

A guide to using the Dairy Effluent Storage Calculator (DESC)

Step by step instructions on how to calculate storage requirements





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Ministry for Primary Industries
Manatū Ahu Matua



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How to use the Dairy Effluent Storage Calculator (DESC)

Introduction

The Dairy Effluent Storage Calculator is a software tool developed by Horizons Regional Council and Massey University to determine the effluent storage requirements of a farm.

It works by looking at a farm's inputs of soil risk in the effluent block, catchment areas, feedpads or barns and their use; wash water in the dairy, effluent irrigation depths, and the daily volume of effluent able to be irrigated.

The DESC then looks at 30 plus years of rainfall and evapotranspiration data from a local climate site, and from there it can calculate a daily soil water balance to determine how often effluent irrigation could occur, or if conditions are unsuitable how much effluent should be directed to storage.

This produces a graph showing the maximum storage volume required for each season over the past 30 plus years.

The storage calculator is great for checking existing pond volumes if there is a pond already on farm. It can also help determine pond volumes for new systems, and for running scenarios to compare the different inputs to find out where the farmer gets the best value for money.

Farmers may be asking themselves questions like:

- What happens if I put in a green water yard wash?
- What if I put in low depth irrigation?
- What will a storm water diversion do to my storage requirements?
- What if I shift the effluent block to include an area of low risk soil?
- By investigating each of the input variables, and the impact these have on storage requirements, we can make informed decisions on effluent system designs or changes for individual farms.

About this booklet

This booklet has been written by DairyNZ as a supporting resource to assist those using the DESC software to understand how to correctly use the tool and how to correctly interpret the outputs.

The document provides an explanation of the software and the assumptions behind it and gives step by step guidance on how to use the DESC to calculate storage requirements.

It is important to realise that:

1. The DESC is only as good as the data and information that you enter.
2. The recommendations are appropriate at a particular point in time. If a farm has any system changes then the DESC needs to be recalculated.
3. The DESC assumes that the farm will be irrigated on every occasion when soil conditions are suitable.

Why is having adequate dairy effluent storage important?

Having adequate farm dairy effluent (FDE) storage capacity for your dairy farm is the basis of sustainable and successful FDE irrigation.

Sufficient effluent storage enables you to irrigate FDE at a time that suits you and your soils, and as a result maximise the nutrient and water value of FDE.

If your farm does not have the ability to store adequate quantities of FDE, then no farm management strategies, technological innovation or good intention, will allow successful FDE irrigation at all times of the year.

The purpose of FDE systems is to capture and apply FDE to land. This is done to maximise the beneficial use of nutrients for plant growth, and to minimise contamination of ground water and surface water bodies. The consequences of inadequate FDE storage capacity are plain and simple – environmental damage to our waterways and financial/production losses to the farming system.

Environmental damage and non-compliance with regional council FDE regulations continues to be a issue in many regions of New Zealand. Common causes of non-compliance with regional council guidelines include:

- FDE storage overflow
- FDE ponding, surface runoff and/or drainage caused by excessive FDE application rates or application depths for the conditions.

Attempts to identify FDE storage requirements using industry averages is not a robust or recommended strategy, not least because each farm will require a *unique* storage volume to successfully practise deferred FDE irrigation.

How does deferred irrigation benefit your farm?

The purpose of FDE systems is to maximise the beneficial use of nutrients for plant growth. The main reason why this is not always achieved is forced application of FDE when there is insufficient soil water deficit. This occurs because the farm has inadequate FDE storage capacity.

For FDE application to be sustainable, effluent must be retained in the soil to allow plant uptake of nutrients. The longer the effluent stays in the soil's active root zone, the greater the opportunity for the soil to physically filter the effluent while decreasing potential contaminants and making the nutrients available to plants.

Deferred irrigation involves storing effluent in a pond/ tank then irrigating it strategically when there is a suitable soil water deficit. This avoids the risk of generating surface runoff or direct drainage of effluent and maximises the use of nutrients for plant growth.

The objective of the FDE calculator is to highlight to farmers opportunities to:

- improve returns on FDE application
- improve nutrient use efficiency
- reduce risk of nutrient loss.

By improving the uptake and understanding of FDE systems, farmers can be more strategic in the management of nutrients within their operations and ultimately become more profitable and sustainable.

What is the Dairy Effluent Storage Calculator (DESC)?

The Dairy Effluent Storage Calculator (DESC) is a software tool to help determine the dairy effluent storage requirements for an individual dairy farm in New Zealand. The report provided by the calculator is intended to inform decision making; it is not an absolute or final figure.

The DESC uses long-term daily climate data and individual farm details to provide recommendations customised for each farm. The climate data involves approximately 30 years of daily Regional rainfall data supplied by NIWA and Plant & Food Research. The analysis provided by the DESC informs decision making around FDE storage requirements.

The DESC will provide the volume of storage required. In simple terms this is the difference between the rate that FDE is generated by your farming system and the rate that it can be irrigated to land in a sustainable manner i.e., only when there is adequate soil moisture deficit.

Important: Considerations when using the DESC

- It is assumed that you have completed an Overseer Nutrient Budget before using the DESC.
- It assumes application is evenly spread across high risk and low risk soils.
- The DESC is based on soil hydraulic principles. It is NOT a nutrient calculator.
- Soil risk level is based on runoff and preferential flow, not nutrient load.
- Low risk soils still have the potential to have nutrient loss if effluent is over applied.

What information do you need before using the calculator?

Before using the DESC there are a number of individual farm details that need to be known. These will all impact on the quantity of FDE produced by the farm system. These input details include:

- Climate
- The soil risk factor: Soils under FDE irrigation are classified as either 'high' or 'low' risk. Low risk soils are free draining with slope less than 7 degrees. High risk soils include artificial or impeded drainage, and/or with slope equal or greater than 7 degrees.
- Rainfall catchment areas: These include the shed roof, yards, tanker aprons, sumps, stonetrap, feed pads, silage bunkers, and any other hard, impervious area that drains storm water to the FDE pond.
- Wash water and farm dairy water use volumes: Principally water used to clean the milking plant and to wash the yard.
- Storage pond: Current size and/or estimate of likely size.
- Irrigation: The volume of FDE applied each day and the irrigation depth. These are related to the irrigator type and irrigator management.
- Descriptive, individual farm details.

The following pages provide a datasheet of what information must be collected from a farm prior to using the DESC.

