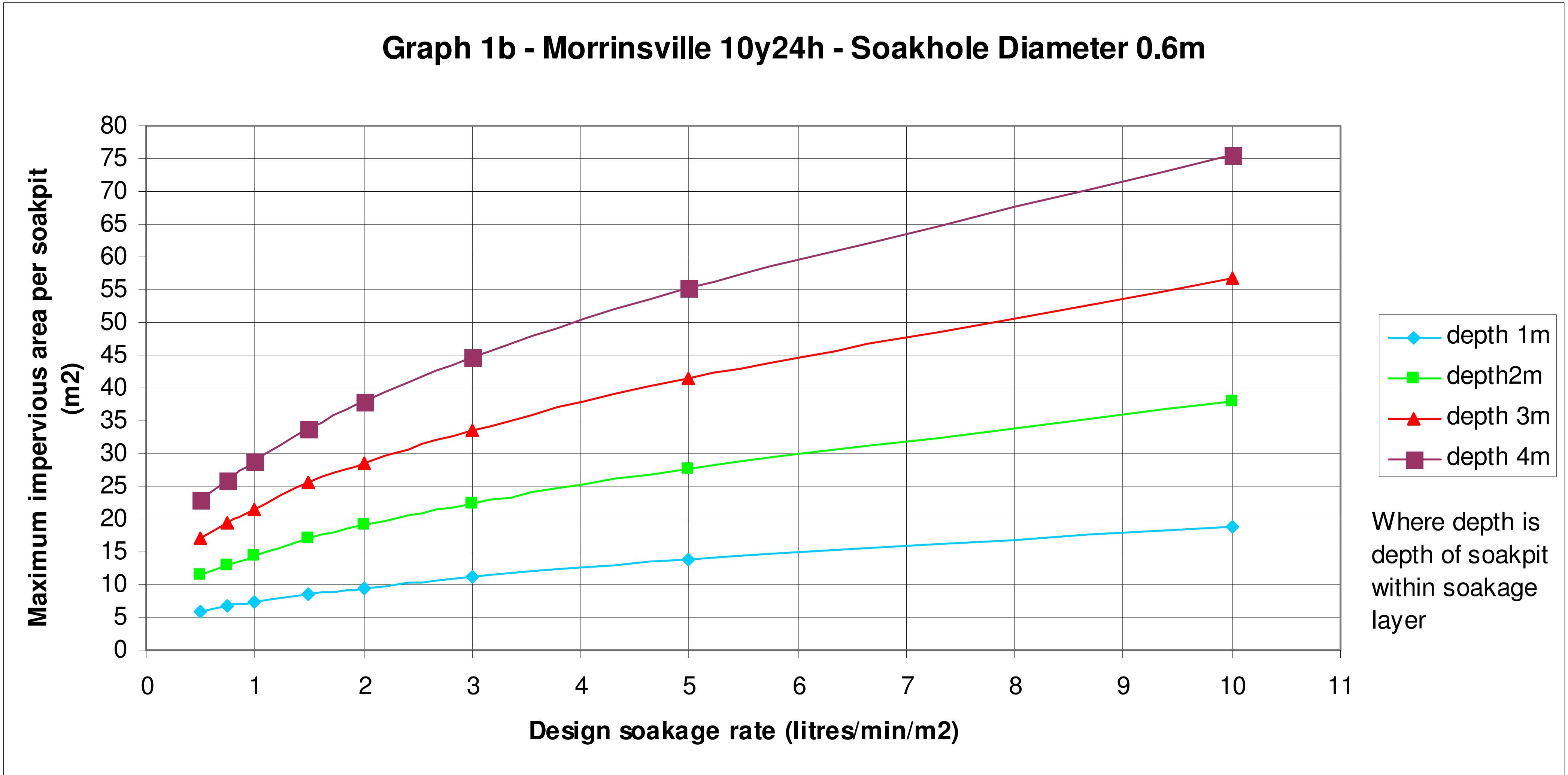
Drawn	pp WAH	Date	22.05.09
Designed	RK		
Verified	JVA	Scale 1:20	Sheet Size A4
Approved	NR		
Project No. 41874-001-03		Drawing No. SK05	Rev. 02

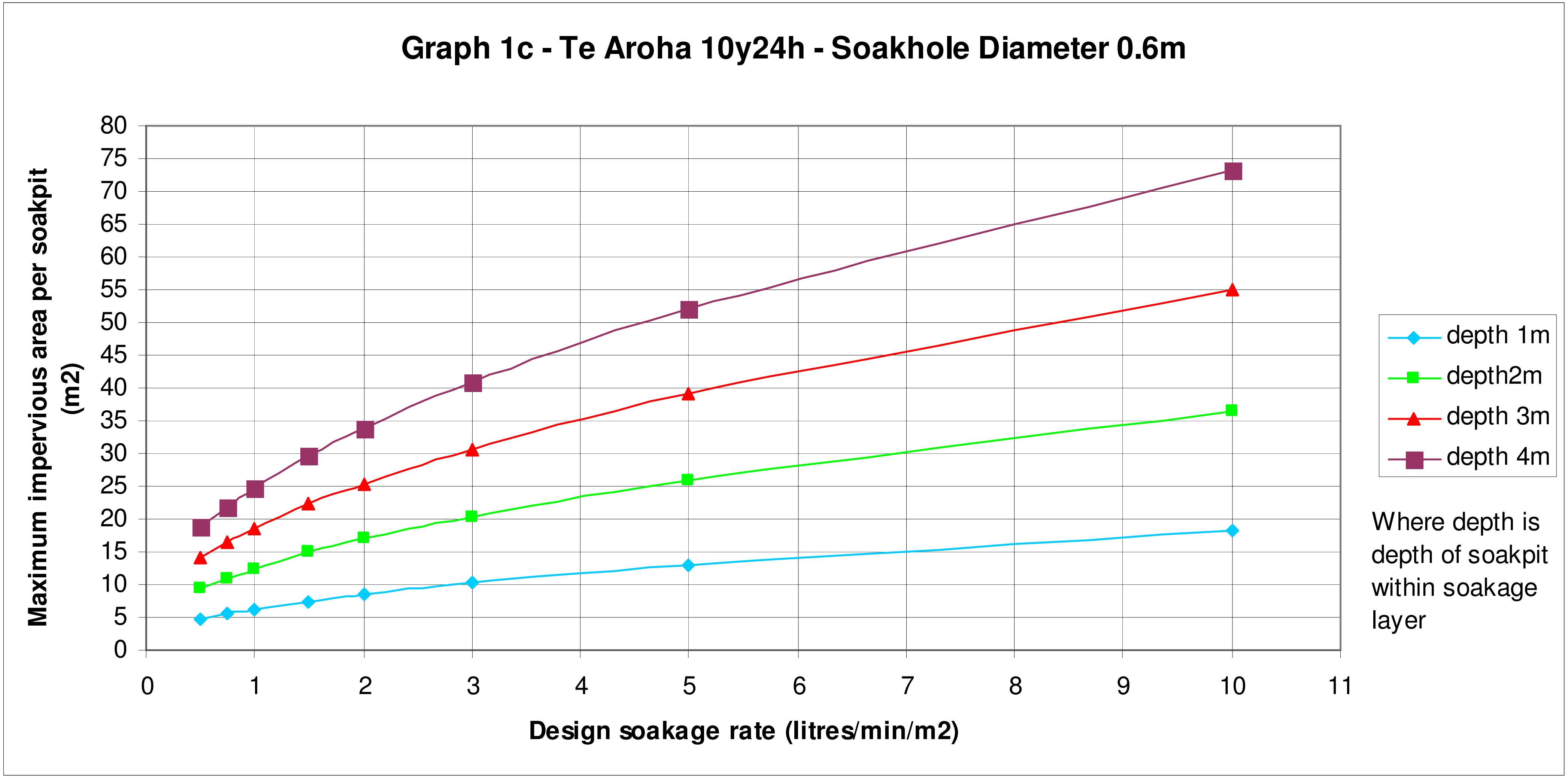
CONCEPT
FOR REPORT PUROSES

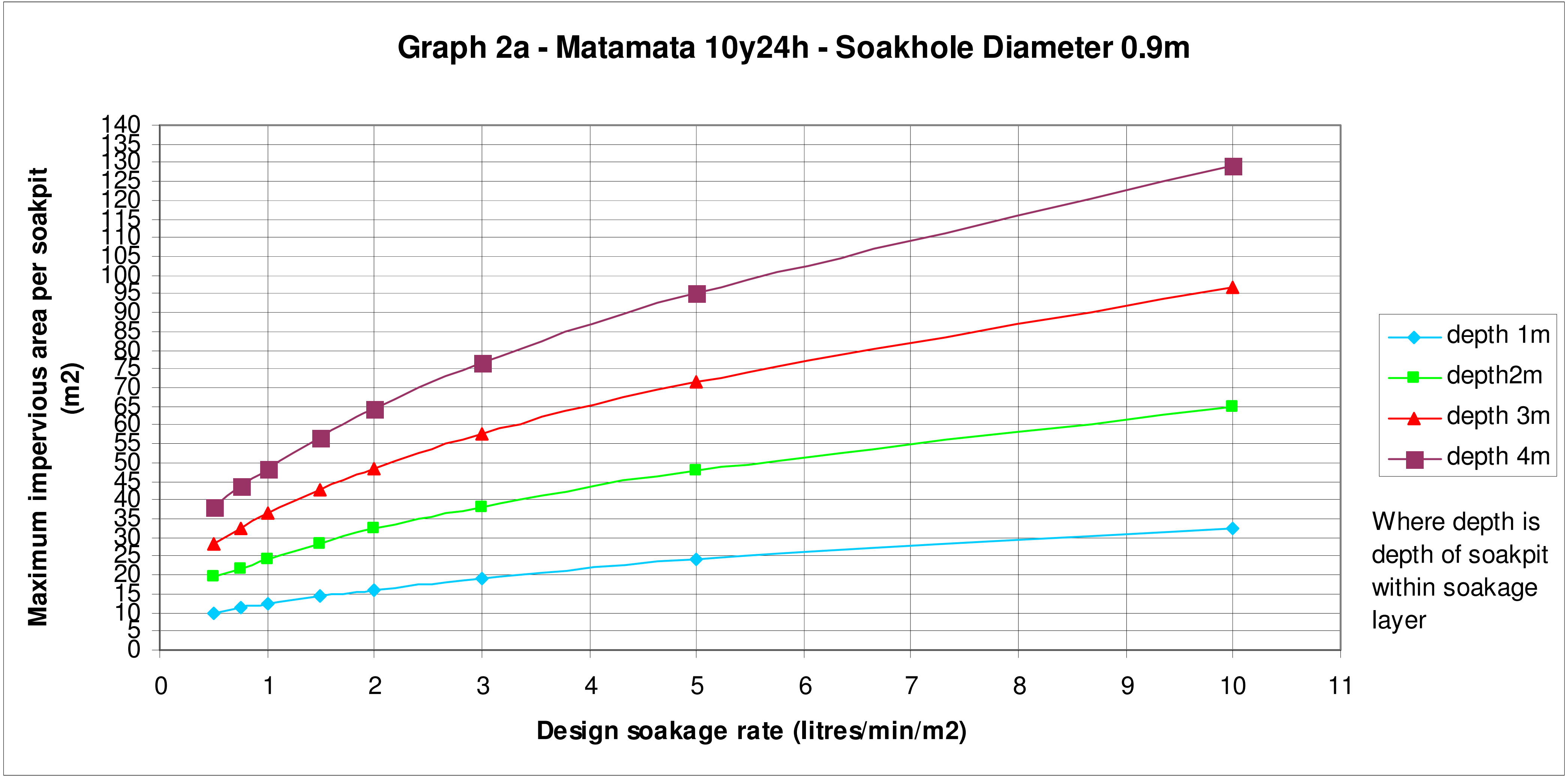
20 10 0 10 20 30 40 50mm

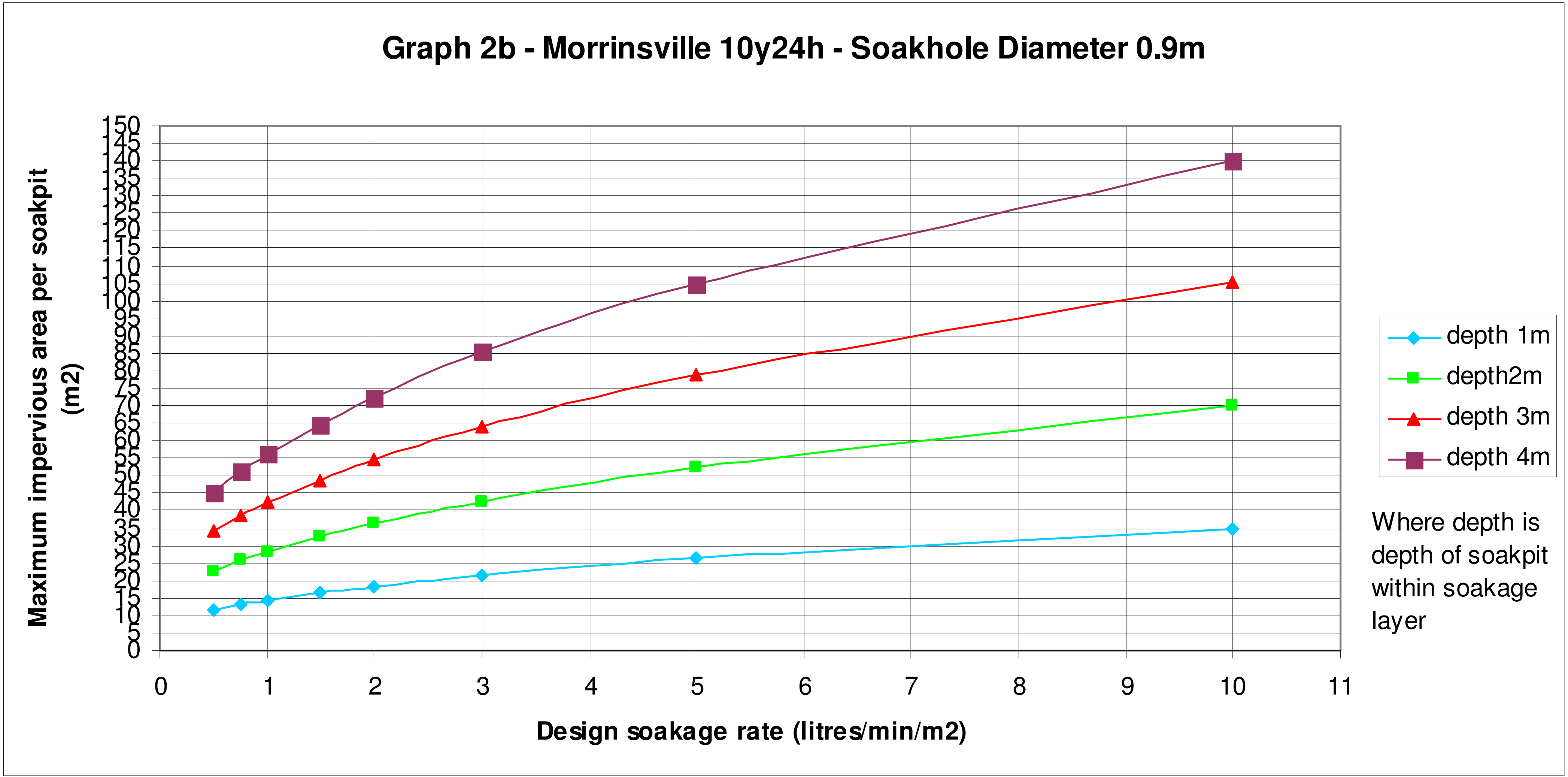


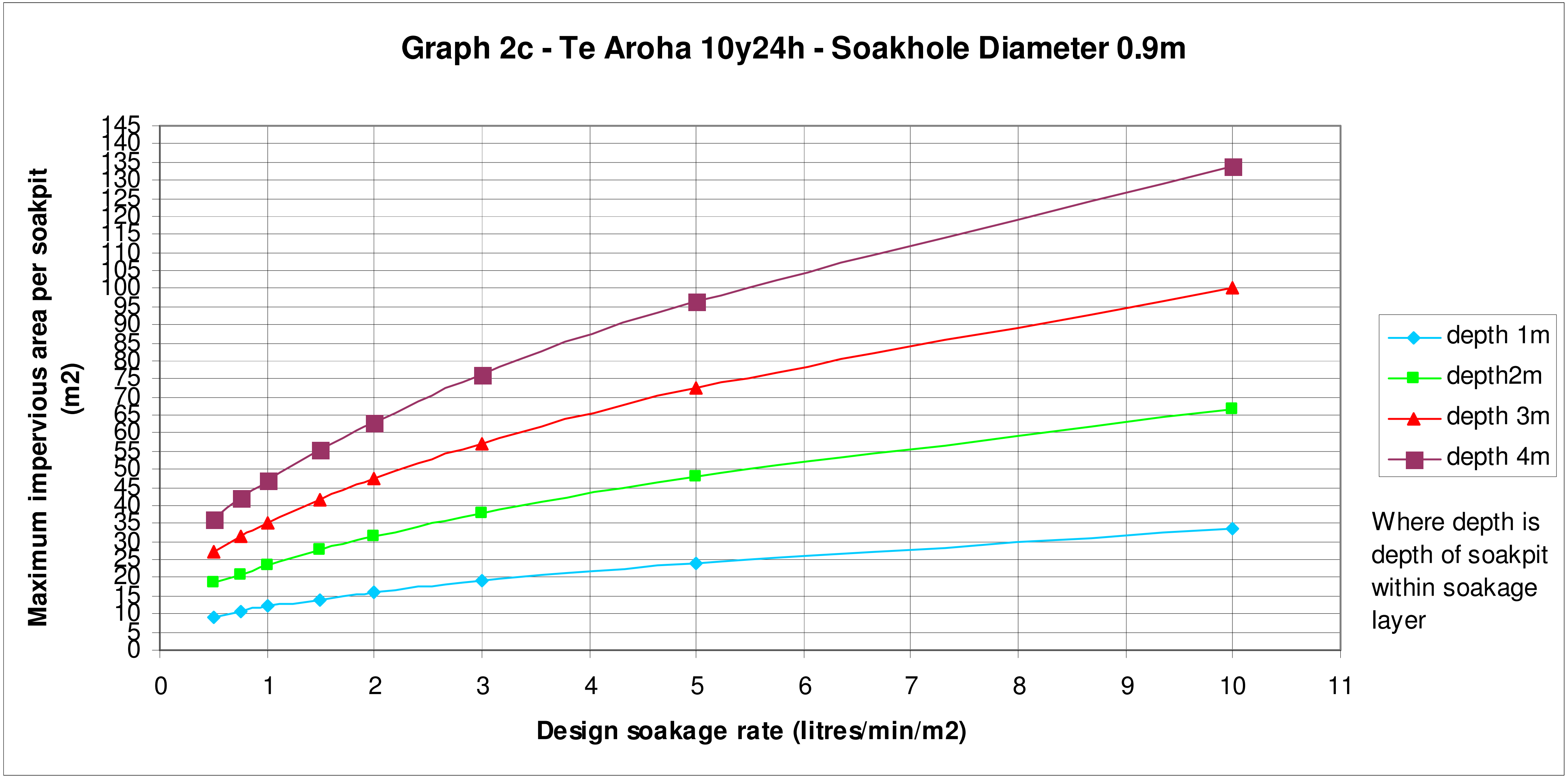
Graph 1a - Matamata 10y24h - Soakhole Diameter 0.6m
Maximum impervious area per soakpit (m2)
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer


Graph 1b - Morrinsville 10y24h - Soakhole Diameter 0.6m
Maximum impervious area per soakpit (m2)
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer

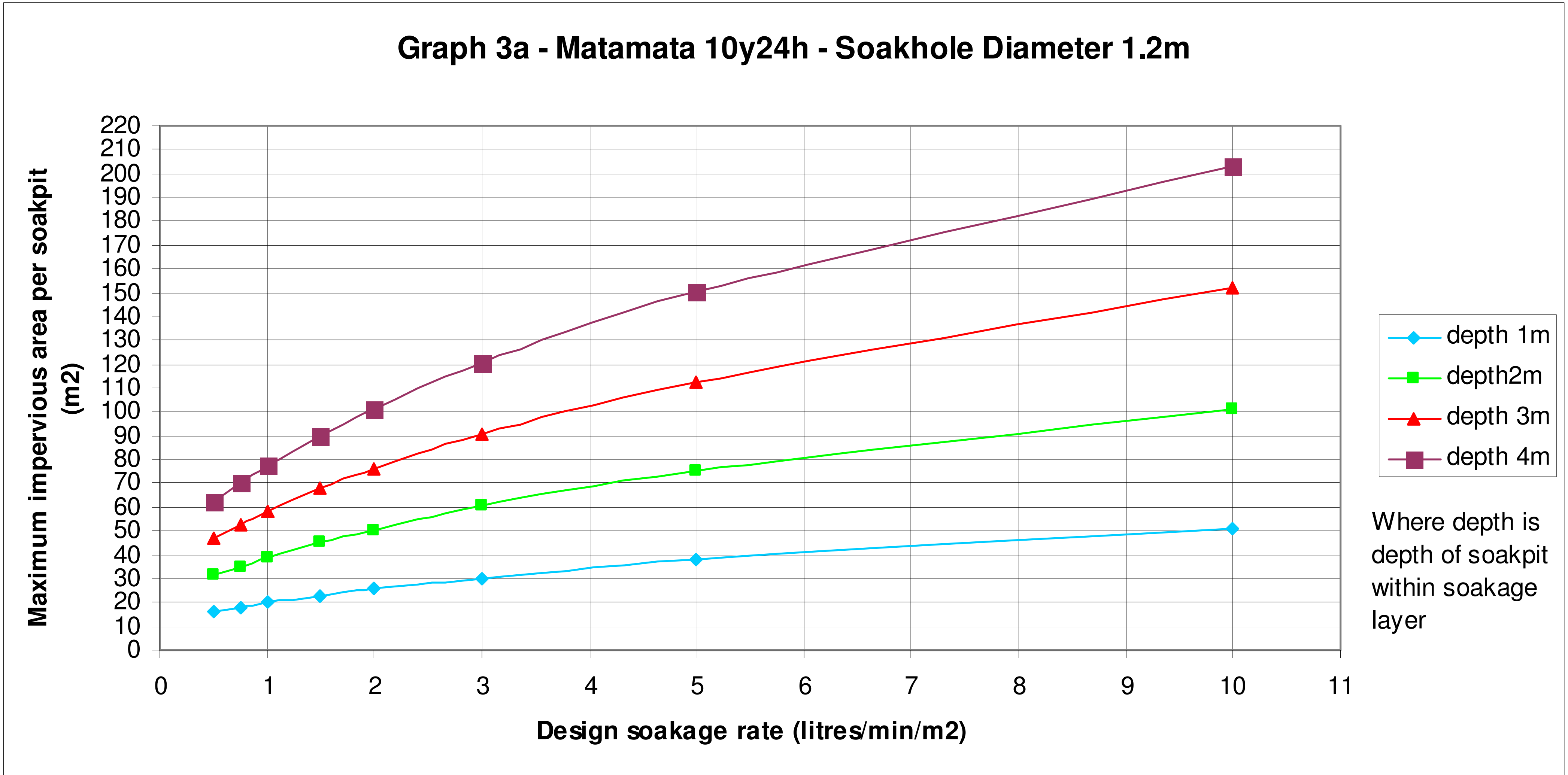

Graph 1c - Te Aroha 10y24h - Soakhole Diameter 0.6m
Maximum impervious area per soakpit (m2)
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer


Graph 2a - Matamata 10y24h - Soakhole Diameter 0.9m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
130
135
140
0
1
2
3
4
5
6
7
8
9
10
11
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer

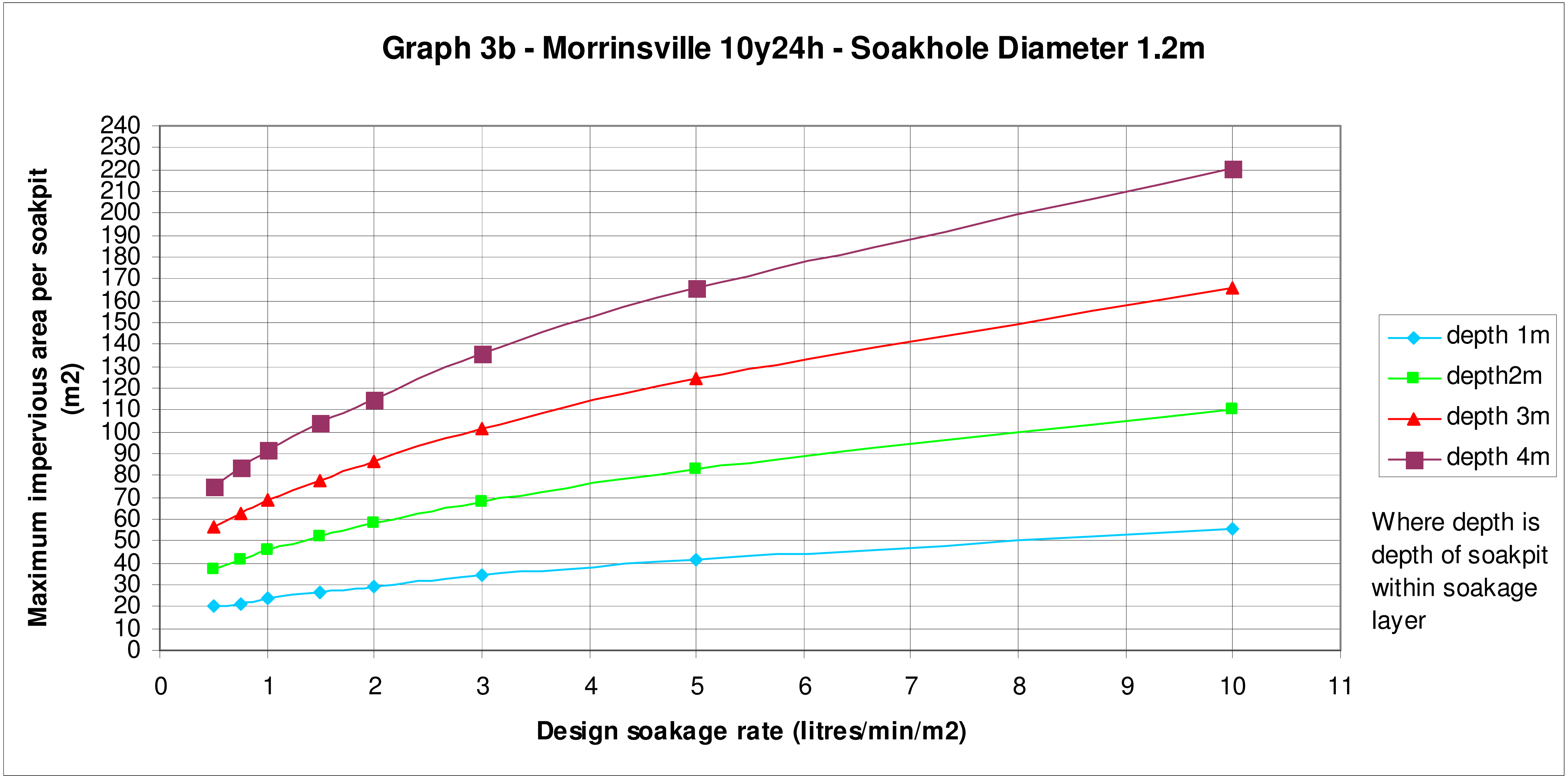

Graph 2b - Morrinsville 10y24h - Soakhole Diameter 0.9m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
130
135
140
145
150
0
1
2
3
4
5
6
7
8
9
10
11
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer

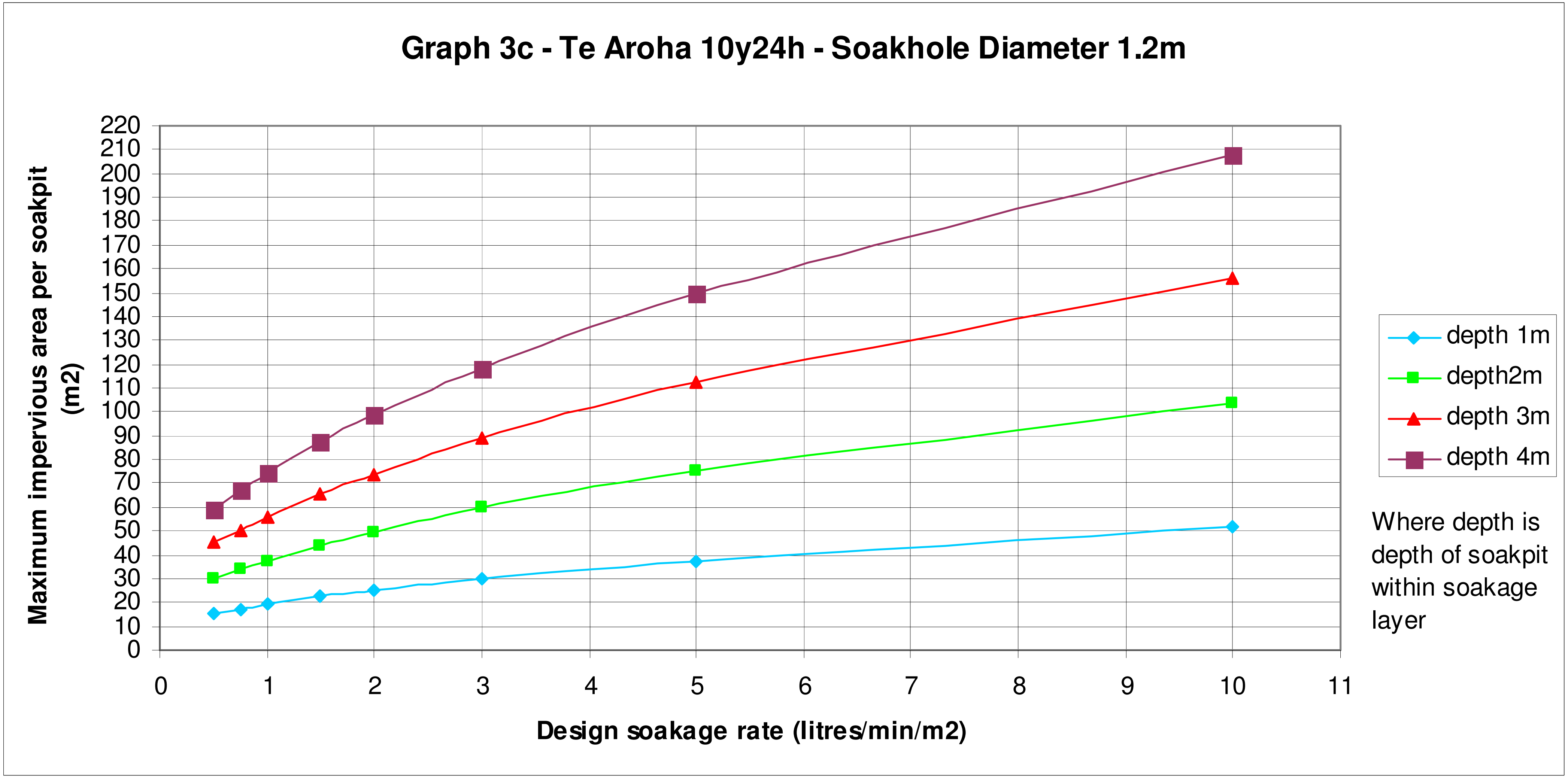


Graph 2c - Te Aroha 10y24h - Soakhole Diameter 0.9m
Maximum impervious area per soakpit (m2)
145
140
135
130
125
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer

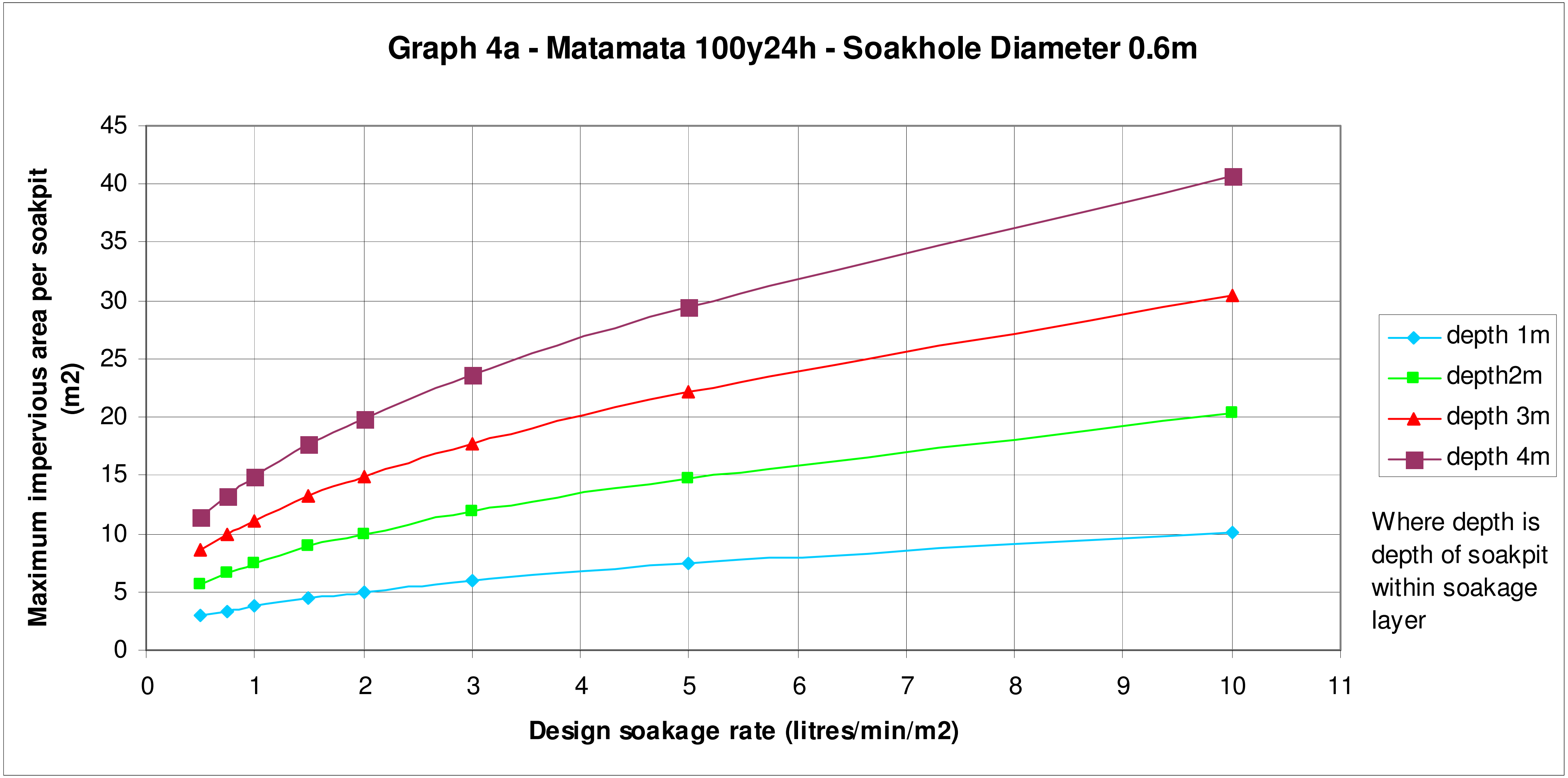


Graph 3a - Matamata 10y24h - Soakhole Diameter 1.2m
Maximum impervious area per soakpit (m2)
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer

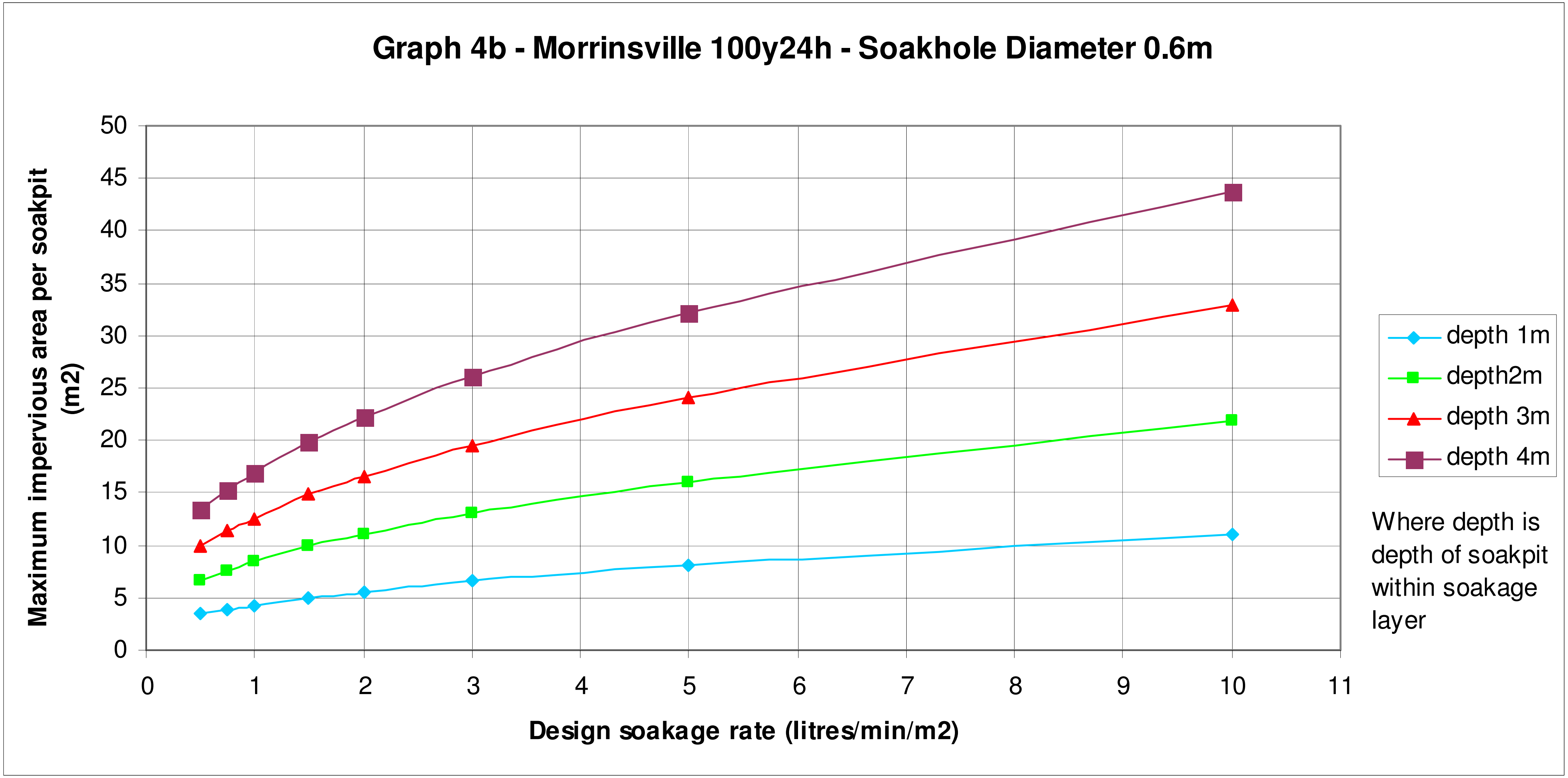

Graph 3b - Morrinsville 10y24h - Soakhole Diameter 1.2m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer

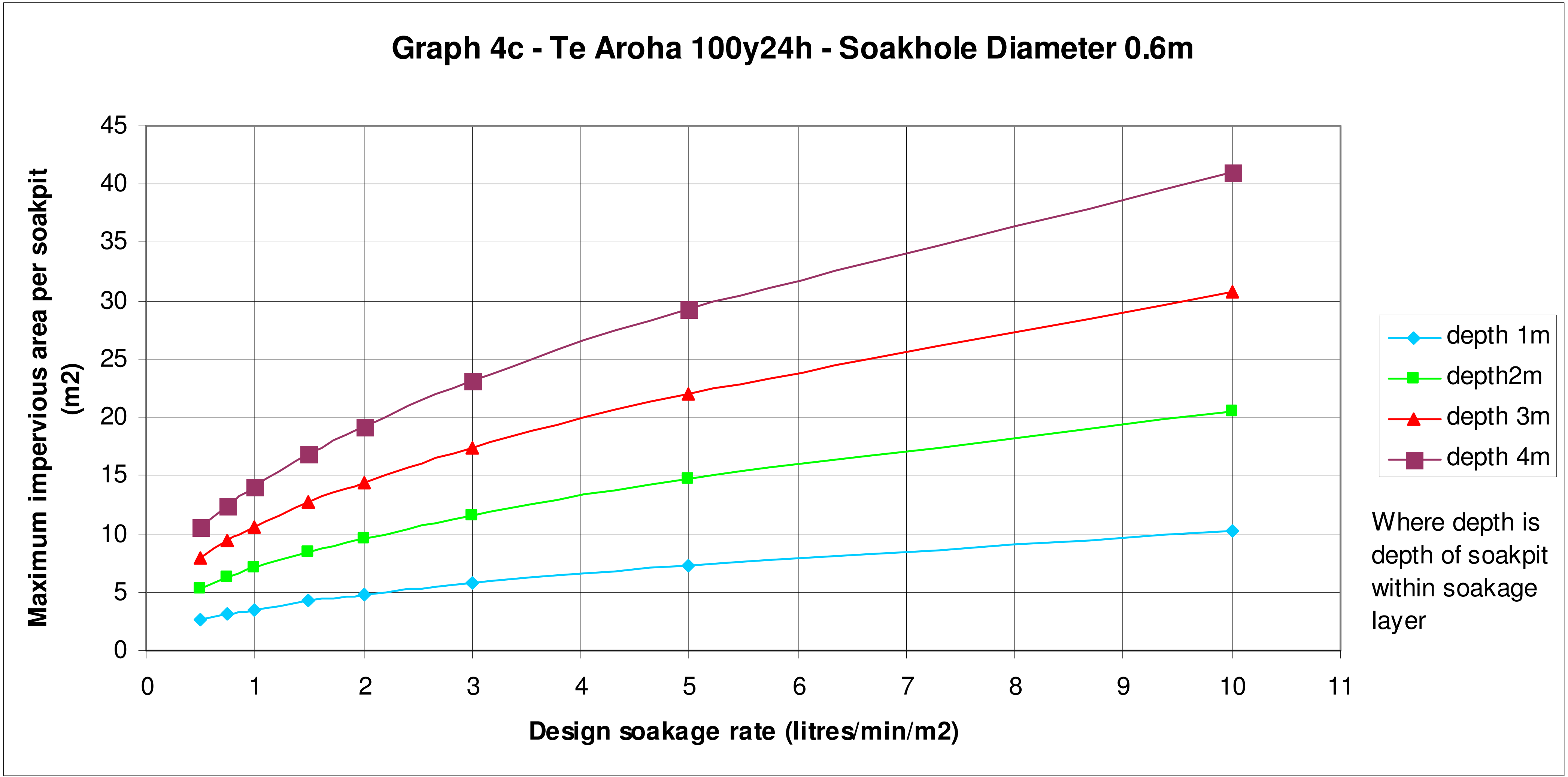


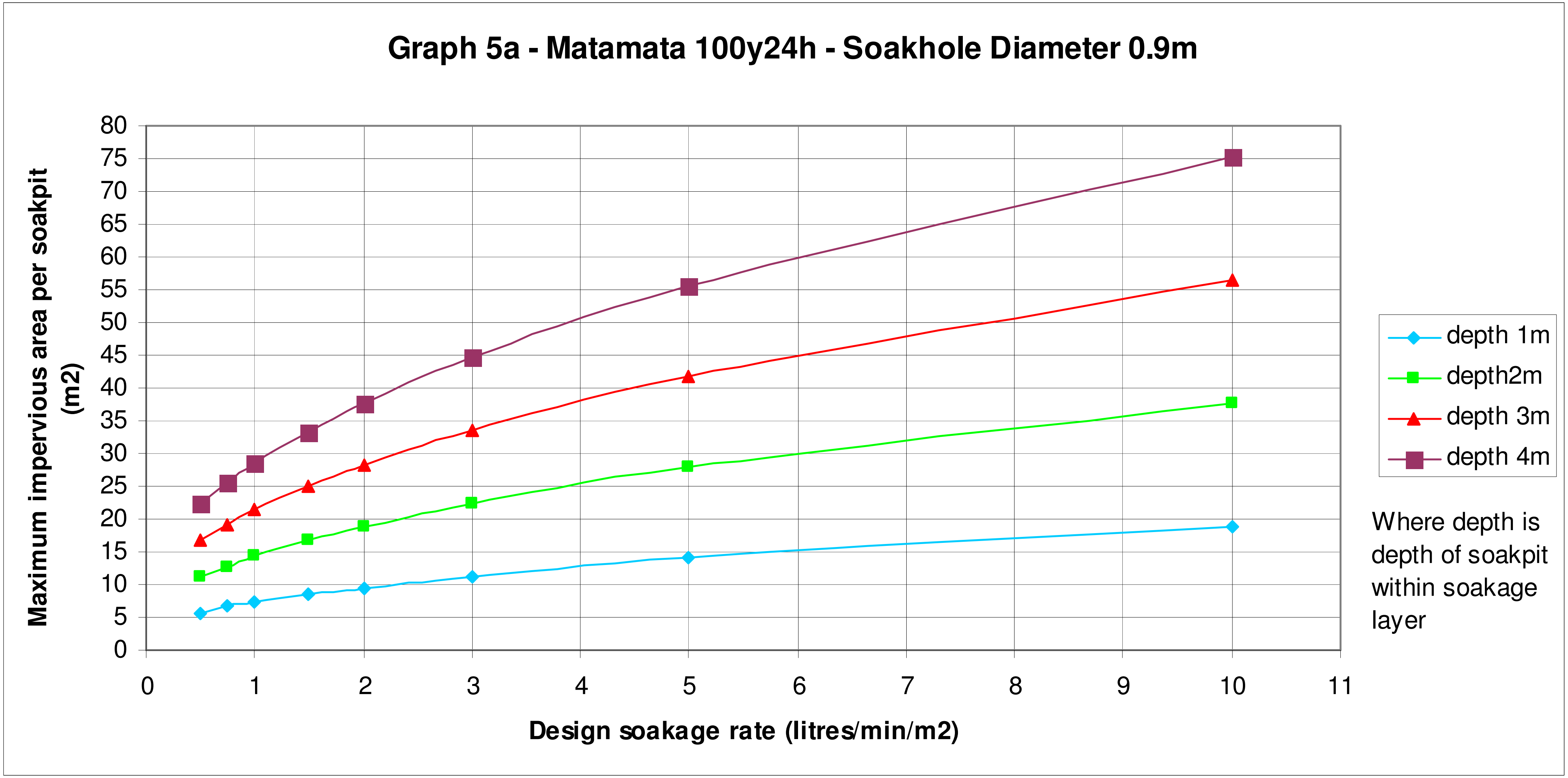
Graph 3c - Te Aroha 10y24h - Soakhole Diameter 1.2m
Maximum impervious area per soakpit (m2)
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer

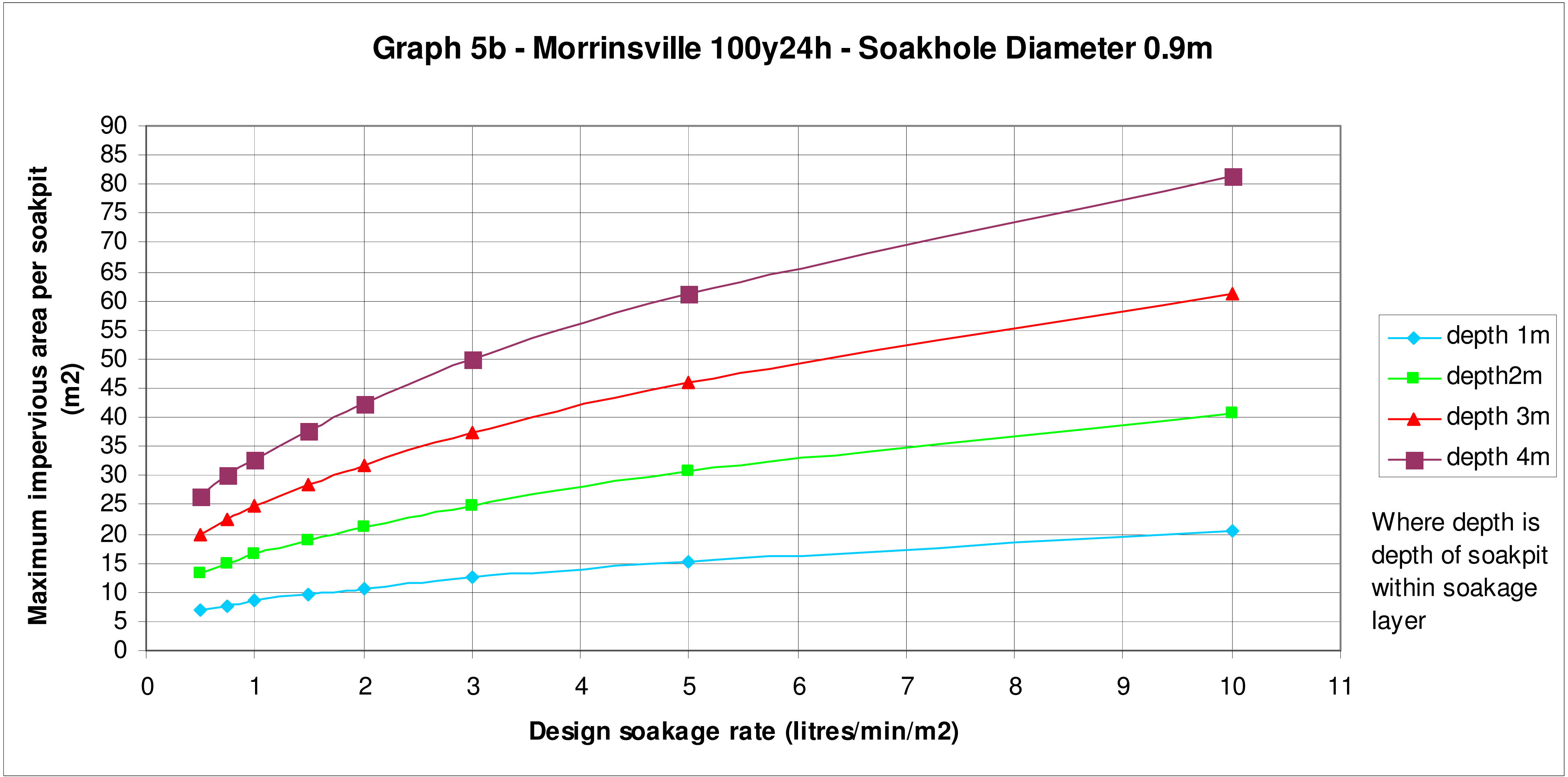


Graph 4a - Matamata 100y24h - Soakhole Diameter 0.6m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
0
5
10
15
20
25
30
35
40
45
0
1
2
3
4
5
6
7
8
9
10
11
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer

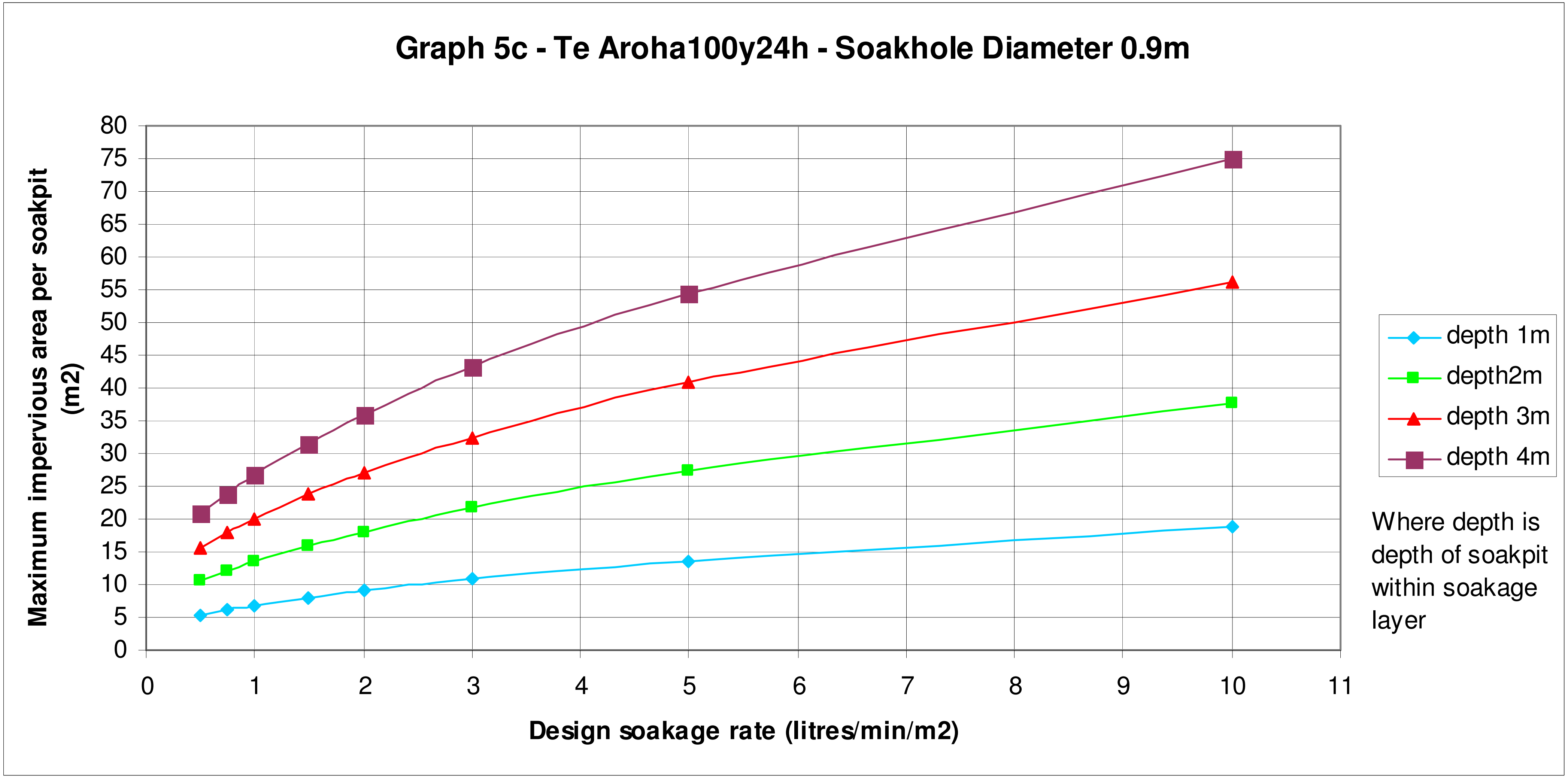

Graph 4b - Morrinsville 100y24h - Soakhole Diameter 0.6m
Maximum impervious area per soakpit (m2)
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer

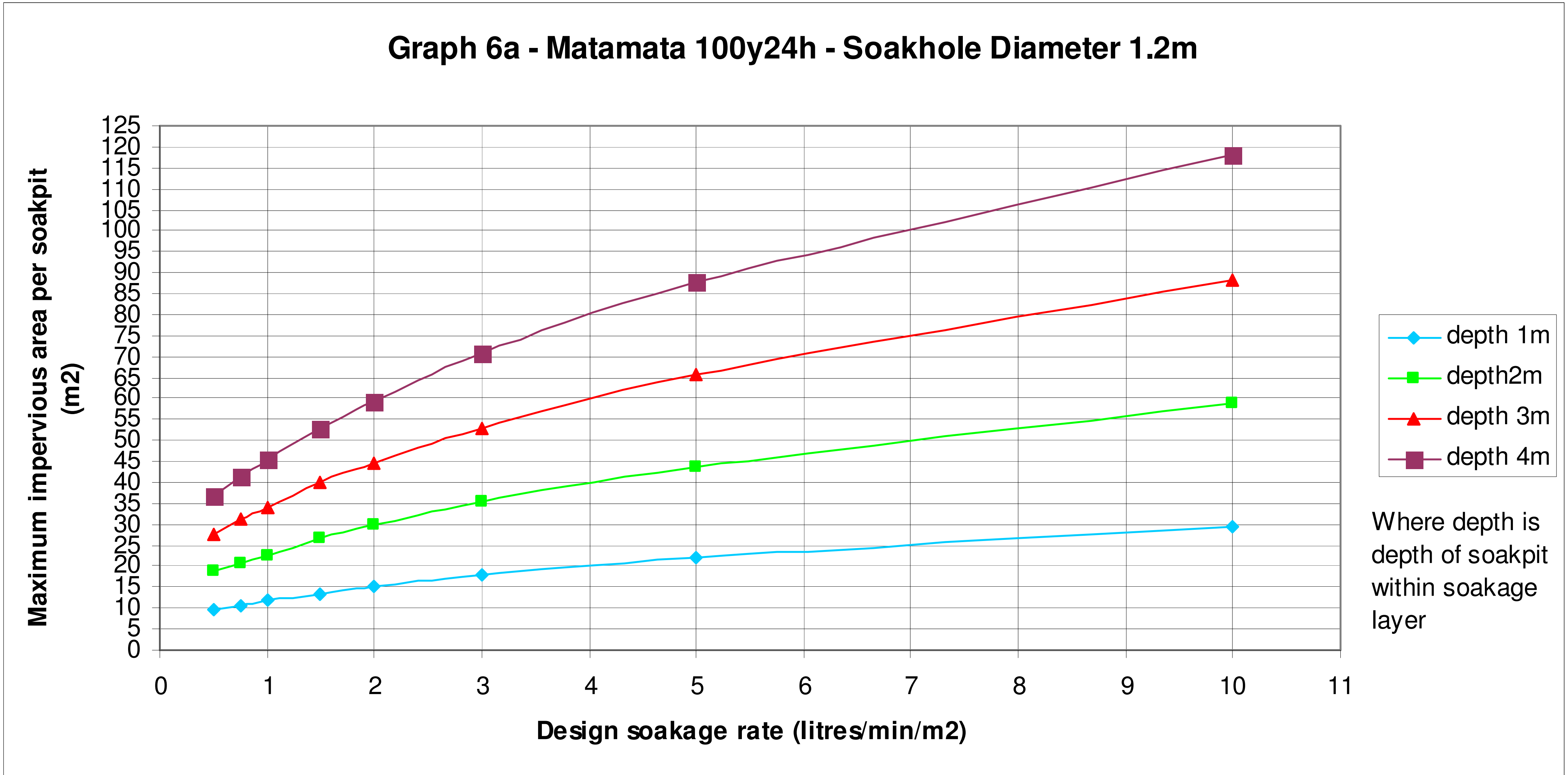

Graph 4c - Te Aroha 100y24h - Soakhole Diameter 0.6m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
0
5
10
15
20
25
30
35
40
45
0
1
2
3
4
5
6
7
8
9
10
11
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer

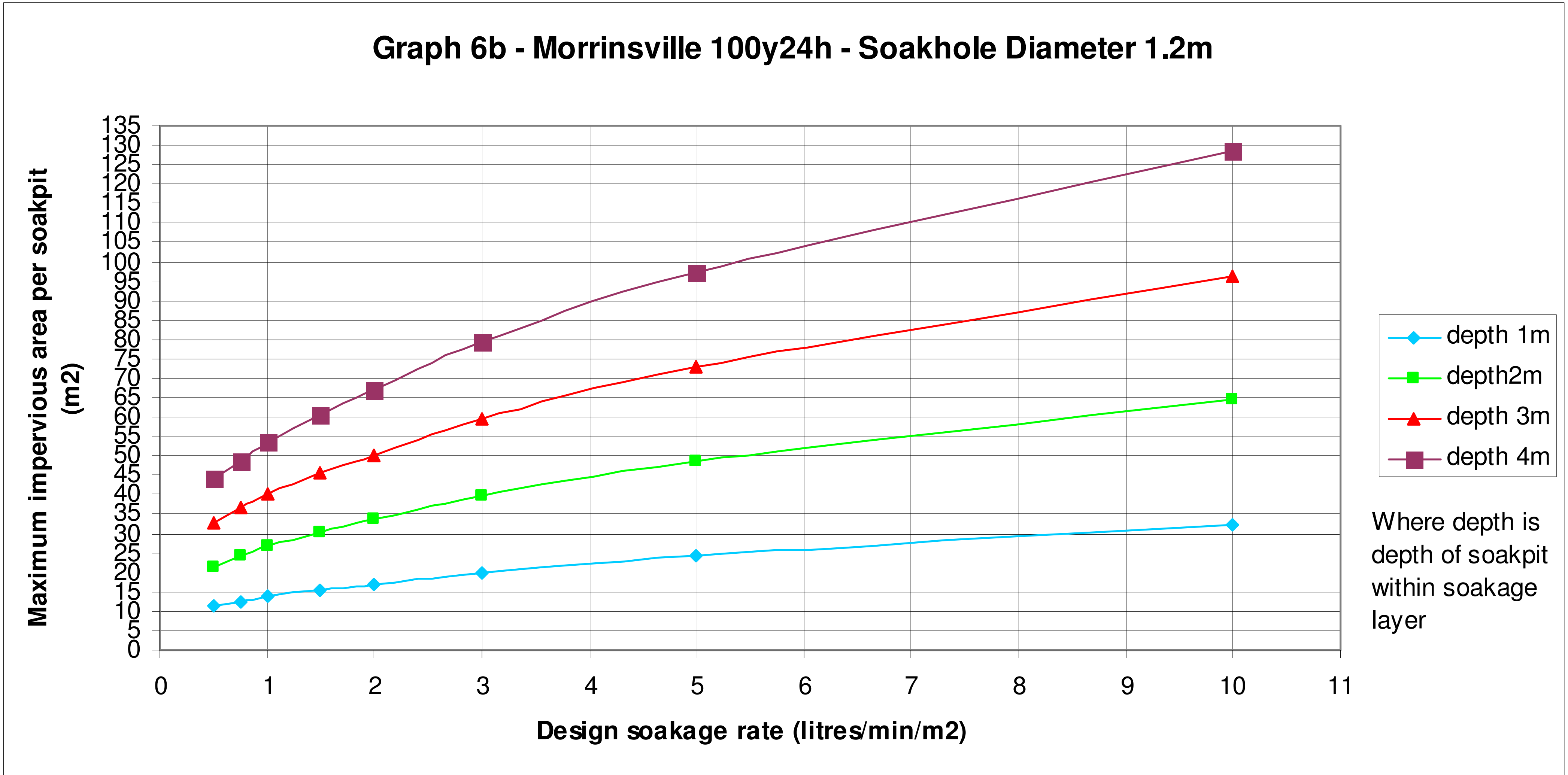

Graph 5a - Matamata 100y24h - Soakhole Diameter 0.9m
Maximum impervious area per soakpit (m2)
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer



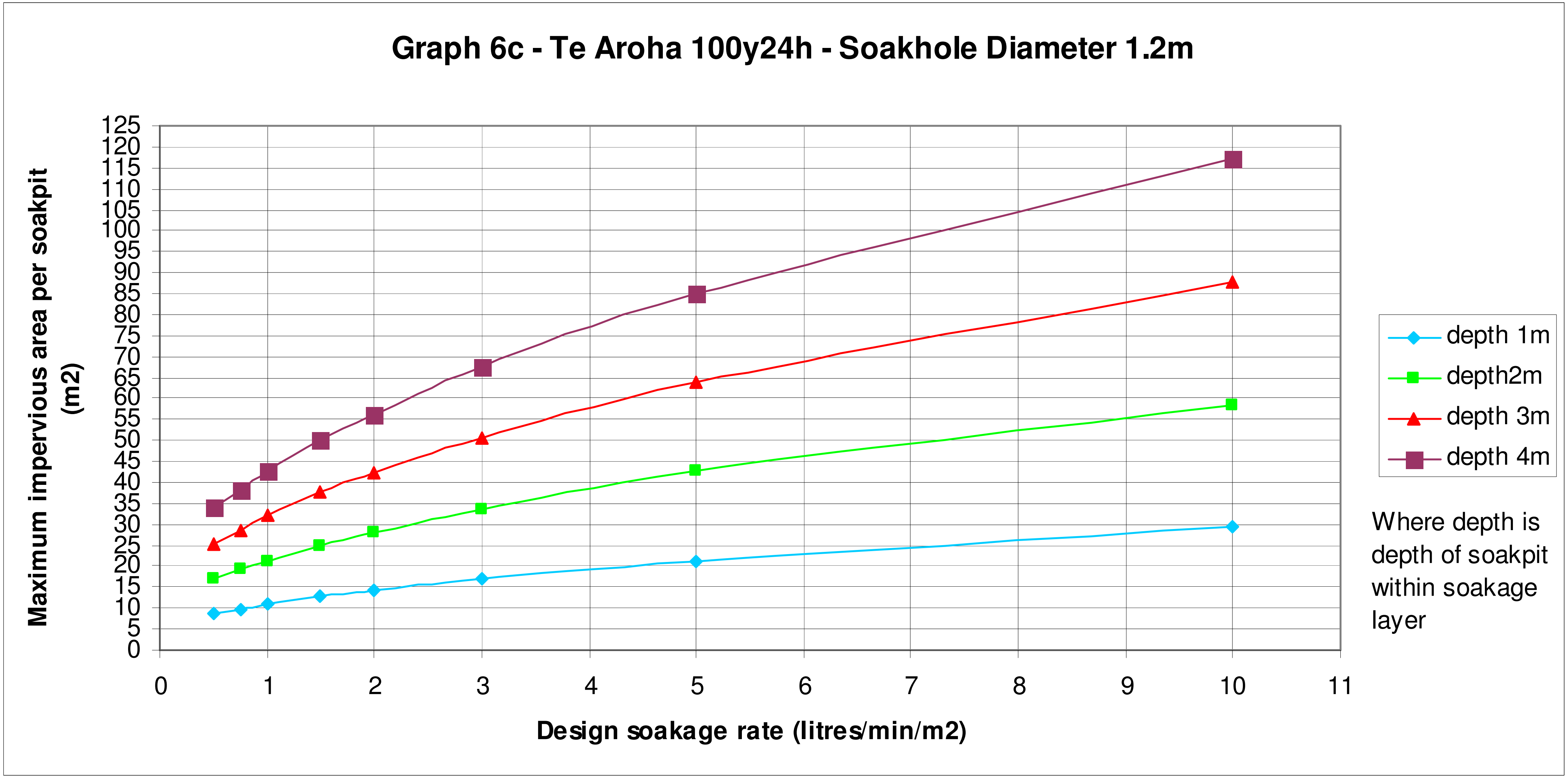
Graph 5b - Morrinsville 100y24h - Soakhole Diameter 0.9m
Maximum impervious area per soakpit (m2)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer


Graph 5c - Te Aroha100y24h - Soakhole Diameter 0.9m
Maximum impervious area per soakpit (m2)
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer


Graph 6a - Matamata 100y24h - Soakhole Diameter 1.2m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
0
1
2
3
4
5
6
7
8
9
10
11
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer



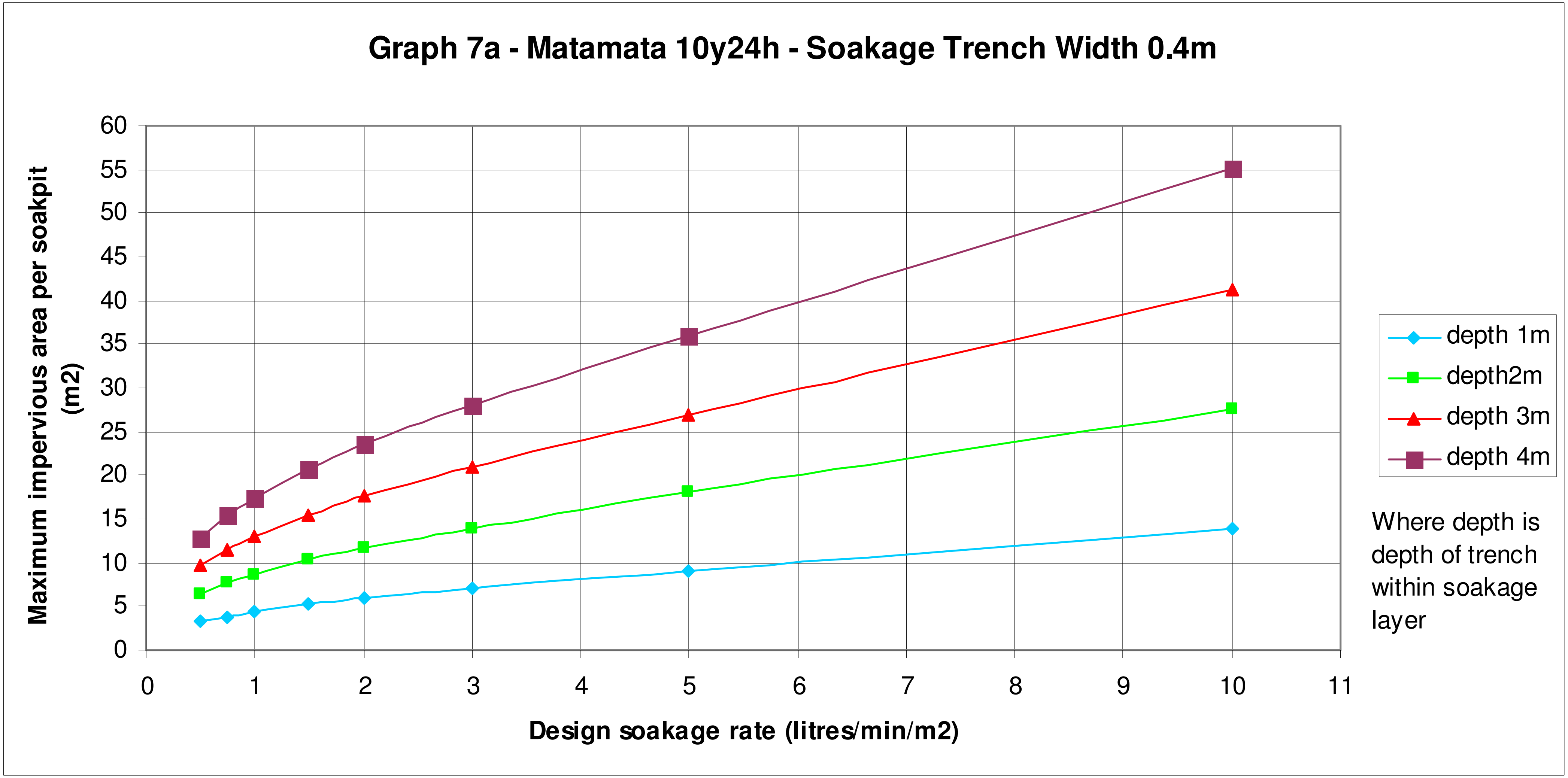
Graph 6b - Morrinsville 100y24h - Soakhole Diameter 1.2m
Maximum impervious area per soakpit (m2)
135
130
125
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer

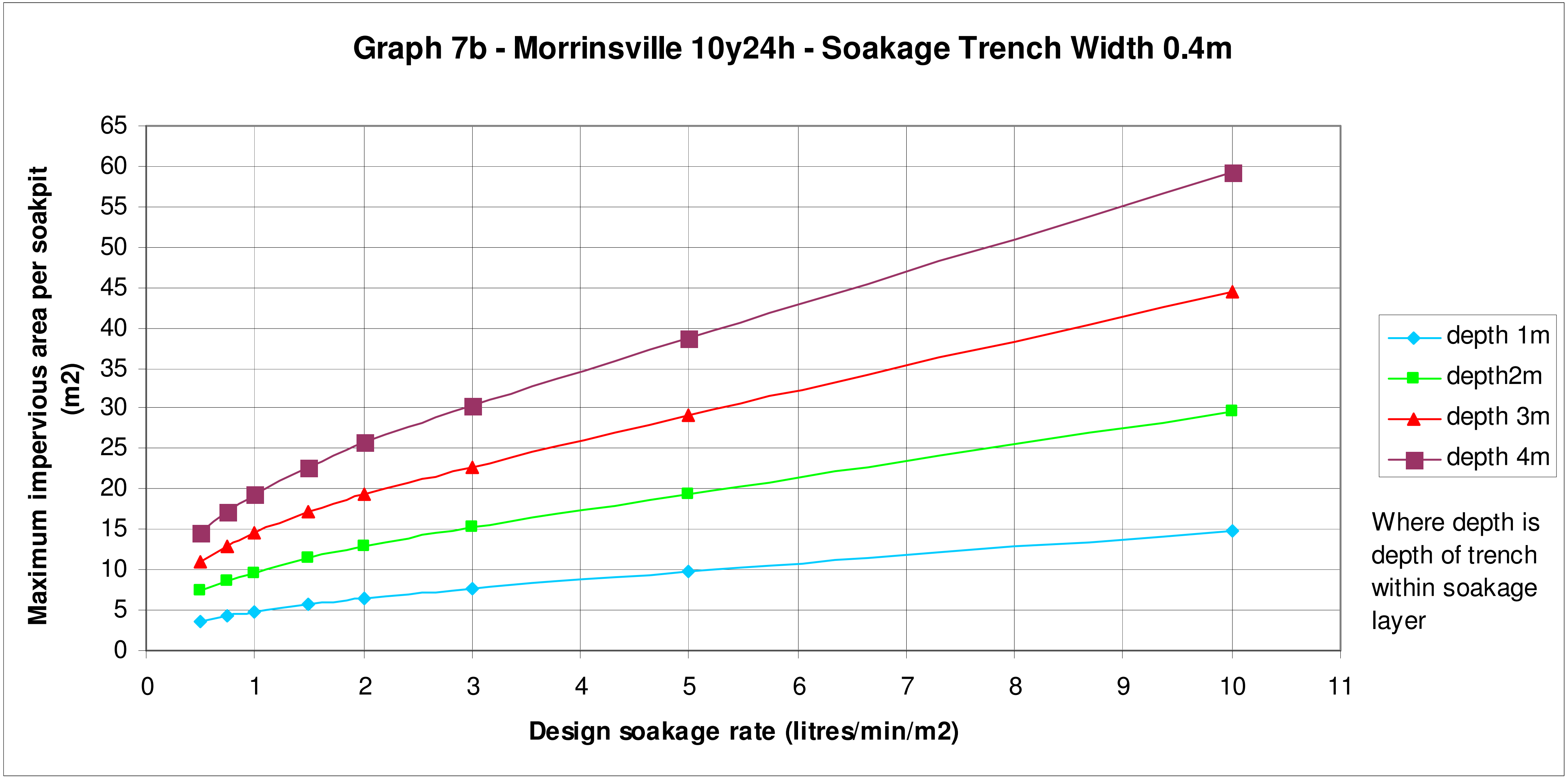

Graph 6c - Te Aroha 100y24h - Soakhole Diameter 1.2m
Maximum impervious area per soakpit (m2)
125
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of soakpit within soakage layer