Dairy Effluent Storage Calculator information sheet

Date: / /							
Client name:							
Farm name:							
Farm address:	Supply No:						
Postal address:							
Email:							
Regional council:							
Authorised agent name:							
Climate							
Area mean annual rainfall:	mm/yr						
Soils							
Total area of effluent block as required by regional council or nutrient budget	ha						
Soil type(s): e.g. clay, peat, pumice, sandy loam	(smap.landcareresearch.co.nz)						
Area of low risk soil (ha):	Area of high risk soil (ha):						
Catchments							
Yard area	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%; text-align: right;">m²</td> <td style="width: 30%;">Storm water diversion? Y/N</td> <td style="width: 50%;">Divert all year Y/N Only when cows dry Y/N Start diversion / / End diversion / /</td> </tr> </table>	m ²	Storm water diversion? Y/N	Divert all year Y/N Only when cows dry Y/N Start diversion / / End diversion / /			
m ²	Storm water diversion? Y/N	Divert all year Y/N Only when cows dry Y/N Start diversion / / End diversion / /					
Other areas e.g. vat stand, tanker apron, silage pits, underpass etc.	m ²						
Milking shed and other roofed area	m ² Diverted? Y/N						
Feed pad area	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%; text-align: right;">m²</td> <td style="width: 30%;">Covered Y/N</td> <td style="width: 50%;">Storm water diversion Y/N</td> </tr> <tr> <td></td> <td>Start diversion / /</td> <td>Stop diversion / /</td> </tr> </table>	m ²	Covered Y/N	Storm water diversion Y/N		Start diversion / /	Stop diversion / /
m ²	Covered Y/N	Storm water diversion Y/N					
	Start diversion / /	Stop diversion / /					
Wash water							
No. of cows milked in the spring (peak)	Milking time (hrs. per day)						
Lactation season start date / /	Lactation season end date / /						
Plant and vat wash-litres hot and cold / day	Litres/day						
Alkali wash (plant and vat) litres per wash x washes per week, divided by 7	Litres/day						
Yard wash – e.g.; flood wash	Litres/day						
Or wash-down hose rate (l/m) x min per milking x milking's per day	Litres/day						
Platform sprinklers	Litres/day						
Shed type Rotary <input type="checkbox"/> Herringbone <input type="checkbox"/>	Cluster number						
Total dairy shed wash volume	Litres / day						

Feed pad or animal shelter use and washwater						
Month	Average daily cow numbers		Average daily hours on pad		Average daily wash volume (cubic metres)	
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						
Storage ponds/tanks						
Storage present?	Y/N	Emergency Storage Period				days
Pond 1		Length	m Width	m Depth	m Batter	:1 Pumped Y/N
Pond 2		Length	m Width	m Depth	m Batter	:1 Pumped Y/N
Tank/saucer		Diameter		m Depth	m Batter	:1 Pumped Y/N
Solids separation						
Weeping wall(s)		Length	m Width	m Depth	m Batter	:1
Solids bunker		Length	m Width	m Depth	m Batter	:1
Irrigation						
Winter-spring application depth:				mm	(dependent on irrigator application rate)	
Spring – autumn application depth				mm		
Winter – spring volume				m ³ / hour	Total daily volume	m ³
				Hours pumped/day		
Spring – autumn volume				m ³ / hour	Total daily volume	m ³
				Hours pumped/day		
Irrigate all year when soil and weather allow?						Y/N
Nominate the time period that you will not irrigate		/	/	to	/	/
		DD/MM/YYYY			DD/MM/YYYY	
Irrigator type(s):				Pump(s):	HP/KW	

Getting started

Downloading the DESC

Go to www.massey.ac.nz/~flrc/FDE.html then click on the free copy of the Dairy Effluent Storage Calculator. Read the download and installation instructions *before* downloading the calculator.

Version control: Each version has an expiry date, this can be seen on the very bottom of the main screen. Once this date passes the software will no longer function and you are required to download the latest version of the DESC. Before you can install the new version you will need to uninstall the old one.

Opening the calculator

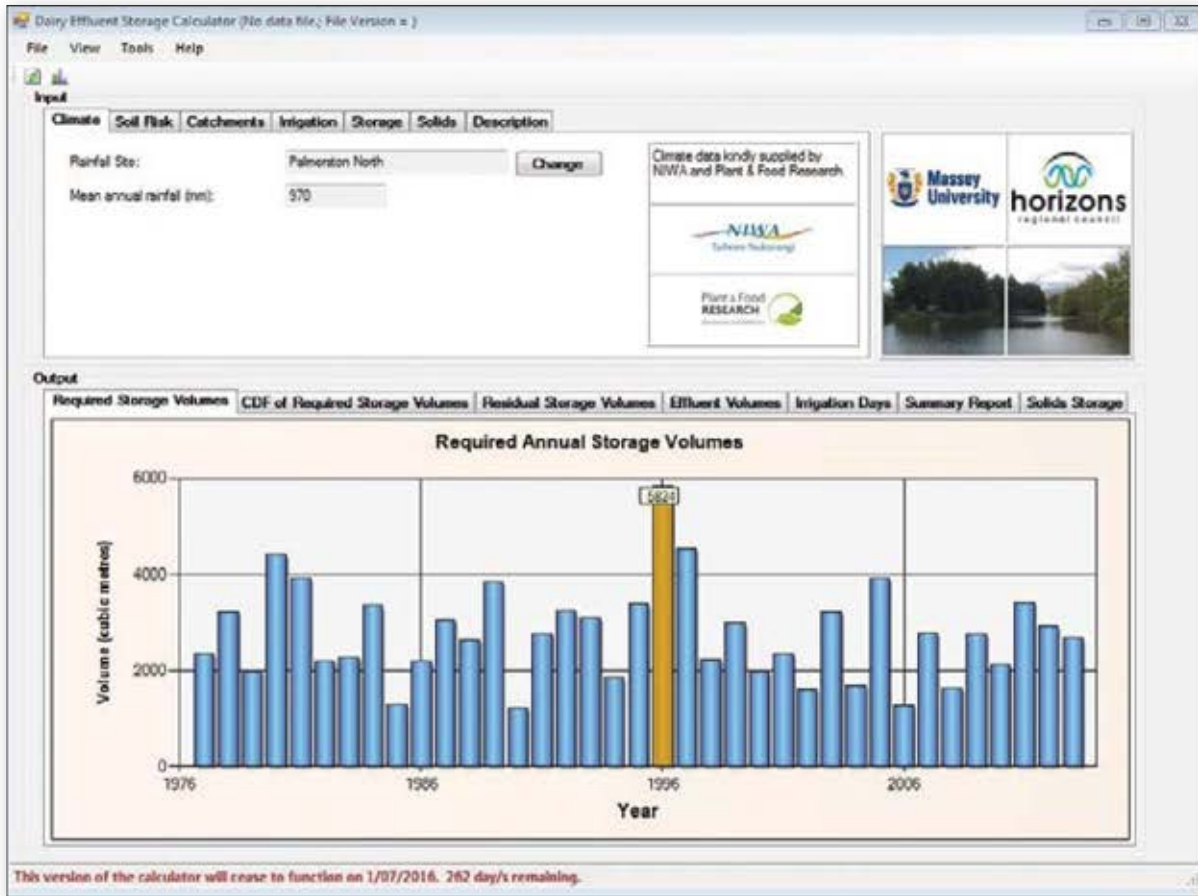
1. Click on the DESC title in the programme menu

A Foreword dialogue box will pop up. If this is the first time you have used the calculator, please read the information in this box and the version history. It will explain some important points about the calculator.

2. Click on the Accept button at the bottom of the box. (If you click Reject it will close the calculator down).
3. The calculator will open. The screen will flash for a few seconds while it starts up.



Main screen overview



1. The screen is made up of two sections, the top has the **inputs** and the lower section has the **outputs**. The **output** section automatically updates with every input change.
2. You must enter individual farm data in all input fields so the output data will be relevant for your farm.

Tips

- To change the regional council logo in the top right of the screen go to the top of the page and click on the **"Tools"** toolbar then select the correct logo for your regional council – Massey and Horizons logos will remain as the owners.
- Most of the data fields have explanations built in. To view the explanation box hold the mouse over the data field and the information box will pop up.

Input tabs

There are seven input tabs along the top of the input section. You MUST fill in every tab to get a meaningful, individualised output report.

- Climate
- Soil Risk
- Catchments
- Irrigation
- Storage
- Solids
- Description

Input tab 1: Climate



The Climate field requires information about your average local rainfall levels. Some areas receive more rainfall and evapotranspiration than others, which directly influences the storage capacity required. Generally, higher rainfall areas require greater storage volume. However, it is not only the volume of rainfall falling on the catchment areas that is dictating the required volume, but also the pattern of rainfall and evapotranspiration throughout the year that determines soil moisture deficits on any given day.