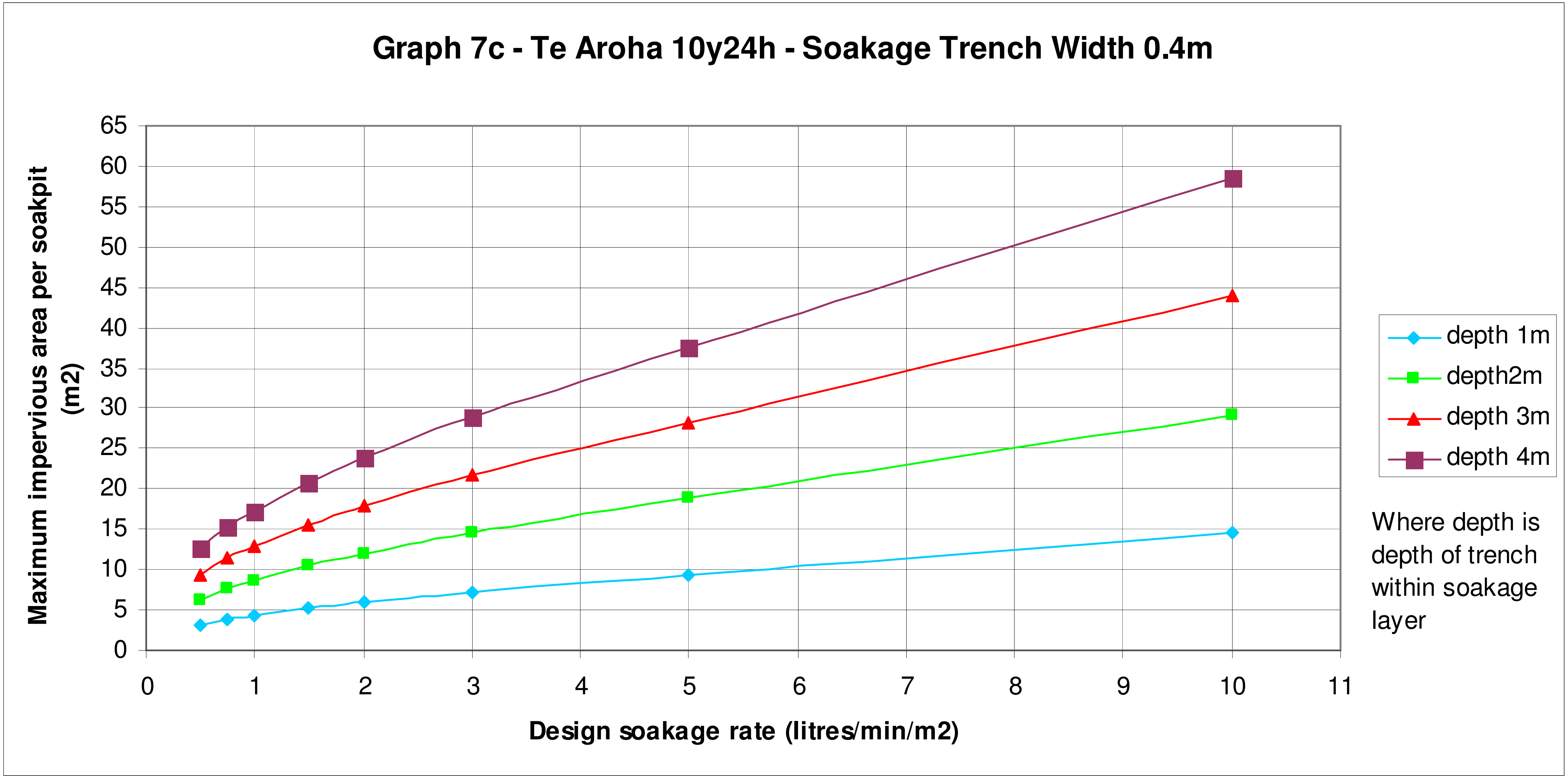
Appendix D

Graphs to determine required length of soakage trench

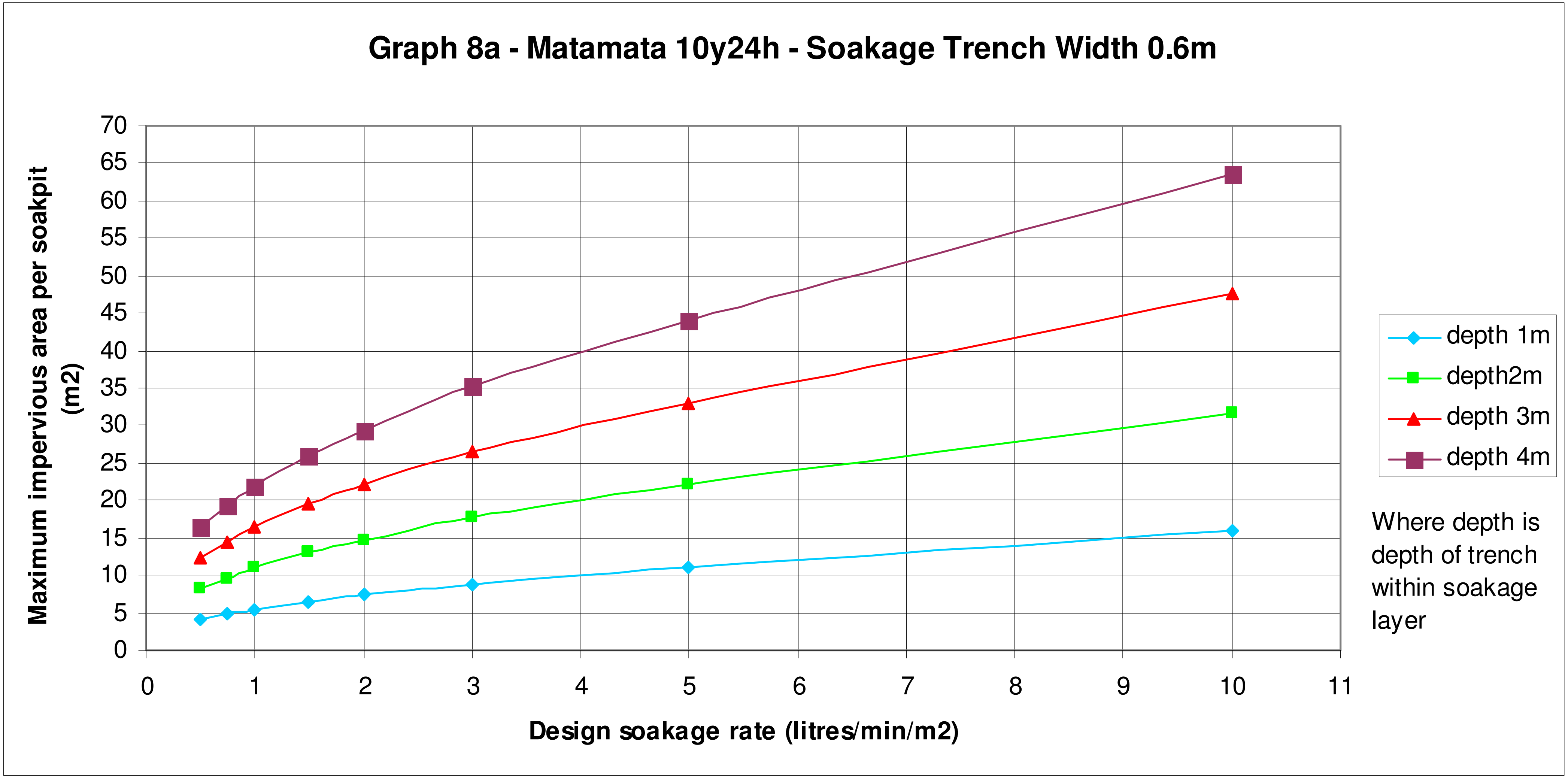
Graph	Township	Soakhole Trench Width	Storm Event
7a	Matamata	0.4	10 y
7b	Morrinsville	0.4	10y
7c	Te Aroha	0.4	10y
8a	Matamata	0.6	10 y
8b	Morrinsville	0.6	10 y
8c	Te Aroha	0.6	10 y
9a	Matamata	0.8	10 y
9b	Morrinsville	0.8	10 y
9c	Te Aroha	0.8	10 y
10a	Matamata	0.4	100 y
10b	Morrinsville	0.4	100 y
10c	Te Aroha	0.4	100 y
11a	Matamata	0.6	100 y
11b	Morrinsville	0.6	100 y
11c	Te Aroha	0.6	100 y
12a	Matamata	0.8	100 y
12b	Morrinsville	0.8	100 y
12c	Te Aroha	0.8	100 y

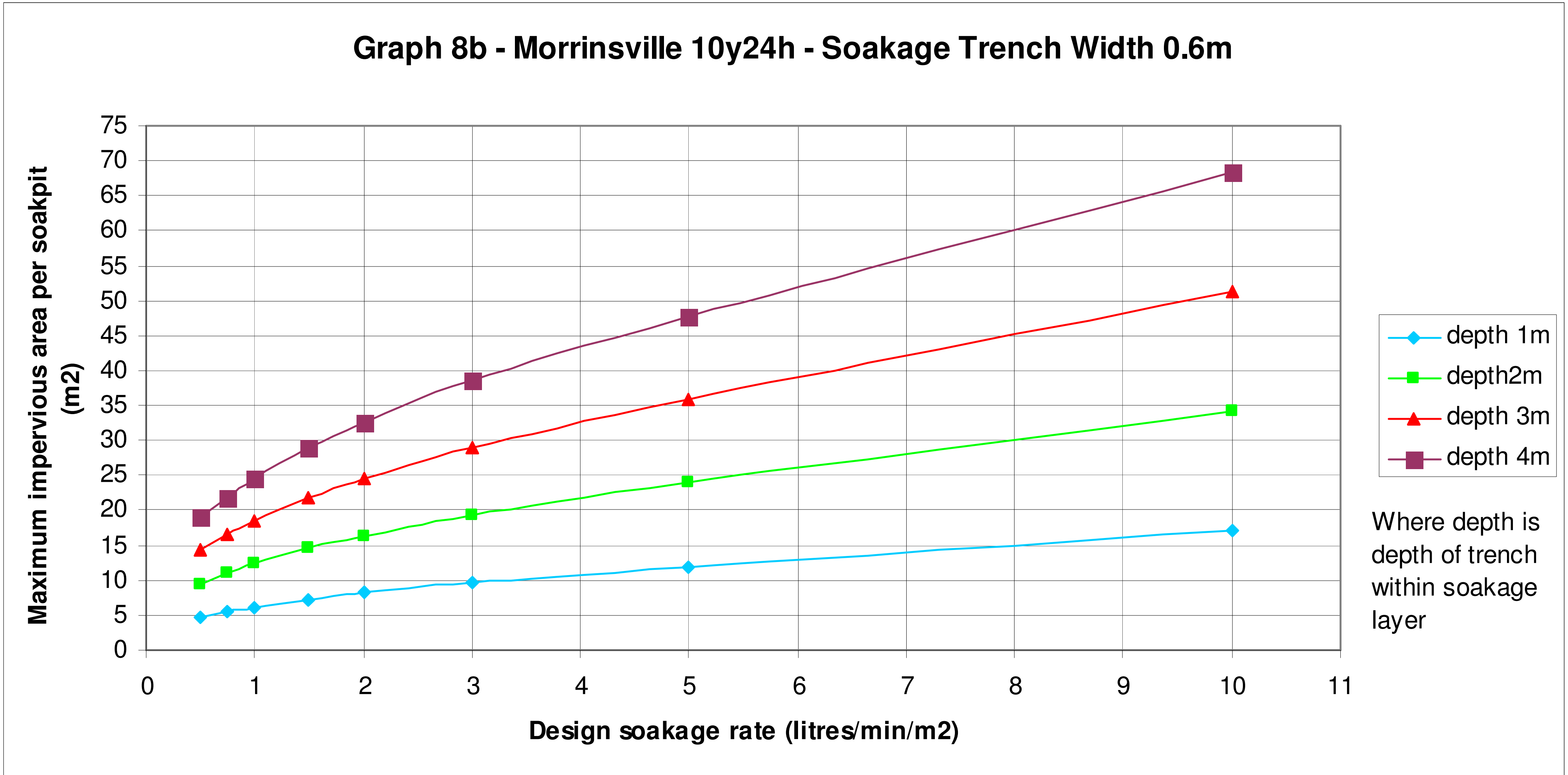

Graph 7a - Matamata 10y24h - Soakage Trench Width 0.4m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer
0
5
10
15
20
25
30
35
40
45
50
55
60
0
1
2
3
4
5
6
7
8
9
10
11


Graph 7b - Morrinsville 10y24h - Soakage Trench Width 0.4m
Maximum impervious area per soakpit (m2)
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer

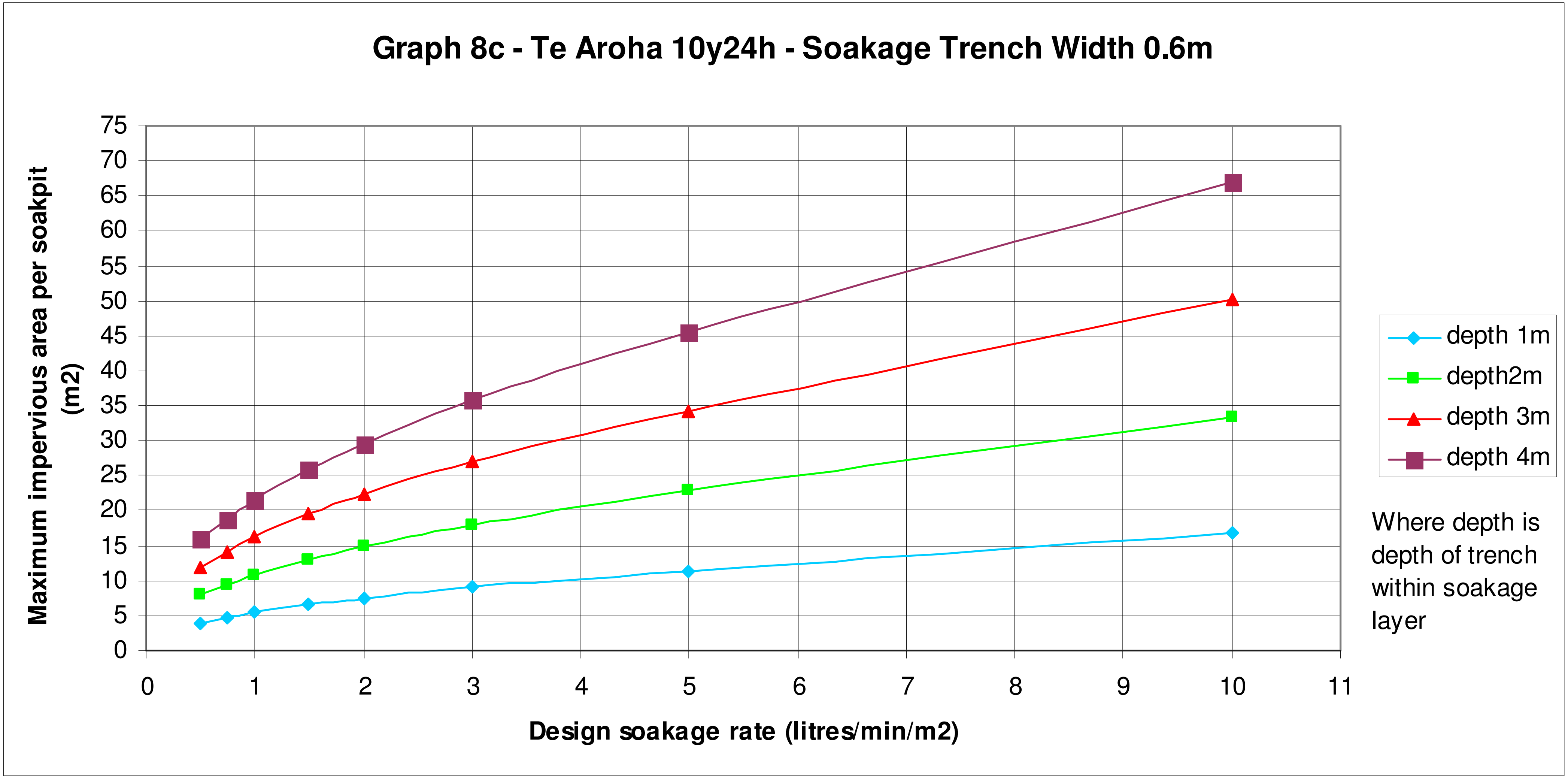


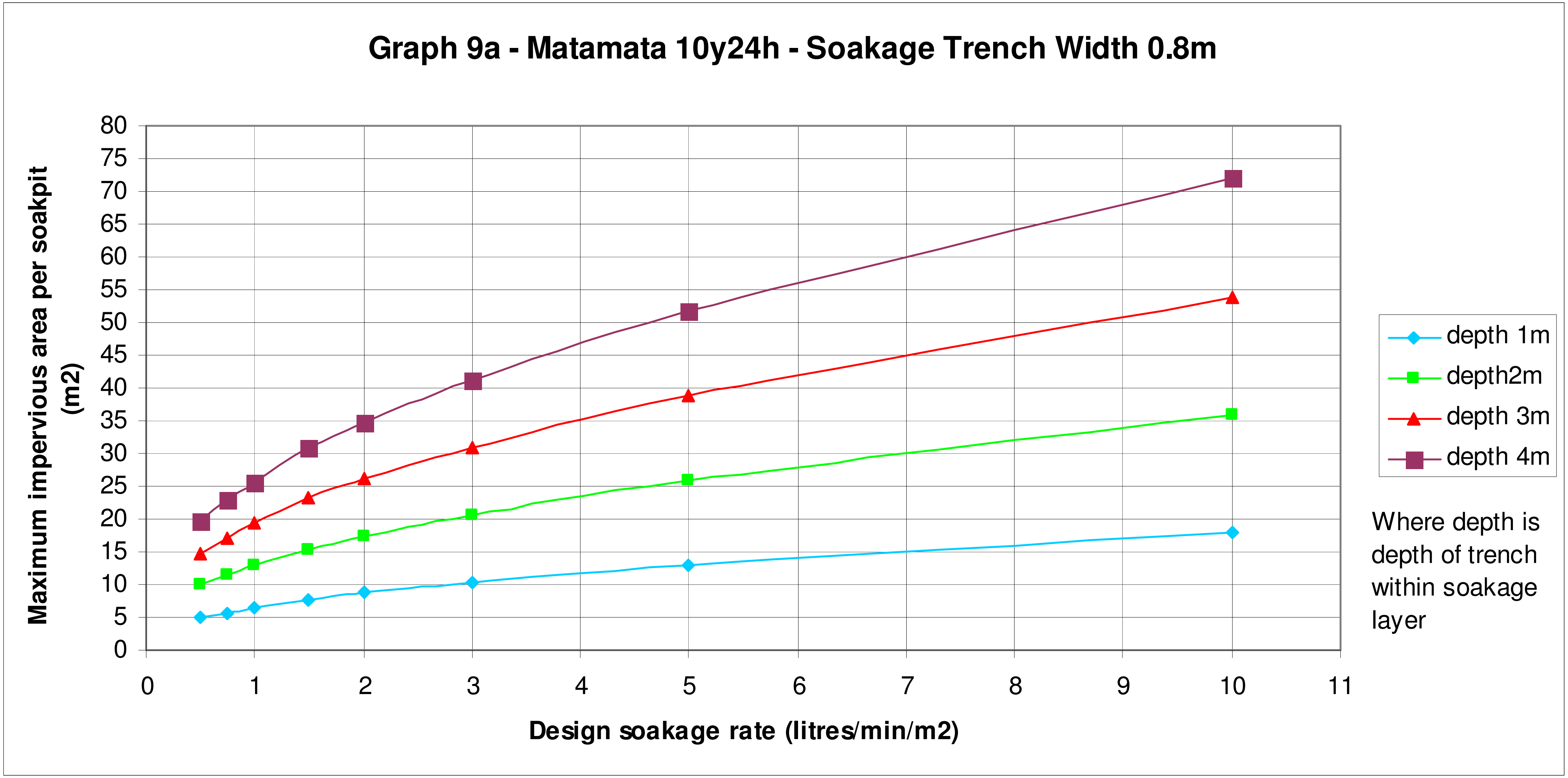
Graph 7c - Te Aroha 10y24h - Soakage Trench Width 0.4m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
0
1
2
3
4
5
6
7
8
9
10
11
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer


Graph 8a - Matamata 10y24h - Soakage Trench Width 0.6m
Maximum impervious area per soakpit (m2)
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer

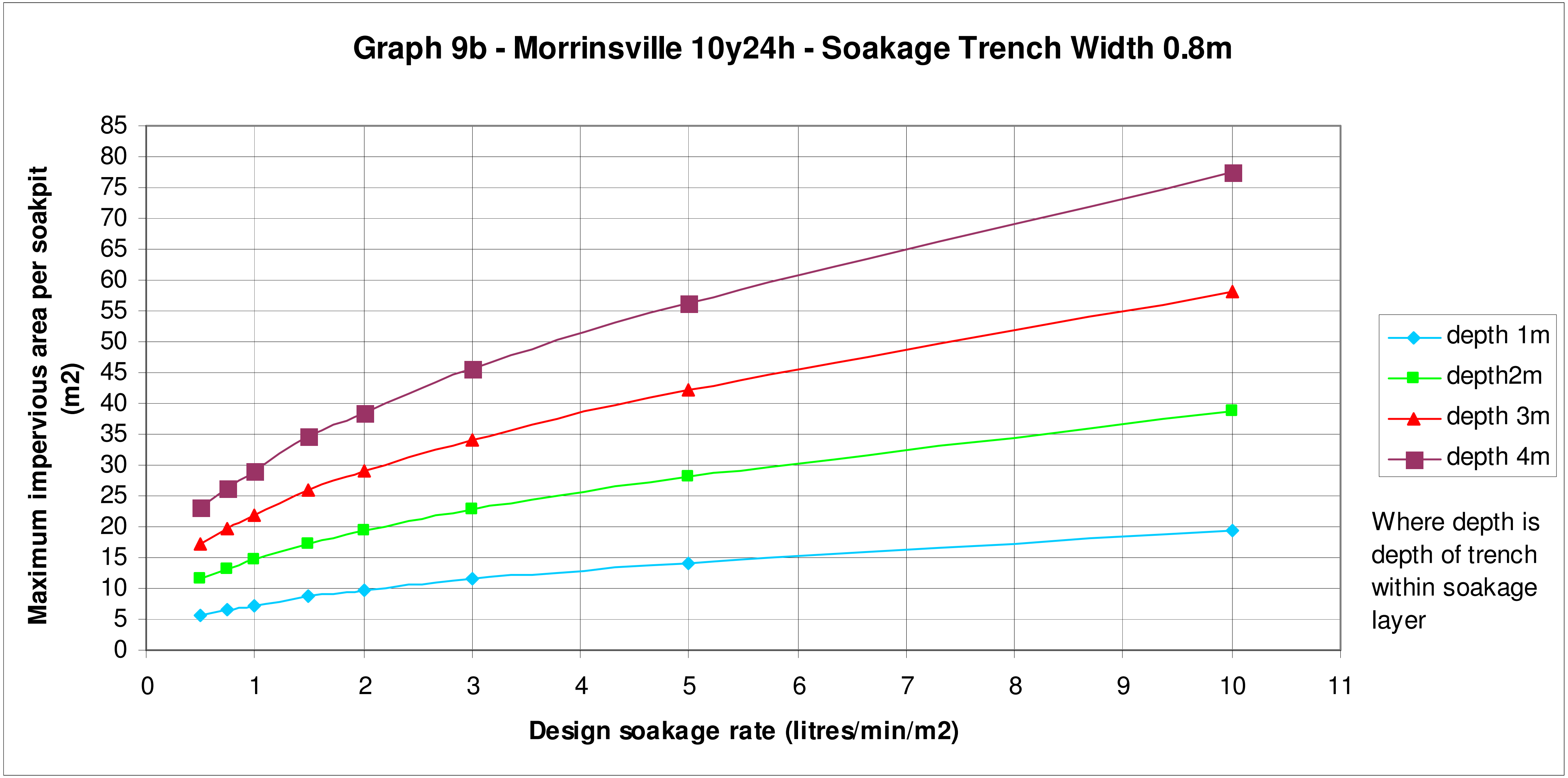


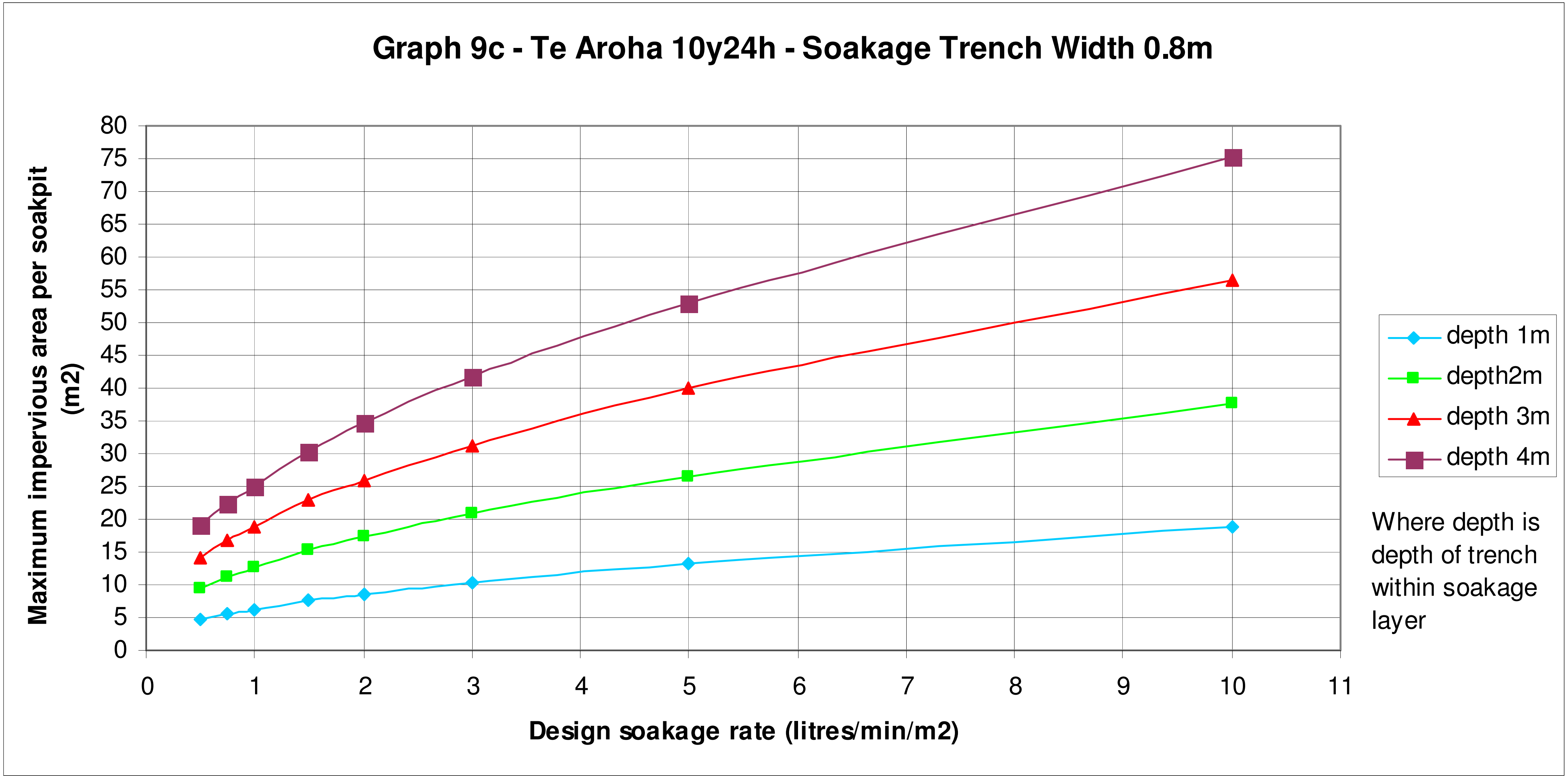
Graph 8b - Morrinsville 10y24h - Soakage Trench Width 0.6m
Maximum impervious area per soakpit (m2)
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer

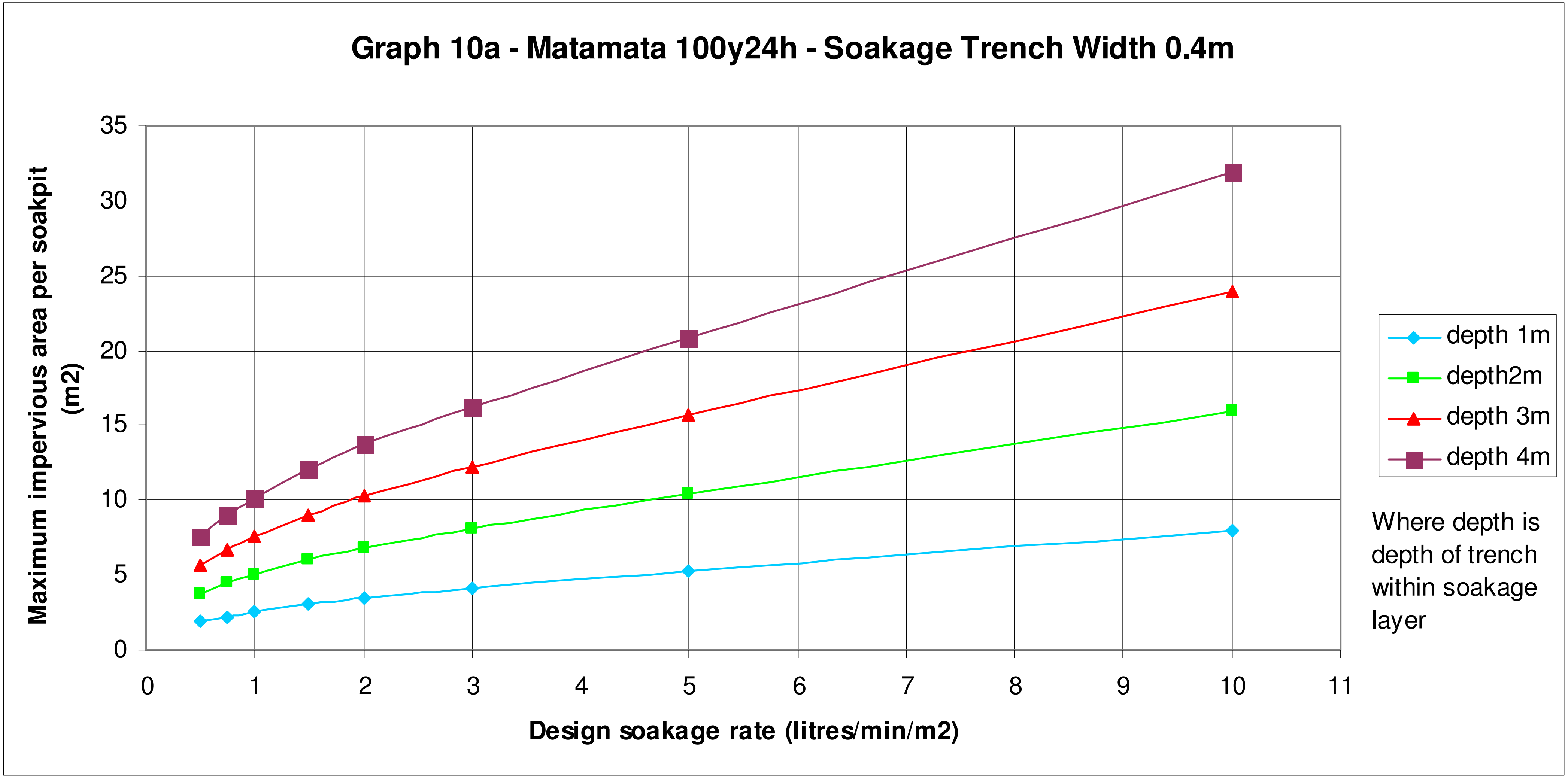

Graph 8c - Te Aroha 10y24h - Soakage Trench Width 0.6m
Maximum impervious area per soakpit (m2)
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer

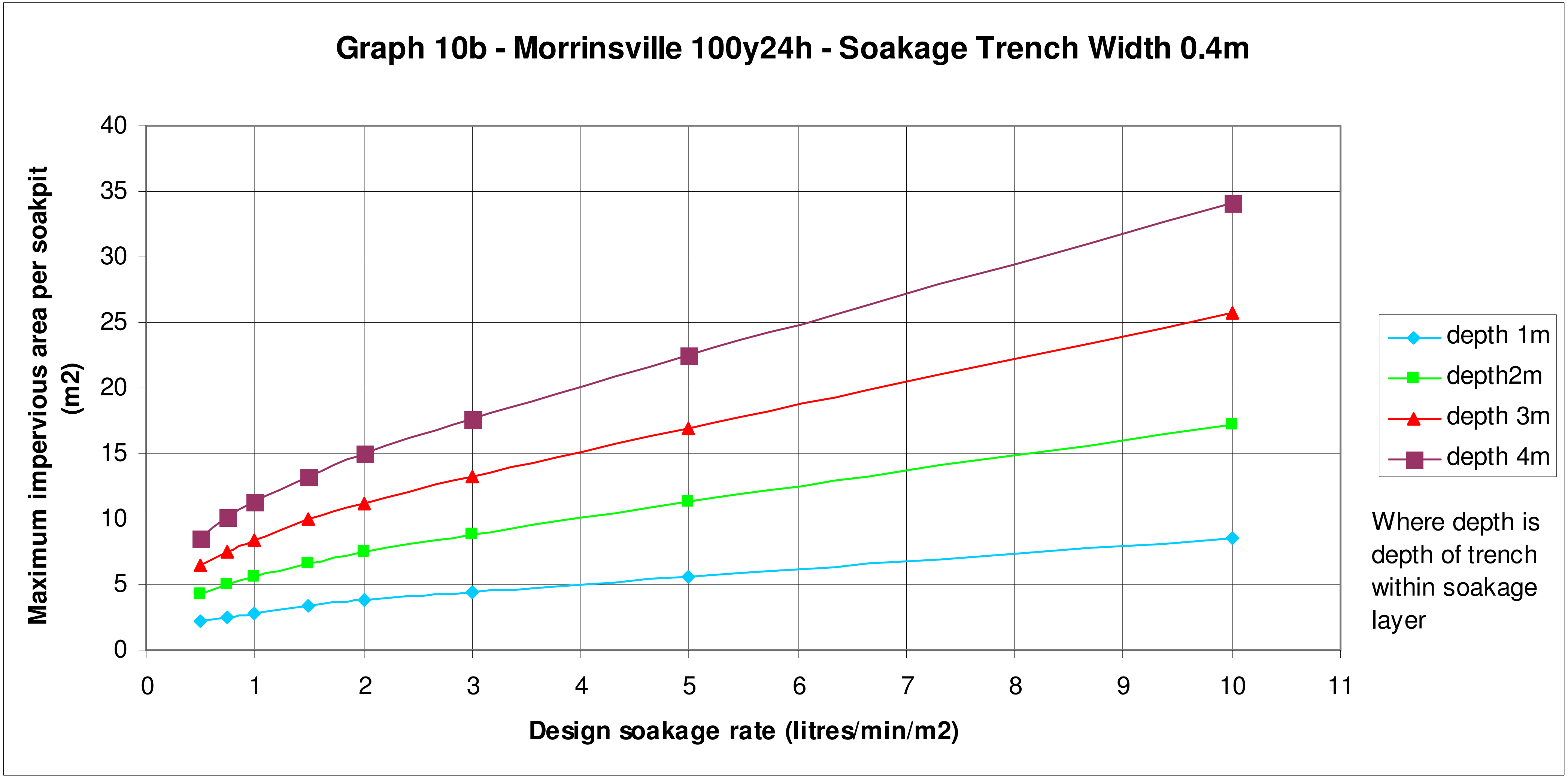


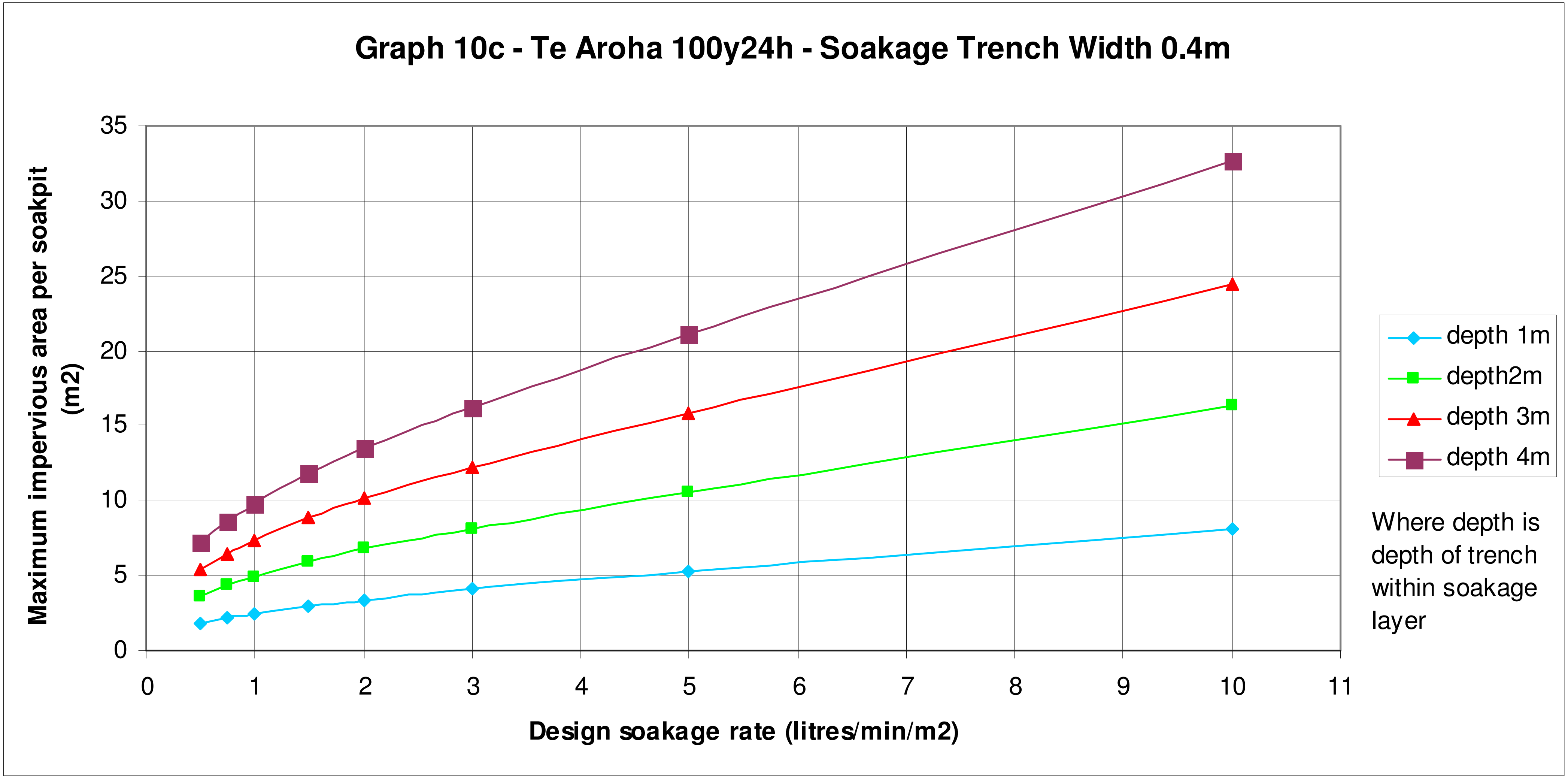
Graph 9a - Matamata 10y24h - Soakage Trench Width 0.8m
Maximum impervious area per soakpit (m2)
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer


Graph 9b - Morrinsville 10y24h - Soakage Trench Width 0.8m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
0
1
2
3
4
5
6
7
8
9
10
11
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer

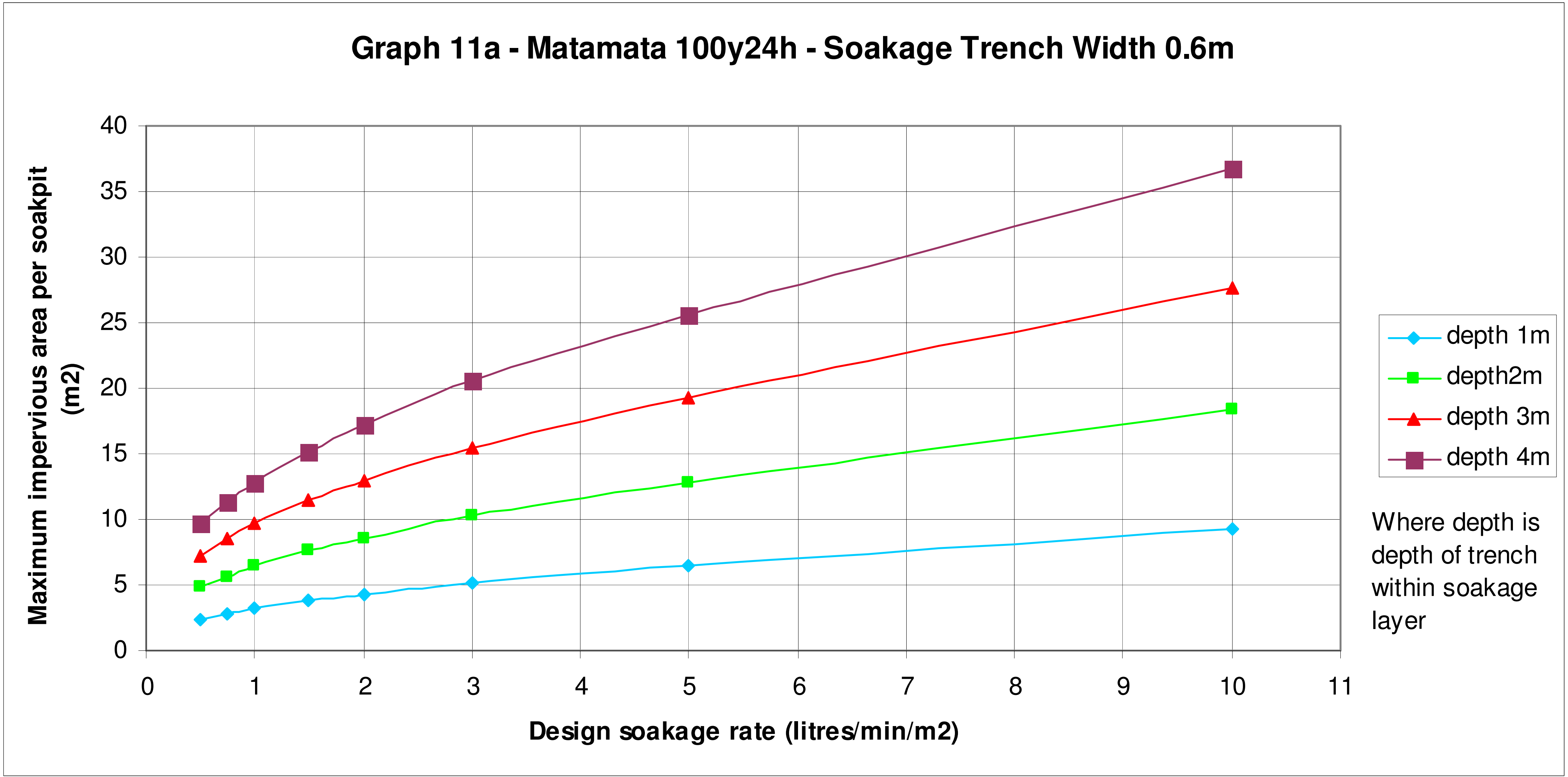

Graph 9c - Te Aroha 10y24h - Soakage Trench Width 0.8m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
0
1
2
3
4
5
6
7
8
9
10
11
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer

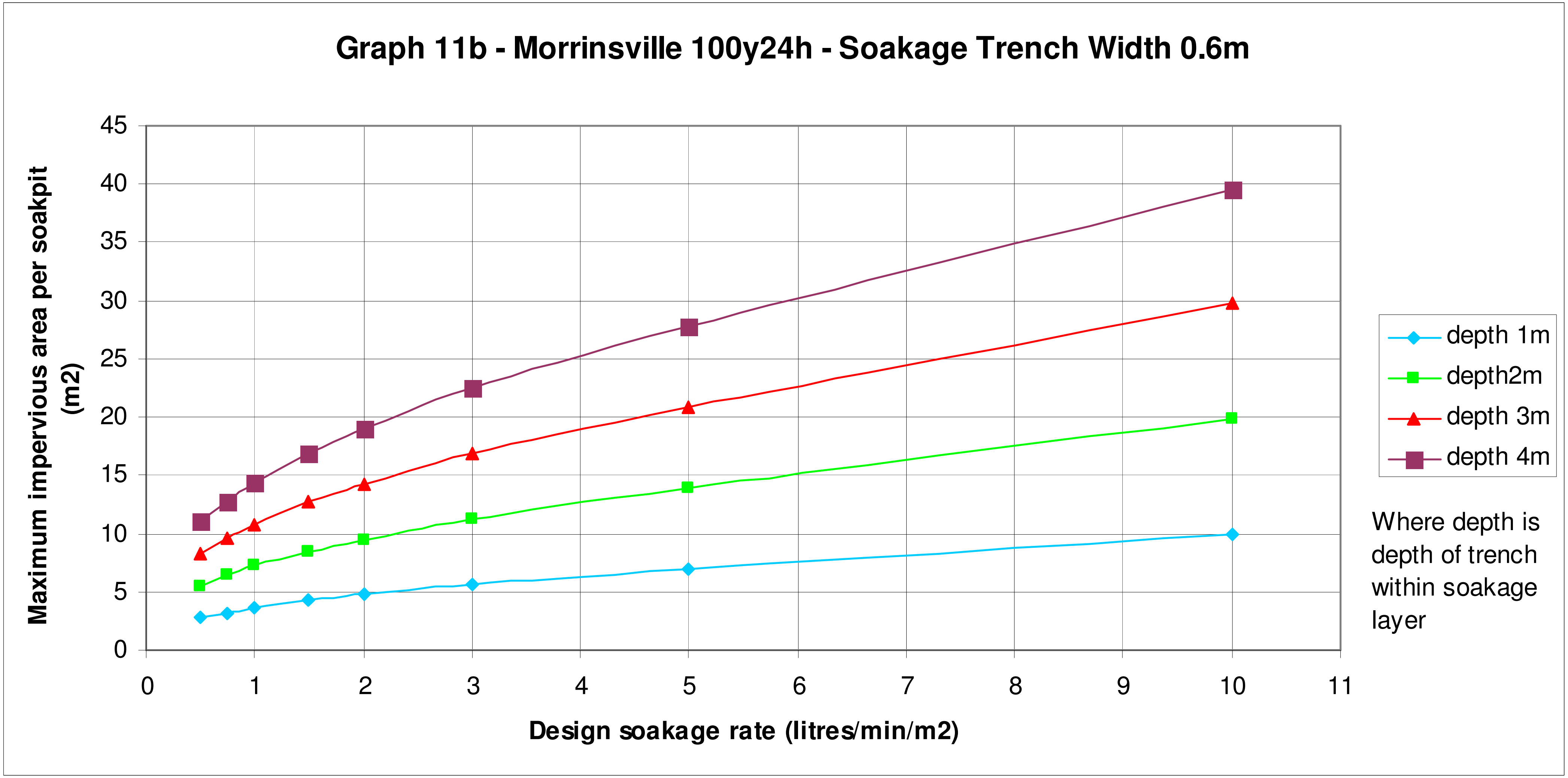

Graph 10a - Matamata 100y24h - Soakage Trench Width 0.4m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
0
5
10
15
20
25
30
35
0
1
2
3
4
5
6
7
8
9
10
11
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer


Graph 10b - Morrinsville 100y24h - Soakage Trench Width 0.4m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
0
5
10
15
20
25
30
35
40
0
1
2
3
4
5
6
7
8
9
10
11
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer

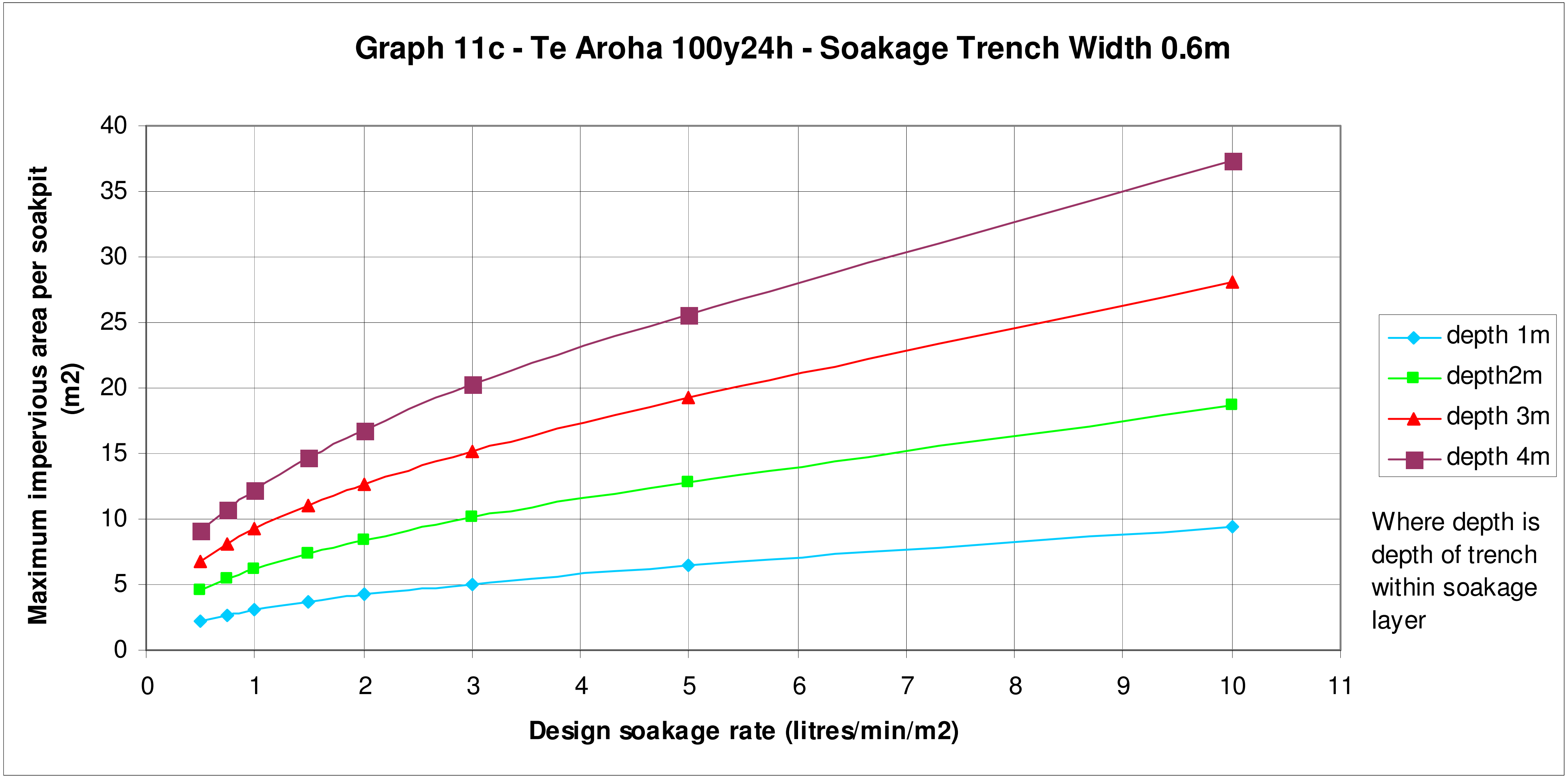


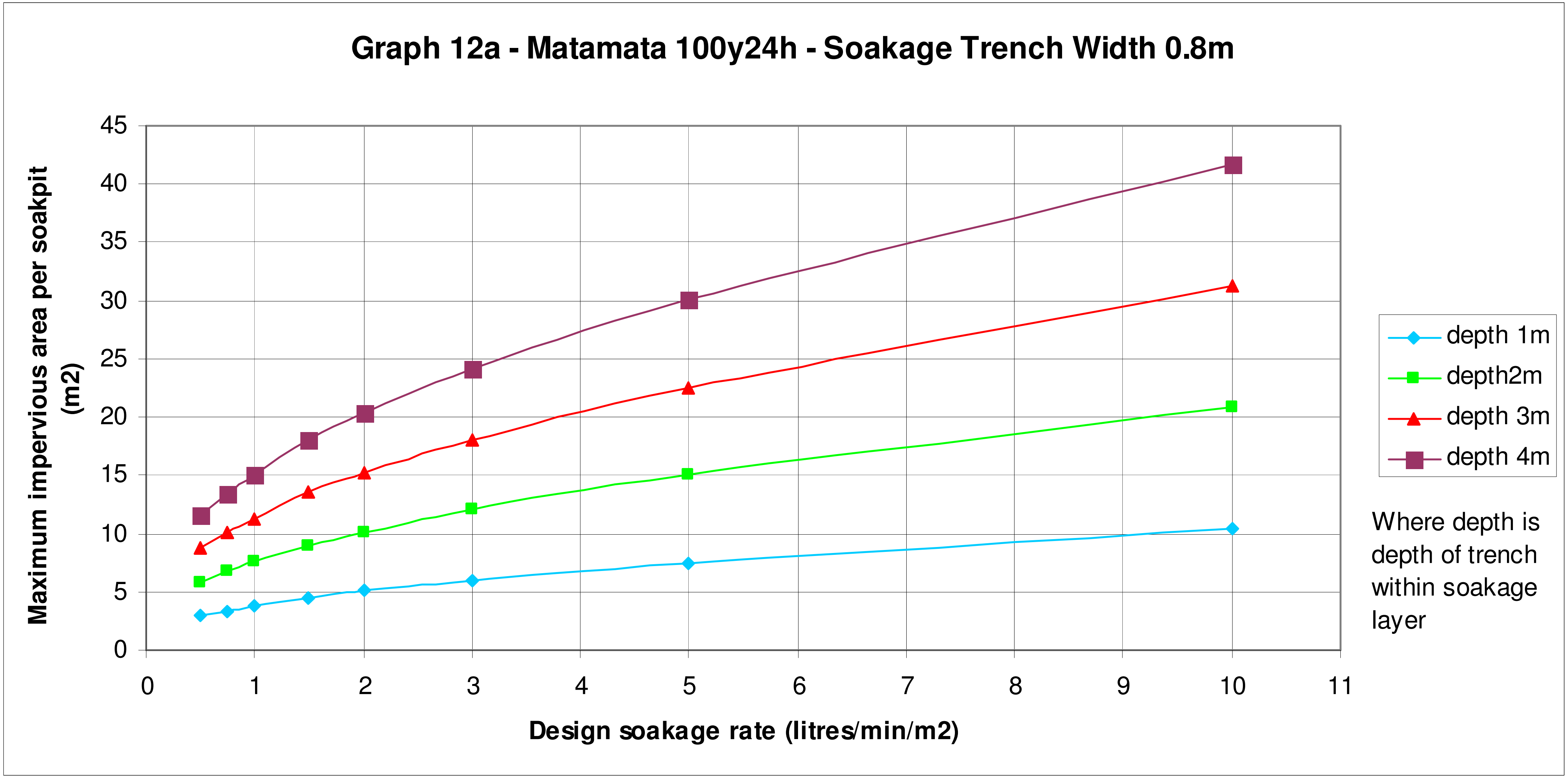
Graph 10c - Te Aroha 100y24h - Soakage Trench Width 0.4m
Maximum impervious area per soakpit (m2)
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer

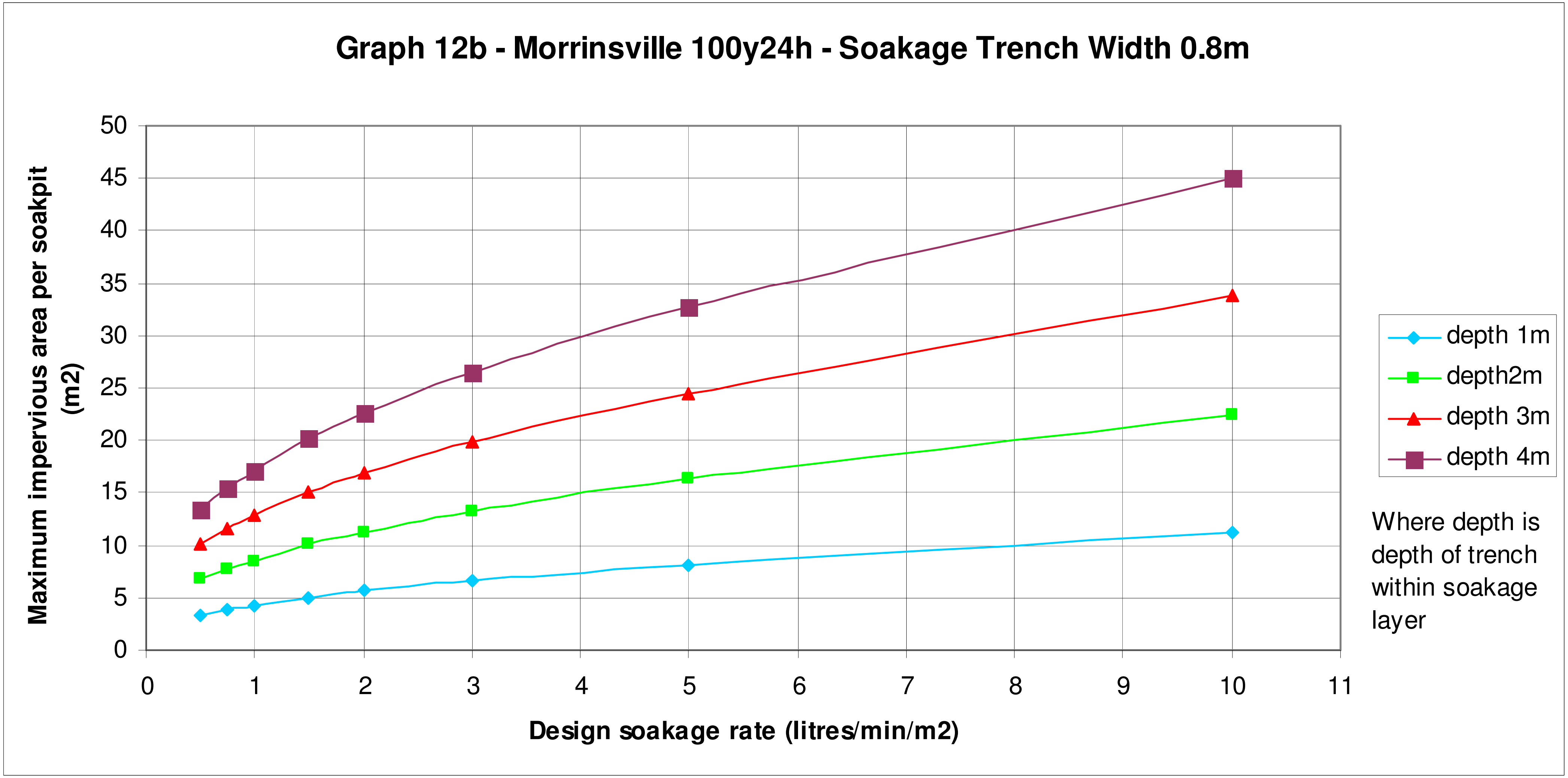

Graph 11a - Matamata 100y24h - Soakage Trench Width 0.6m
Maximum impervious area per soakpit (m2)
0
5
10
15
20
25
30
35
40
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer

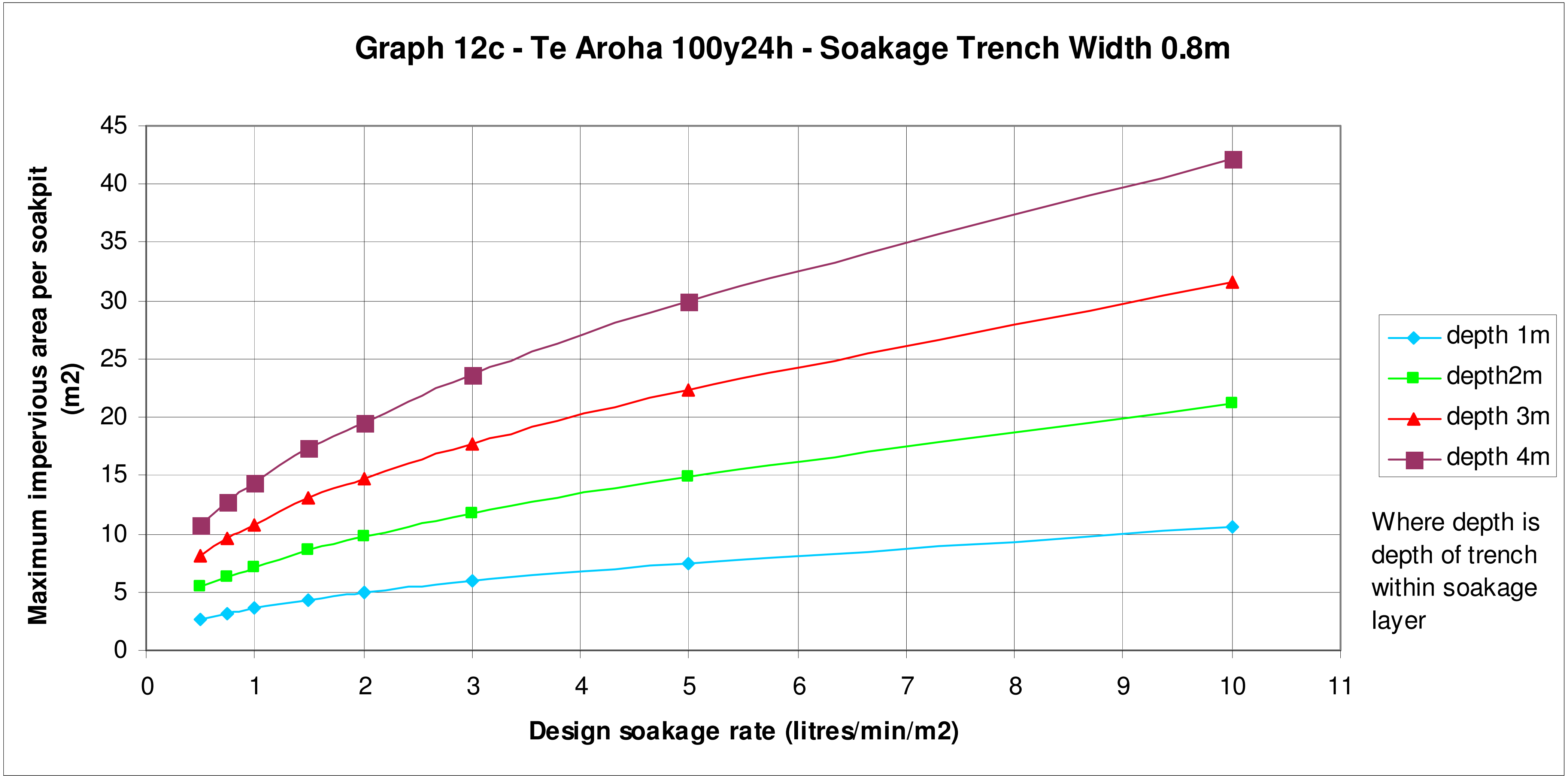


Graph 11b - Morrinsville 100y24h - Soakage Trench Width 0.6m
Maximum impervious area per soakpit (m2)
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer


Graph 11c - Te Aroha 100y24h - Soakage Trench Width 0.6m
Maximum impervious area per soakpit (m2)
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer


Graph 12a - Matamata 100y24h - Soakage Trench Width 0.8m
Maximum impervious area per soakpit (m2)
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer


Graph 12b - Morrinsville 100y24h - Soakage Trench Width 0.8m
Maximum impervious area per soakpit (m2)
Design soakage rate (litres/min/m2)
0
5
10
15
20
25
30
35
40
45
50
0
1
2
3
4
5
6
7
8
9
10
11
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer



Graph 12c - Te Aroha 100y24h - Soakage Trench Width 0.8m
Maximum impervious area per soakpit (m2)
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
Design soakage rate (litres/min/m2)
depth 1m
depth2m
depth 3m
depth 4m
Where depth is depth of trench within soakage layer

Appendix E

Design Assumptions and Rainfall Figures to use for specific design

Matamata

Rainfall Intensities to be used in stormwater soakage design (incl climate change)

Rainfall Rates (mm/hr) for Matamata - 24 hour nested storm based on HIRDS v2 (incl climate change)

Time (min)	1 in 2 y	1 in 10 y	1 in 20 y	1 in 50 y	1 in 100y
0	0.0	0.0	0.0	0.0	0.0
360	1.9	2.8	3.3	4.1	4.7
540	2.9	4.3	5.0	6.2	7.2
660	5.1	7.2	8.5	10.4	12.2
690	8.7	12.6	14.8	18.3	21.5
705	15.6	22.7	26.4	32.2	37.8
710	21.4	30.1	35.3	44.2	51.9
715	28.0	40.1	47.3	57.5	68.0
720	72.2	104.4	121.9	152.1	180.8
725	72.2	104.4	121.9	152.1	180.8
730	28.0	40.1	47.3	57.5	68.0
735	21.4	30.1	35.3	44.2	51.9
750	15.6	22.7	26.4	32.2	37.8
780	8.7	12.6	14.8	18.3	21.5
900	5.1	7.2	8.5	10.4	12.2
1080	2.9	4.3	5.0	6.2	7.2
1440	1.9	2.8	3.3	4.1	4.7

Cumulative rainfall Depths (mm) for Matamata - 24 hour nested storm based on HIRDS v2 (incl climate change)

Time (min)	1 in 2 y	1 in 10 y	1 in 20 y	1 in 50 y	1 in 100y
0	0	0	0	0	0
360	12	17	20	24	28
540	20	30	35	43	50
660	31	44	52	64	74
690	35	50	59	73	85
705	39	56	66	81	95
710	41	59	69	85	99
715	43	62	73	89	105
720	49	71	83	102	120
725	55	79	93	115	135
730	57	83	97	120	140
735	59	85	100	123	145
750	63	91	106	131	154
780	67	97	114	141	165
900	77	112	131	161	189
1080	86	125	146	180	211
1440	98	141	165	204	239

Design Assumptions to be sused

1. Used design soakage rate calculated on worksheet 1
2. Use full 24 hour nested storm (refer above) for all design calculations
3. Time of concentration to be 10 minutes except on Lots greater than 5000m2 - in which case it is to be calculated separately
4. Assume soakage is from sides of devices only. To be conservative it must be assumed that base becomes silted up and no longer soaks
5. Calculations must be done for the 1 in 100 year event except where there is a formal designated overland flowpath available
6. Based on NZMG coordinates 6372987N 2754164E

Morrinsville

Rainfall Intensities to be used in stormwater soakage design (incl climate change)

Rainfall Rates (mm/hr) for Matamata - 24 hour nested storm based on HIRDS v2 (incl climate change)

Time (min)	1 in 2 y	1 in 10 y	1 in 20 y	1 in 50 y	1 in 100y
0	0.0	0.0	0.0	0.0	0.0
360	1.3	1.9	2.3	2.9	3.4
540	2.0	3.0	3.6	4.5	5.3
660	3.7	5.3	6.3	7.9	9.3
690	6.8	10.0	11.6	14.5	17.2
705	14.5	20.6	24.0	29.4	34.3
710	20.0	28.0	32.5	39.9	47.0
715	26.0	36.7	43.2	53.3	62.4
720	67.3	97.4	113.5	141.6	168.9
725	67.3	97.4	113.5	141.6	168.9
730	26.0	36.7	43.2	53.3	62.4
735	20.0	28.0	32.5	39.9	47.0
750	14.5	20.6	24.0	29.4	34.3
780	6.8	10.0	11.6	14.5	17.2
900	3.7	5.3	6.3	7.9	9.3
1080	2.0	3.0	3.6	4.5	5.3
1440	1.3	1.9	2.3	2.9	3.4

Cumulative rainfall Depths (mm) for Matamata - 24 hour nested storm based on HIRDS v2 (incl climate change)

Time (min)	1 in 2 y	1 in 10 y	1 in 20 y	1 in 50 y	1 in 100y
0	0	0	0	0	0
360	8	11	14	17	20
540	14	21	24	31	36
660	21	31	37	46	55
690	24	36	43	54	64
705	28	41	49	61	72
710	30	44	52	64	76
715	32	47	55	69	81
720	38	55	65	81	95
725	43	63	74	92	109
730	45	66	78	97	115
735	47	68	80	100	118
750	51	74	86	108	127
780	54	79	92	115	136
900	61	89	105	131	154
1080	67	98	116	144	170
1440	75	110	129	161	191

Design Assumptions to be sused

1. Used design soakage rate calculated on worksheet 1
2. Use full 24 hour nested storm (refer above) for all design calculations
3. Time of concentration to be 10 minutes except on Lots greater than 5000m2 - in which case it is to be calculated separately
4. Assume soakage is from sides of devices only. To be conservative it must be assumed that base becomes silted up and no longer soaks
5. Calculations must be done for the 1 in 100 year event except where there is a formal designated overland flowpath available
6. Based on NZMG coordinates 6391220N 2732940E

Te Aroha

Rainfall Intensities to be used in stormwater soakage design (incl climate change)

Rainfall Rates (mm/hr) for Te Aroha - 24 hour nested storm based on HIRDS v2 (incl climate change)

Time (min)	1 in 2 y	1 in 10 y	1 in 20 y	1 in 50 y	1 in 100y
0	0.0	0.0	0.0	0.0	0.0
360	2.1	3.1	3.7	4.7	5.6
540	3.2	4.8	5.6	7.0	8.3
660	5.4	7.9	9.2	11.6	13.7
690	9.2	13.4	15.9	20.0	23.8
705	16.8	24.3	28.5	35.0	41.3
710	22.1	31.5	37.4	47.0	55.4
715	28.7	41.5	48.1	60.3	72.2
720	66.6	97.4	114.9	145.1	175.2
725	66.6	97.4	114.9	145.1	175.2
730	28.7	41.5	48.1	60.3	72.2
735	22.1	31.5	37.4	47.0	55.4
750	16.8	24.3	28.5	35.0	41.3
780	9.2	13.4	15.9	20.0	23.8
900	5.4	7.9	9.2	11.6	13.7
1080	3.2	4.8	5.6	7.0	8.3
1440	2.1	3.1	3.7	4.7	5.6

Cumulative rainfall Depths (mm) for Te Aroha - 24 hour nested storm based on HIRDS v2 (incl climate change)

Time (min)	1 in 2 y	1 in 10 y	1 in 20 y	1 in 50 y	1 in 100y
0	0	0	0	0	0
360	13	19	22	28	33
540	23	33	39	49	58
660	33	49	58	72	86
690	38	56	66	82	98
705	42	62	73	91	108
710	44	64	76	95	113
715	46	68	80	100	119
720	52	76	90	112	133
725	58	84	99	124	148
730	60	87	103	129	154
735	62	90	106	133	158
750	66	96	113	142	169
780	71	103	121	152	181
900	81	119	140	175	208
1080	91	133	157	196	233
1440	104	152	179	224	266

Design Assumptions to be used

1 Used design soakage rate calculated on worksheet 1
2 Use full 24 hour nested storm (refer above) for all design calculations
3 Time of concentration to be 10 minutes except on Lots greater than 5000m2 - in which case it is to be calculated separately
4 Assume soakage is from sides of devices only. To be conservative it must be assumed that base becomes silted up and no longer soaks
5 Calculations must be done for the 1 in 100 year event except where there is a formal designated overland flowpath available
6 Based on NZMG coordinates 6402968N 2749897E

Appendix F

Downpipe and gutter size requirements

Matamata Piako District Council
Soakage Manual Annotation (Red)

4.0 Downpipes

4.1 Materials

4.1.1 Materials for downpipes shall comply with Table 4.

Table 4: Acceptable Material Standards for Downpipes
Paragraph 4.1.1

Amend 1 Sep 1993 Amend 2 Aug 1994

uPVC	NZS 7642 or AS 1273
Galvanised steel	NZS 3441
Zinc	BS 6561
Copper	BS 2870
Aluminium	BS 1470
Stainless steel	NZS/BS 970

4.1.2 Downpipes, gutters, roofing, fastenings and all adjoining components shall be of the same or a compatible material to eliminate the risk of galvanic corrosion.

4.2 Sizing of downpipes

4.2.1 Downpipes sized using Table 5 are acceptable. Other downpipes are acceptable provided their cross-sectional area is no less than that required by Table 5, and they permit passage of a 50 mm diameter sphere.

4.2.2 Matamata Piako District Council Soakage Manual Annotation (Red)
Where roof drainage to soakage is to meet a 1 in 100 year Standard, plan roof areas in Table 5 are to be halved.

4.3 Installation of downpipes

4.3.1 Where thermal movement of downpipes cannot be accommodated by movement of the guttering, expansion joints shall be incorporated.

4.3.2 All internal downpipes shall withstand without leakage, a water test with an applied head of 1.5 m of water, or a high pressure air test as described in E1/VM1 Paragraph 8.3. Amend 5 Jul 2001

5.0 Roof Gutters

5.1 Size of roof gutters

5.1.1 Roof gutters shall discharge to downpipes that are sized as given in Paragraph 4.2.

5.1.2 Any gutter under consideration shall be divided into sections and each section shall be sized. A section shall comprise the length of gutter between a downpipe and the adjacent high point on one side only of that downpipe. Each section of gutter shall have a cross-sectional area of no less than that determined from Figure 15 or Figure 16 (depending on whether the gutter is external or internal), and increased where required in accordance with Paragraph 5.1.3. Amend 2 Aug 1994

5.1.3 Figures 15 and 16 are based on a rainfall intensity "I" of 100 mm/hr. Where "I" exceeds 100 mm/hr the required gutter size shall be increased by taking the value read from the figures and multiplying it by the ratio of "I"/100. Paragraph 3.2.2 describes how to determine the value of "I". Amend 2 Aug 1994 Amend 1 Sep 1993

For 1 in 100 year event "I" is 180mm/hr

Table 5: Downpipe Sizes for Given Roof Pitch and Area
Paragraph 4.2.1

Downpipe size (mm) (minimum internal sizes)	Roof pitch 0-25°	25-35°	35-45°	45-55°
	Plan area of roof served by the downpipe (m²)			
63 mm diameter	60	50	40	35
74 mm diameter	85	70	60	50
100 mm diameter	155	130	110	90
150 mm diameter	350	290	250	200
65 x 50 rectangular	60	50	40	35
100 x 50 rectangular	100	80	70	60
75 x 75 rectangular	110	90	80	65
100 x 75 rectangular	150	120	105	90

Amend 1 Sep 1993 Amend 2 Aug 1994

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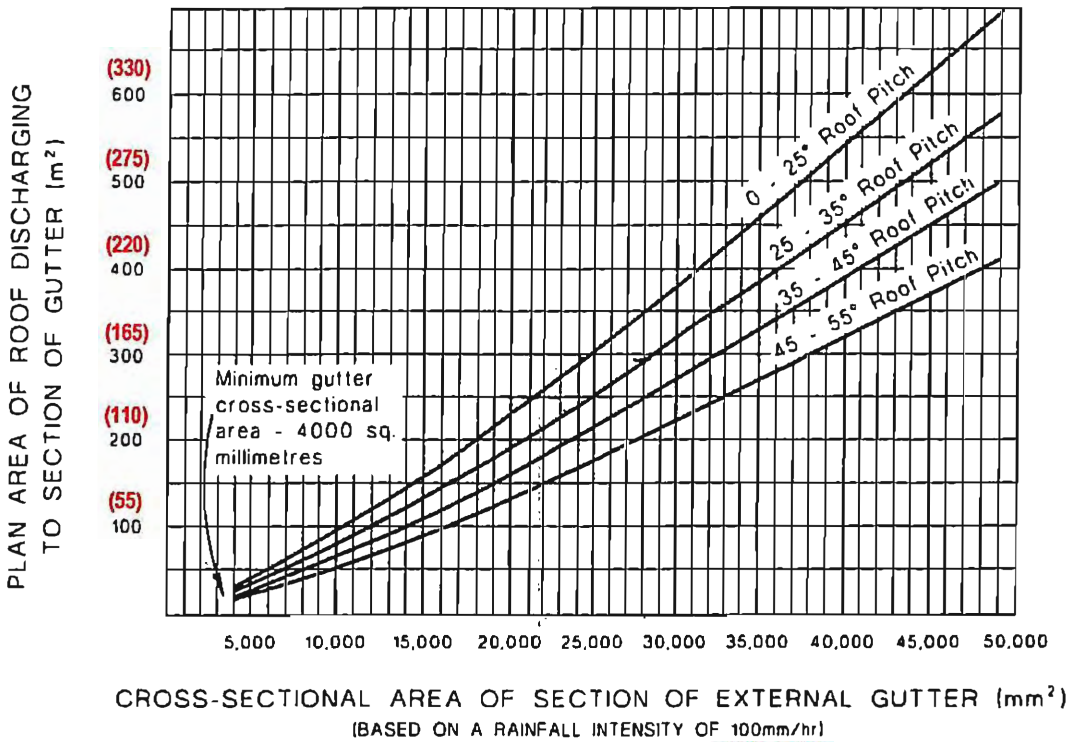
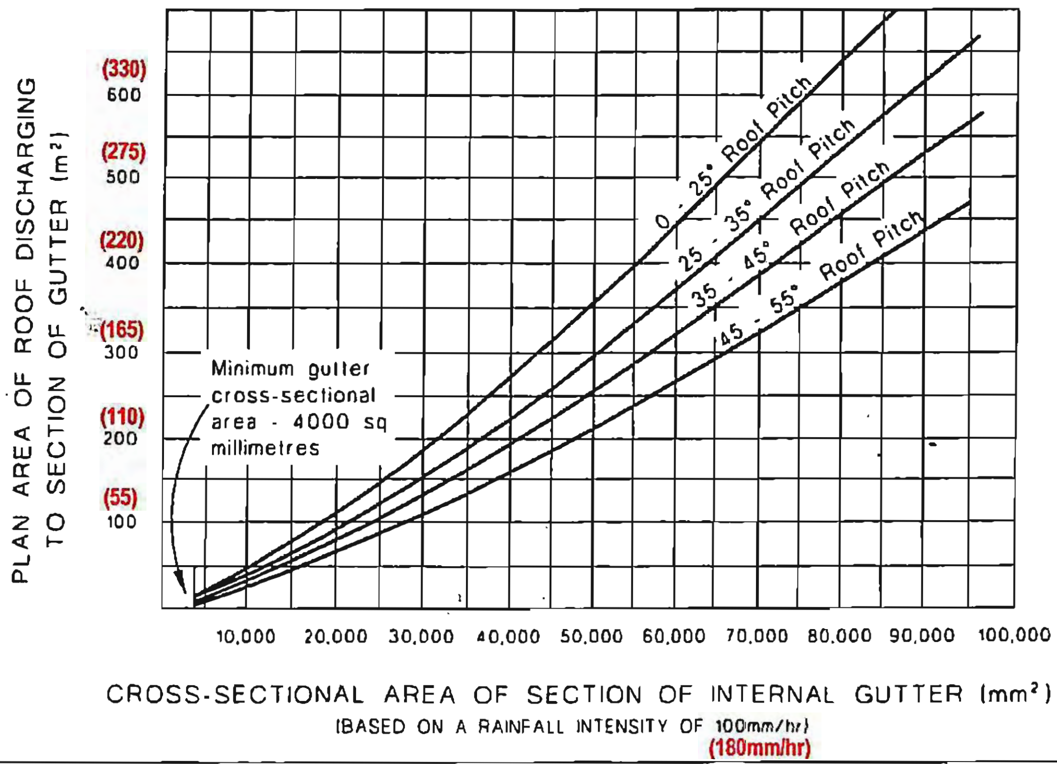
Figure 15: Cross-sectional Area of External Gutter
Paragraphs 5.1.2 and 5.1.3



Amend 1
Sep 1993

Figure 16: Cross-sectional Area of Internal Gutter
Paragraphs 5.1.2 and 5.1.3



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