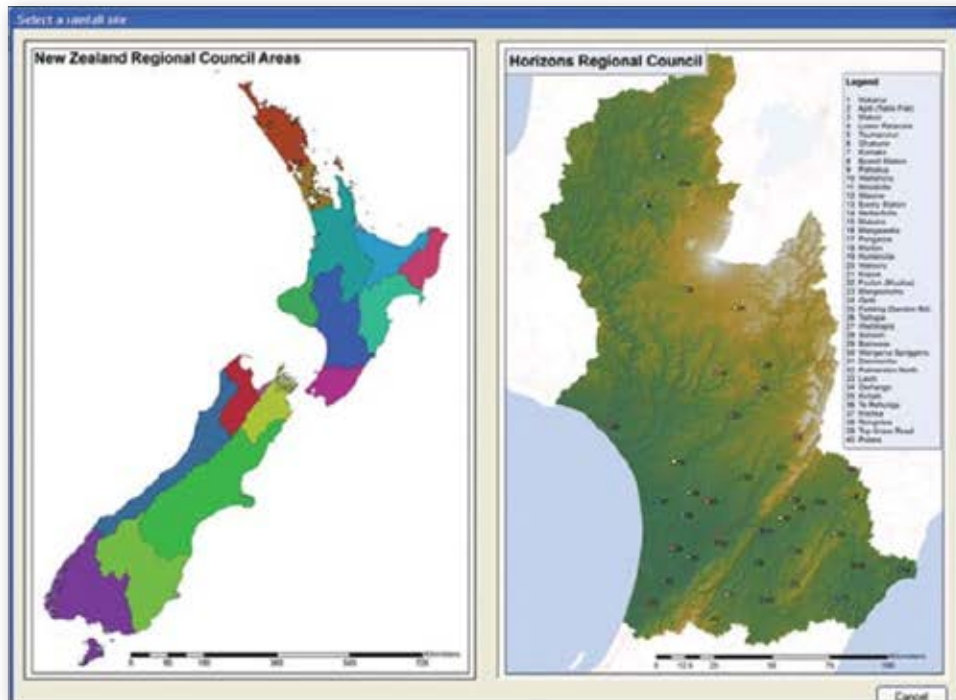
Regional climate data has been supplied by regional councils, NIWA and Plant & Food Research, and is built into the calculator.

Important

- There are limited climate sites on the DESC. Selecting a climate site requires a level of flexibility.
- It is best to choose a site that is geographically close to you if the rainfall and altitude is similar.
- If the site closest to you has a significantly different rainfall, then you can choose an alternative site that better represents your rainfall. However keep in mind that as you move away geographically, the annual rainfall may be similar but the distribution may differ. This may impact on the reliability of the soil water balance.

STEP 1 The default rainfall site is set on Palmerston North. Click on Change

STEP 2 The Change button will bring up the screen below, the map on the left-hand side shows New Zealand's regional council areas. Select the region your farm is in.



STEP 3 The right-hand map will now show all rainfall sites in your region. Select and hover over the rainfall site nearest your farm. It is possible to zoom in using the mouse scroll wheel. Click when the finger point icon appears. The data from this site will now be inputted into the main climate field.



Input tab 2: Soil risk

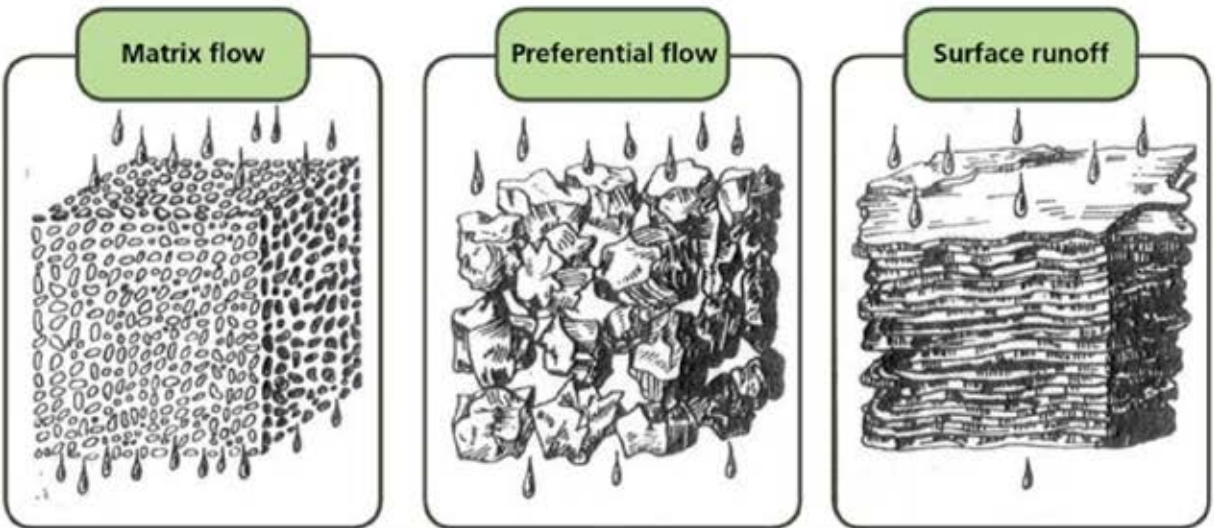


The Soil Risk tab records information about the amount of low risk and high risk soils that you will be applying effluent to.

For soil risk factor there are two soil classifications 'low' or 'high'

Low risk soils: Are generally described as free draining soils, where effluent can move through the soil profile in a uniform manner (matrix flow), without any preferential or overland flow. These soils must also have a slope less than 7 degrees to be considered low risk.

High risk soils: Are generally those soils which have impeded drainage and/or artificial drainage, or land with a slope equal or greater than 7 degrees. These soils are at high risk of preferential flow due to artificial drainage and overland flow due to low infiltration rates and/or slope.



Low risk soil

High risk soil

High risk soil

Soil risks continued

Effluent moves through low and high risk soils differently. Low risk soils have the ability to retain nutrients more efficiently, as effluent moves through the profile in a uniform manner (matrix flow). Therefore, it is possible to apply effluent more frequently than on high risk soils. High risk soils, are more vulnerable to effluent losses either through the profile, due to the preferential flow, or as run off on low permeable soils and require drier soil conditions to irrigate to (deficit irrigation).

The Soil Risk Framework used in the Dairy Effluent Storage Calculator

Category	A	B	C	D	E
Soil and landscape feature	Artificial drainage or coarse soil structure	Impeded drainage or low infiltration rates	Sloping land (> 7°) hump and hollow drained land	Well drained flat land (> 7°)	Other well drained but very stony* flat land
Application depth (mm)	< SWD	< SWD	< SWD	< 50% of FAW	≤ 30 mm and < 50% of FAW
Intermittent application rate (mm.hr ⁻¹)	N/A	N/A	< soil infiltration rate	N/A	N/A
Average application rate (mm.hr ⁻¹)	< soil infiltration rate	< soil infiltration rate	< soil infiltration rate	< soil infiltration rate	< soil infiltration rate
Storage requirement	Apply only when SWD exists	Apply only when SWD exists	Apply only when SWD exists	24 hours drainage post saturation	24 hours drainage post saturation
Maximum N load	50 kg N/ha/yr	150 kg N/ha/yr	150 kg N/ha/yr	150 kg N/ha/yr	150 kg N/ha/yr
Risk	High	High	High	Low	Low

SWD = soil water deficit
 FAW = plant available water in the top 300 mm of soil
 * Very stony = soils with > 35% stone content in the top 300 mm of soil
 N/A = not an essential criteria, however the level of risk and management is lowered if low application rates are used

Soil type

Having an understanding of your farm and its different soil types is an important step in effective effluent irrigation. Having a farm scale soil map is a major benefit when designing a FDE system.

The major soil types for each region have been classified as either high or low risk, based on the Soil Risk Framework developed by AgResearch (see above). Use the HELP button in the Soil Risk Tab to find your soil type.

If you cannot find your soil type listed under the Help button, click on the link at the bottom of the table to S-map. S-map is the national online soils database; it allows you to search either geographically or by soil type name and access the information relating to that soil. The associated fact sheet for each soil type will have the soil risk shown as A to E.

Alternatively, the DairyNZ Pocket guide to determine soil risk for farm dairy effluent application can be accessed from dairynz.co.nz or by calling 0800 4 DAIRYNZ. This field guide takes you step by step through the process of working out the farm's soil risk.



Soil water deficit: Is the amount of water or effluent that is required to bring the soil moisture content back to field capacity. Therefore, any effluent that is applied in excess of the soil moisture deficit will drain and/ or possibly runoff the soil.

The DESC makes a theoretical decision about effluent irrigation based on the following:

For low risk soils irrigation can take place on any day that the soil water deficit is greater than 0 mm. Irrigation depth can be greater than the soil moisture deficit due to the matrix flow through the profile.

For high risk soils, irrigation can only take place when the soil water deficit is greater than the application depth. Irrigation depths greater than soil water deficit will cause preferential flow, run off, or ponding, and result in reduced uptake of nutrients through the soil profile and increased nutrient losses from the system.

Effluent block area

To work out the appropriate effluent block area you need to complete an Overseer nutrient budget. This total effluent area needs to be divided up into high and low risk areas, if you have both.

As low risk soils allow more irrigation days, it is beneficial to have more low risk area available. Enter the maximum area of low risk soils available on farm into the *low risk* box.

The remaining area up to the required total to meet your nutrient budget needs to be entered into the *Minimum area for high risk soil* box. If your total actual effluent block is greater than the required effluent block based on your nutrient budget, then record the additional area in the *Remaining area for effluent irrigation* box.

Example of the correct way to enter the effluent block



Correct allocation of the effluent block

If 20 ha is the minimum required effluent area indicated by your nutrient budget, but your actual effluent block is 30 ha, of which 10ha is low risk, you should allocate it as follows:

- Low risk area 10 ha
- Minimum area for high risk soil 10 ha
- Remaining available area for irrigation 10 ha

Total storage required for an example farm = **1796 m³**

This situation apportions 50% to low risk soil and 50% to high risk soil

If you do not follow the correct method of allocation, you will significantly influence your storage requirements



Incorrect allocation of the effluent block

If 20 ha is the minimum required effluent area indicated by your nutrient budget, but your actual effluent block is 30 ha, of which 10ha is low risk and you incorrectly allocate it as follows:

- Low risk area 10 ha
- Minimum Area for High Risk soil 20 ha
- Remaining available area for irrigation 0 ha

Total storage required for same example farm as above = **2520 m³**

This situation apportions 33% to low risk soil and 66% to high risk soil

Important

- Having an Overseer nutrient budget will help establish the appropriate size of effluent area for your farm.
- The Calculator assumes that the size of effluent area you have entered is accurate as determined by an Overseer nutrient budget.
- A greater proportion of high risk soil to low risk soil will result in fewer days you can irrigate, and therefore a higher FDE storage requirement.
- A nutrient budget should be available from either the farm's fertiliser rep, dairy company or farm consultant.

STEP 1

You need to know the size of your effluent block (ha) and the respective areas of high and low risk soils within it. See the previous notes. Having an Overseer nutrient budget will help establish the appropriate effluent area for your farm.

STEP 2**Low risk area:**

Enter the total area of low risk soil you currently have available to spread your FDE.

STEP 3**Minimum area for high risk soil:**

If, according to Overseer, you need more irrigation area to meet your nutrient loading limits over and above the low risk area you have, then you need to enter the additional area required in this box.

STEP 4**Remaining area available for irrigation:**

If your current high risk effluent irrigation area is larger than the area recommended by Overseer, enter the extra high risk area in this field.

Input tab 3: Catchments



The catchment information informs the calculator about how much rainfall is being collected and directed into the effluent system. Hence the contribution that rainfall is making to the overall effluent storage volume.

Important

- A catchment area is any area where rain is collected and directed to the effluent system.
- If you have an area which is covered and runoff water does not enter the effluent system, it is not considered a catchment area.
- Storage ponds and tanks are not considered catchments – these are accounted for under the Storage tab.
- Weeping walls and solids bunkers are not considered catchment areas – these are accounted for under the Solids tab.
- If you have a covered feed pad, it is not considered a catchment area as long as the roof runoff does not enter the effluent system. If the roof runoff does enter the effluent system, then it is considered a catchment area.
- Remember to include the tanker apron, vat stands, silage pits and underpass areas if they flow into the effluent system.

What is considered a catchment area	What is not a catchment area
<ul style="list-style-type: none"> • Yard • Shed roof • Feed pad • Sumps • Stone traps • Any other area where water is collected and directed to the effluent system e.g. underpass, silage pit • Tanker aprons • Uncovered vat stands • Covered animal shelters/houses are entered here even though rainfall on these should be directed away from the effluent system 	<ul style="list-style-type: none"> • Tanks • Ponds • Solids bunkers • Roof runoff from covered structures must not enter the FDE system

STEP 1 Identify what catchment areas are relevant to your particular farm.

STEP 2 For shed enter the dairy shed roof catchment area (m²) and select yes if diverted.

STEP 3 Enter dairy yard catchment area, diversion details, milking season start and end dates, average daily milking cow numbers, average daily milking hours, and average daily wash water details (these can be entered either as a daily wash volume (m³/day) or by clicking on the swap button entering litres/cow).

Note: Average industry wash water estimates of 70 l/cow/day are misleading and should not be used. This figure can vary anywhere from 30-120 l/cow/day. Instead it is recommended that you measure the actual water use on farm and change the default value using accurate information for the farm. See the Estimating water use in the farm dairy worksheet on the next page.

If you select 'yes' for storm water diversion, then enter the start and finish dates that runoff is diverted from the FDE system.

For example: If over the period when cows are dry and the shed is not being used you have the yard stormwater diversion in place, then enter the period that you are dry for.

If you choose to divert runoff from your yard all year round, then you can check the tick box. However this requires the yard to be clean at all times other than during milking and wash down.

STEP 4 If a feed pad or animal shelter is present enter the catchment area. If covered, check the covered box, and enter storm water diversion details if diversion is present and then populate the fields of *Average daily cow numbers, Average daily hours on pad and Average daily wash volume* if washed with fresh water.

Important

- Average daily wash water volumes can be entered/changed in the details section. This can be entered on a monthly basis.
- Wash water volumes may change throughout the season as milking routines and herd sizes vary. However, there is generally not enough of a variation to warrant changing volume figures throughout the season when you consider plant wash stays the same, and yard wash will only have a minor reduction.

Worksheet: How to estimate water use in the farm dairy

Metering water use in the farm dairy is the best and most accurate way to track water consumption over time. In the absence of meters, you can use this form to record all your water uses, then do the calculation to estimate total use.

Measure...	Record...
<p>A. Milk cooling</p> <p>Measure exit flow during milking: Time how long it takes to fill a 200 litre drum and use it to gauge the flow rate (in litres/min). Determine total milking time for the day.</p>	<p>Water use A = _____ l/min (flow) x _____ minutes milking time = _____ litres</p>
<p>B. Plant/vat wash</p> <p>Wash tubs and hot water cylinders use set amounts of water. Refer to washing routine instructions supplied by the detergent companies</p>	<p>B = _____ litres</p>
<p>C. Yard wash down</p> <p>To do a bulk tank calculation, follow these steps.</p> <ul style="list-style-type: none"> • Turn off any automatic tank refilling from source water during measurement (milking). • Turn off stock water tap during measurement period if it draws off this tank. • Turn off connections to other tanks. <p>Measure amount of water drawn off during the whole milking time (Remove the lid and use a stick to measure the difference in cm between 'start' and 'finish' water levels.) Divide this by 10 cm (for 25,000 L tank) or 9 cm (for 30,000 L tank) to approximate water volume in m³. Multiply by 1,000 to convert to litres. This amount is the "change"</p> <p>For single tanks: C = "change" minus B</p> <p>For multiple tanks (tank for yard wash down): If there is more water in the tank at finish due to refill from milk cooler greater than use, then C = A minus "change". If less water in the tank, C = A plus "change". If you run out of water for yard wash, refill the tank to provide the water needed to finish. Measure the flow rate x amount of time to refill and call this volume "E". In this case, C = A + "change" + E.</p>	<p>C = _____ litres</p> <p><i>Note: For tanks other than 25,000 or 30,000 litres, divide 1,000 by 3.14 x r² (i.e. radius of the tank squared) to determine the "volume/height" per cubic metre.</i></p>
<p>D. Other water uses</p> <p>These uses of water are captured under C (bulk tank calculation) above. If you are interested in quantifying this water consumption, use appropriate procedures (measure water flow rate, etc). This can include skirt and cluster wash in rotaries, for example, and use of dairy shed water outside of milking activities.</p>	<p><i>Note: For estimating purposes, D (other water uses) is included in the C calculation above.</i></p>
Calculate...	
<p>If you use milk cooling water for yard wash</p> <p>B + C = _____ litres ÷ 1,000 = _____ m³</p> <p>Water use per milking</p>	<p>Total water use for twice-a-day milking</p> <p>_____ m³/milking x 2 = _____ m³</p>
<p>If you do not use milk cooling water for yard wash</p> <p>A + B + C = _____ litres ÷ 1,000 = _____ m³</p> <p>Water use per milking</p>	

For more information on how to improve water efficiency in the shed check out DairyNZ's Smart Water programme at dairynz.co.nz.

Important

- If washing the feed pad using clean water then you must enter the volume used into the calculator.
- If the feed pad is not washed, or only scraped, or uses green water, leave volume at 0.0.
- If the routines for the feedpad are not the same daily e.g. may wash the pad every third day, or have different cow numbers or hours on pad every second day, then you must total the value and average it out to a daily rate e.g. alternate between 6 hours on pad one day then 3 every second day, the average time on pad would be 4.5 hours per day.

Tip

Load Button: This takes the number of cows milked at peak value and enters into the feedpad box the average daily cow number for each month.

Fill button: This button allows you to copy a number to other rows, so you don't have to retype each row. Enter the correct number in the row, highlight the number and the other rows you want to be the same and press the fill button.



Recycled/green water wash-down

A change to the New Zealand Code of Practice for the Design and Operation of Farm Dairies (NZCP1) allows farmers to use Farm Dairy Effluent (FDE) water for yard wash-down, so long as strict guidelines and criteria are followed.

Using recycled or green water to wash down your yard has significant benefits including:

- Less fresh water abstraction and use
- Reduction of the amount of effluent storage volume required
- Less effluent to manage and irrigate

Using recycled FDE for yard wash must be managed to prevent any possible risk to food safety.

For more information on using recycled wash-down water go to dairynz.co.nz and look for Farm Fact 6-65 Using recycled farm dairy effluent water for yard wash-down.

Input tab 4: Irrigation



The Irrigation field requires information about your FDE irrigation practices.

The less you irrigate, the more FDE storage you will need. Irrigation is closely related to your soil type. If you have low risk soil you will be able to irrigate on many more days than you would if you had a high risk soil.

The values you enter here become your critical deficit/irrigation threshold for application to high risk soils. That means that unless you have a soil water deficit greater than the depth values set here, the calculator will not allow irrigation to take place, unless you have low risk soils.

Important

It is important that the depths and volumes you are using are realistic. These have a major impact on storage requirement and *should not be guessed*.

- Make sure your irrigation depth complies with regional council regulations and/or your resource consent conditions.

Irrigation depth

When irrigating what application depths do you apply?

STEP 1 Measure your irrigation depth. Do not rely on manufacturer's specifications as this will vary based on each specific situation i.e. your system pressure, flow and maintenance.
For information on "How to measure irrigation depth" see over the page.

STEP 2 Enter the irrigation depth (mm) for the Winter-Spring and for the Spring-Autumn seasons.
The Winter-Spring value needs to be less than the Spring-Autumn value.
Make sure you enter the irrigation depth not the irrigation rate!

Irrigation volume

Irrigation volume is the amount of effluent you pump daily to land.

STEP 1 If known, enter your irrigation volume (m³/day) for the Winter-Spring and Spring-Autumn seasons.

STEP 2 If you do not know your irrigation volume click on either Option 1 or Option 2.

Option 1 – If you know the hourly pump rate and time.

Option 2 – If you only have the travelling irrigator run details.

Option 1 – Pump rate and time.

a) Check the tick box on the right hand side of the description box.

b) Enter pump rates (m³/hr.) for each season.

c) Enter time (hrs.) you are pumping per day for each season.

d) Click OK.

Determine Irrigation Volume - Pump Rate and Time

Description
If you do not directly know the irrigation volume, but are aware of the hourly pump rate and time then enter those details here. Tick the check box on the right to activate this option.

	Effluent Pumping Details (cubic metres)	Pump Rate (cubic metres/hr)	Pump Time (hrs)
Winter-Spring	80	20	4
Spring-Autumn	120	20	6

OK Cancel

Option 2 – Travelling irrigator run details.

a) Check the tick box on the right hand side of the description box.

b) Enter the details for the length of run, width of run and number of runs for each season.

c) Click OK.

Determine Irrigation Area - Irrigator Travel

Description
If you do not know the daily volume of effluent applied then enter the details of the irrigator travel here. Tick the check box on the right to activate this option.

	Irrigator Travel (cubic metres)	Length of Run (m)	Width of Run (m)	Number of Runs
Winter-Spring	72.0	200	36	1
Spring-Autumn	158.4	200	36	2

OK Cancel

STEP 4 Will you irrigate throughout the year?

Yes – Assumes you will be irrigating every day when the conditions are suitable.

No – You can select a period of the year that you will not irrigate e.g. calving. Enter the dates of the period you will not be irrigating.

How to test application depth and rate

Collection containers

When testing, you can use either rectangle trays with straight sides, rectangle trays with sloped sides or standard round buckets. You will need about 20 of these. You must use a different calculation depending on the type of collection container.



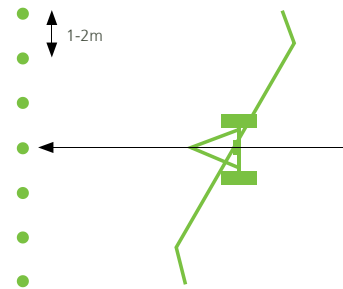
Step 1: Container layout

It is good practice to do the application depth test at the most extreme set up which you run the irrigator at. For instance, at the highest elevation above the pump, or the paddock that is the greatest distance from the pump. For center pivots, depending on the type of effluent installation, application may be deepest at the inner or outer spans of the pivot, or at the end if there is a mounted gun attachment. This will give you an idea of the 'worst case' performance of the system.

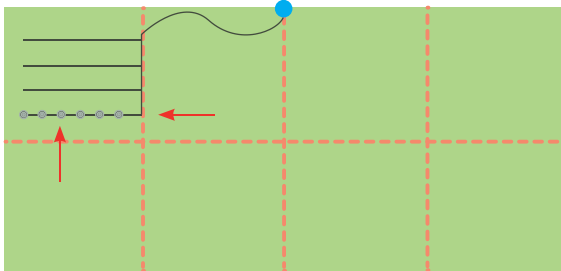
For a travelling irrigator

Before applying effluent, put straight sided containers in a line across the path of the applicator:

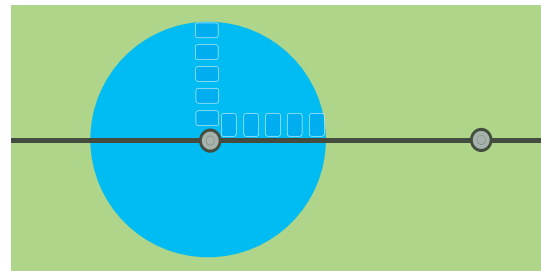
- 1-2 metres apart
- Use enough containers across the spray width of the irrigator
- Put a stone in each container to stop it blowing over.



For a low rate system



1) Go to the middle pod on the last pod line in the series (furthest away from the pump).



2) Layout collection containers in an "L" shape from the middle pod. Containers should be spaced at 1m intervals and cover right to the edge of the spray area of the pod. If necessary put a stone in each container to stop it blowing over.

Step 2: Turn on

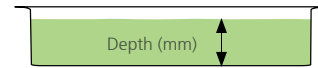
Turn the system on. Run for 1 hour. Record the start and finish time.

Step 3: Measure how much

For **RECTANGLE TRAYS with STRAIGHT SIDES**:

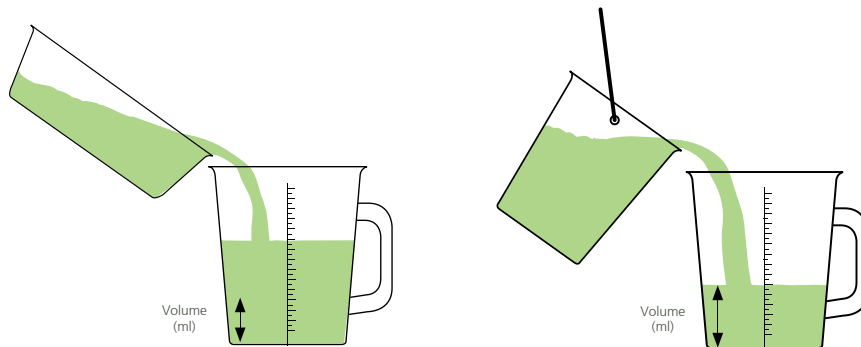
Use a tape measure

1. Remove the stone
2. Measure how deep the effluent is in each container (mm)
3. Write down depth for each container



For **RECTANGLE TRAYS with SLOPED sides, and for ROUND BUCKETS with SLOPED sides**

1. Remove the stone
2. Tip effluent into measuring jug and record the volume (ml)
3. Write down the volume for each container



Step 4: Calculate application depth

For **RECTANGLE CONTAINERS with STRAIGHT sides**

Container 1 Container 2 etc ...

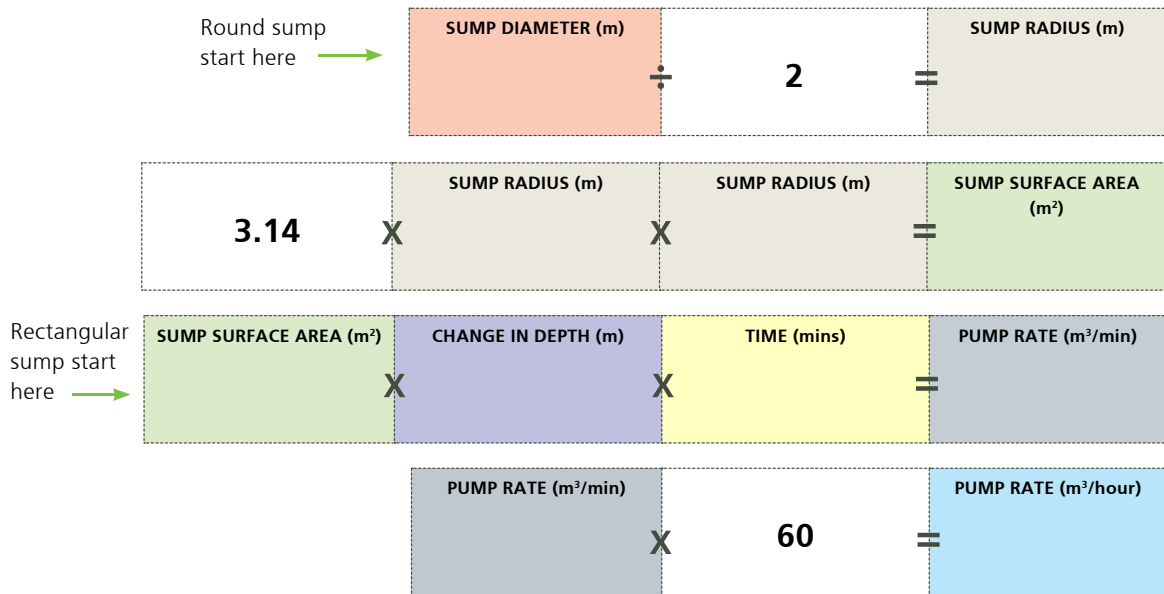
+	+	+	+	+	+	+	+	TOTAL (mm)
TOTAL (mm)							NUMBER OF CONTAINERS	AVERAGE APPLICATION DEPTH (mm)
							÷	=

How to measure pump rate

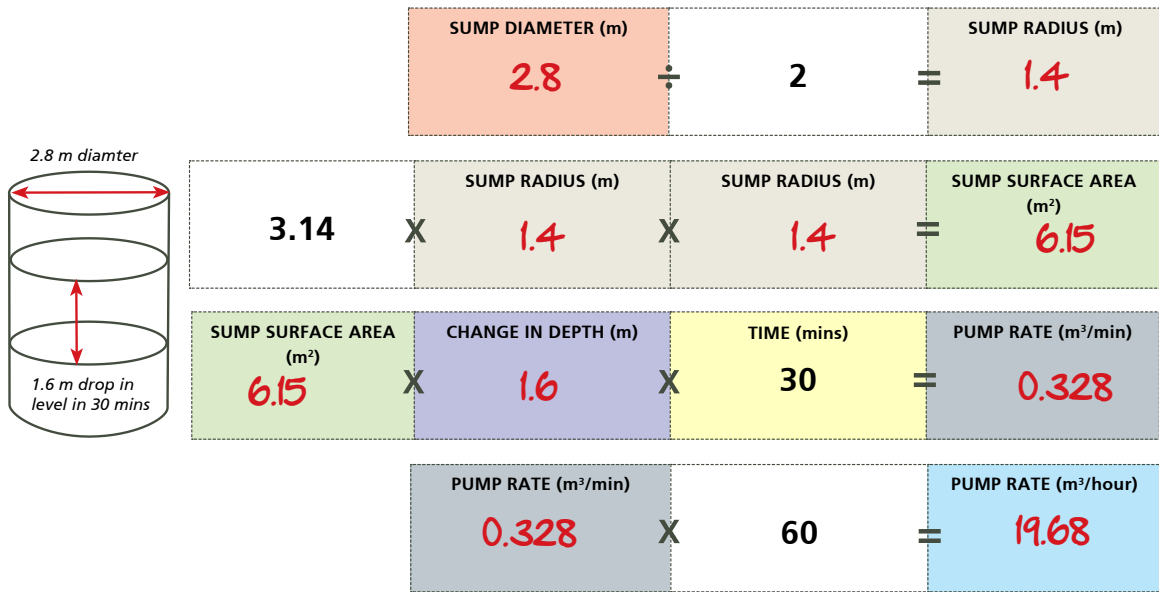
If irrigating from a sump, to work out the pump rate you need to know:

- Diameter of the sump (m) for round sump
- Surface area of the sump (m²) for rectangular sump (length x width)
- Change in depth (m)
- Period of time (mins)

Then use the following calculation:



Worked example



NOTE: If you are not using a travelling irrigator and do not irrigate from a sump, then get an effluent service provider to measure the pump rate for you.

Input tab 5: Storage

The screenshot shows the 'Dairy Effluent Storage Calculator' software. The 'Storage' tab is selected and highlighted with a green circle. The interface includes a menu bar (File, View, Tools, Help), a toolbar, and a main input area. The 'Storage' tab contains a question 'Do you have a storage system?' with three buttons: 'Regular Ponds', 'Irregular Ponds', and 'Storage Tanks'. To the right, there are input fields for 'Emergency Storage Period' (set to 3 days) and 'Likely Surface Area' (set to 5.0 sqm per cow and 44.2 * 44.2 square metres). The bottom right corner features logos for Massey University and horizons regional council, along with a landscape image.

The Storage tab calculates the amount of useable or pumpable storage pond/tank volume (working volume). It requires dimensions and information about either the existing pond/tank system, or the intended system if constructing new ponds/tanks. Pumping information is also required.

Any storage ponds/tanks on farm are also considered catchment areas for rainfall and will contribute volume to the effluent system. If you currently do not have a pond/tank, the one you install will become a catchment area. The calculator needs to account for the increase in catchment area.

Important

- A pond/tank which is not pumped is not considered a storage facility.
- The surface area of the pond/tank needs to be based on the actual physical dimensions at the top of the pond not at the effluent level.
- The more ponds/tanks you have or the greater the surface area of the ponds/tanks, the more your storage requirements will increase, due to the ponds/tanks acting as a catchment area.

If there are existing ponds/tanks

STEP 1

Emergency storage is required to allow for unforeseen situations such as breakdowns. Enter the number of emergency storage days required. Each regional council may have a specific requirement for this.

STEP 2

If ponds are of regular shape or are tanks, select the option on farm and the number of ponds or tanks. Go to Step 4

STEP 3

If ponds are irregularly shaped, select the irregular pond option and check the activation box.

- Work out the total volume, freeboard volume, unpumpable volume and surface area of all irregular shaped ponds and enter into their associated boxes.

STEP 4

Tanks, regular shaped ponds and saucers.

- if the storage is a saucer, select the round option and fill in diameter, total depth, freeboard and sludge/unpumpable heights and batter.
- If storage is square or rectangular, enter the length, width, total depth, freeboard height, sludge/unpumpable height and batter.
- If storage is a tank, fill in dimensions as above.
- Tick the pumped box if the storage is able to be pumped.
- Click on the Pump check box against each pond you are able to pump from. Only ponds with pumps are classified as storage.

If there are no existing ponds/tanks

If there are no existing ponds/tanks currently on farm and you are planning to include one in the system, it is important to account for the proposed pond/tank in terms of its influence as a catchment area. To account for this:

STEP 1

Ensure all other parameters in the DESC are filled in. The pond/tank dimensions should be the last ones you enter.

STEP 2

Emergency storage is required to allow for unforeseen situations such as breakdowns. Enter the number of emergency storage days required. Each regional council may have a specific requirement for this.

STEP 3

Choose either regular ponds or storage tanks; whichever is the option that reflects what type of storage is proposed on farm.

STEP 4

Add the number of ponds or tanks. Circular ponds are round ponds with battered walls; much like a Canterbury saucer, whereas tanks have a vertical wall.

STEP 5

The *Required Storage Volumes* tab will be showing the maximum storage required for each year, or if sizing in accordance with the FDE COP, you can go to the CDF of Required Storage Volumes tab to get the FDE COP 90% volume (see page 31 for this). Now make an estimate of storage dimensions and enter these into the length, width, total height, sludge/unpumpable height, freeboard height and batter boxes.

STEP 6

A dotted green line will have appeared across the screen of the *Required Annual Storage Volumes*. Is the volume depicted by the green line equal to, or greater than, the desired amount of storage?

Yes. Great!

No. Go back to Step 5 and alter the input dimensions to resize the pond or tank. This is an iterative process fine tuning storage dimensions to get the desired storage volume. It is important to note that as the dimensions change, so does the required storage volume due to the surface area of the pond changing and altering the amount of rainfall caught and evaporation lost.

Input tab 6: Solids



It is not uncommon for farmers with cow housing, barns or feedpads to severely underestimate the volume of solids storage they need.

Therefore, this tab has been added to calculate the volume of solids collected or separated, and the size of bunkers or weeping walls needed to contain these solids.

STEP 1

Click on the Solids tab and add a separation unit

Next, select the type of separator. A default related solids percentage will be displayed. This can be changed if detailed information regarding the farm's separation equipment is available.

STEP 2

The identification of catchment areas in the Catchment tab will determine which input sources are available for solids separation. Catchments will be unavailable as sources for separator units if their catchment areas are zero.

Select the catchment areas that will supply effluent to the separator.

Adjust the dates in which separation will occur and then

Enter the solids bunker or weeping wall dimensions if regular shaped. The calculator needs to know both a volume of solids storage and the solids storage surface area to account for rainfall. Therefore, if your bunker is of an irregular shape you need to determine both a volume and surface area of the bunker and enter these accordingly.

It is recommended that dual weeping walls are entered as two separate solids separation units.



STEP 3

Next, you need to choose an emptying option.

Select a minimum soil moisture deficit required before spreading can take place and if required adjust the four day forecast SWD excess.

The four-day soil water deficit excess (mm) forecast is the user's self-imposed limit of soil water deficit excess (drainage and/or runoff (mm)) over a four day period after the intended solids spreading date.

Soil water deficit excess will be caused by the net effect of rainfall events and evapotranspiration exceeding the soil's water holding capacity over the next four days and resulting in a certain amount of drainage/runoff. If the limit is exceeded, the Calculator will not empty the bunker and will continue to store solids.

The purpose here is to mitigate the possible runoff loss of applied effluent due to a forecast rainfall event over the next four days - this will be particularly relevant to high risk soils.

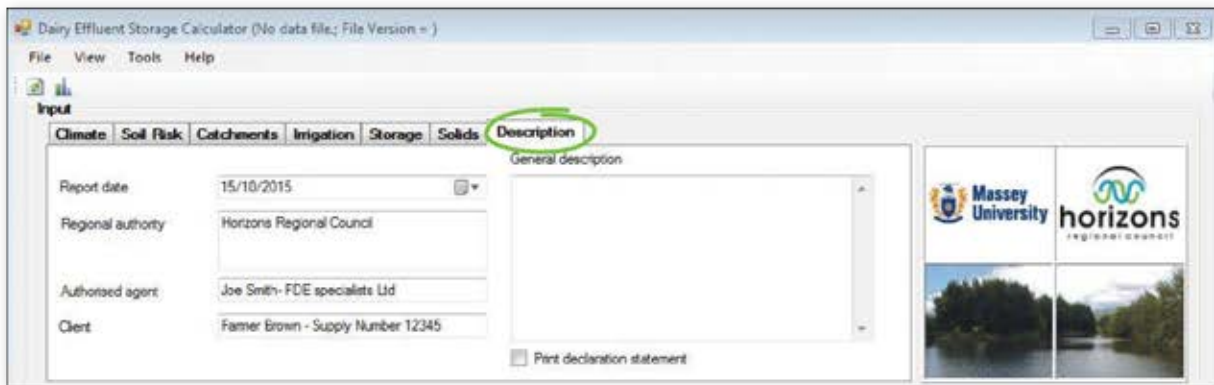
Either highlight *I will empty on specific dates* button and enter the dates that solids emptying will occur (you can have up to 12 dates per season) or

Select the *I will empty more frequently* button, and enter the minimum bunker volume (% full) to be reached before spreading will take place. This button option assumes you will empty the bunker every time soil moisture deficits are greater than the minimum deficit for application AND the bunker is fuller than the minimum percentage selected.

As in the irrigation tab, you can also select a non-spreading period.

Click OK

Input tab 7: Description



This tab is for administration information and to add detail to the summary report.

STEP 1	Enter report date
STEP 2	Enter regional authority
STEP 3	Enter authorised agent name – your name and company is best
STEP 4	Enter client name
STEP 5	<p>Enter a written description of the data inputs in the General Description details.</p> <p>This must include any assumptions you have made e.g. assumed waters use – not measured, assumed soil risk, assumed pond dimensions, assumed pump application depths etc.</p> <p>This may also include the following:</p> <ul style="list-style-type: none">• farm descriptors• soil type• drainage systems• comments• notes• other relevant information.
STEP 6	The person creating the report should tick the print declaration box for legal reasons.

STEP

Stop now and check inputs!

Important

- It is a good idea to create a summary report at this point, and review and check that all the input data is correct.
- The DESC reports must be pdf printed if those without the DESC programme want to view /read the outputs

STEP 1 Click on the Output Tab 6 : Summary Report.

STEP 2 Scroll through to double check the input data is correct and has not been over-ridden by any default values.

STEP 3 Re-check and adjust pond dimensions now that there is an estimate volume to work from.



Interpreting data and understanding output reports

Now that you have entered all the inputs, a customised series of graphs and reports is available. These are accessed via the seven output functions including:

1. Required Storage Volumes
2. Cumulative Distribution Frequency of Required Storage Volumes
3. Residual Storage Volumes
4. Effluent Volumes
5. Irrigation Days
6. Solids – *A new version of this tab is being tested and when it becomes operational more details will be added.*
7. Summary Report

Output tab 1: Required storage volumes

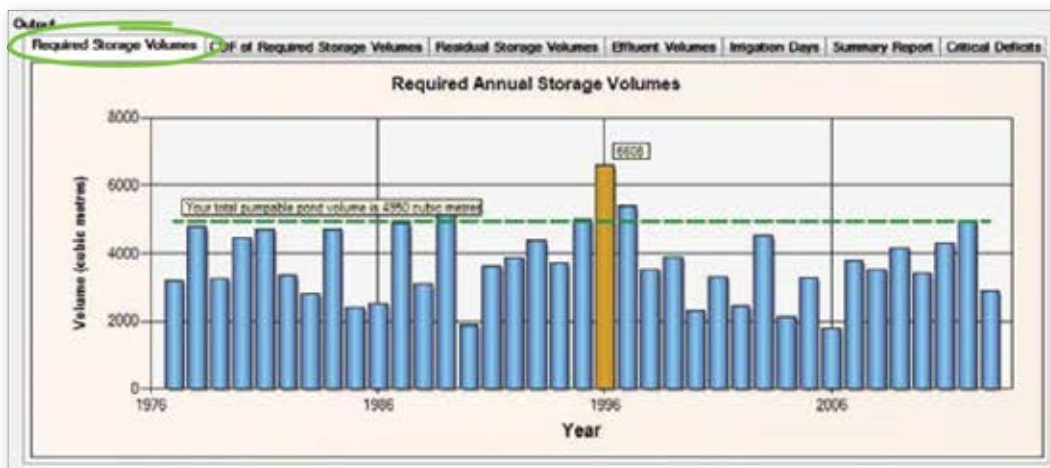
The results window shows a graph of the Required Annual Storage Volume required (m³) to successfully irrigate FDE for each year over the past 30 plus years.

Required Storage Volumes can be viewed at all times while entering input data. When you enter input data you can see how each input section impacts on your storage requirements as the Required Storage Volumes screen will immediately respond to every input field.

If you hover over each bar on the graph you can see the actual volume figure required for that season.

The year with the maximum storage requirement is highlighted in orange.

If the farm currently has storage ponds, then this volume is also depicted via a green dashed line. This figure is the working volume.

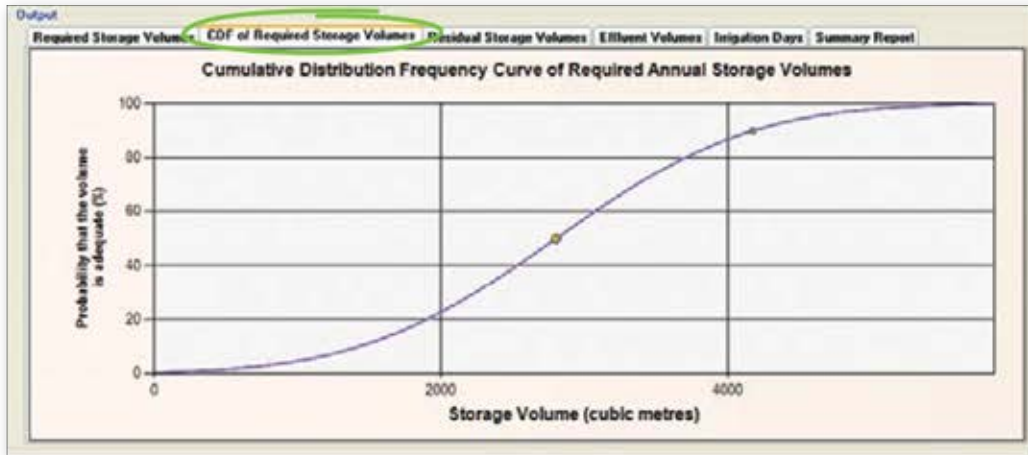


Output tab 2: Cumulative distribution frequency of required storage volumes

This graph shows the probability (%) that a storage volume is adequate for a specified volume in m³.

- The green dot – 90% likely that this amount of storage would be adequate for any one year.
- To get the actual storage volume figures hover over the dots.

The 90% dot is considered best practice from the *Farm Dairy Effluent (FDE) Design Standards and Code of Practice, Version 3, September 2015*. Ninety percent probability means that you may have difficulties once in 10 years. However it is important that you check this figure with your regional council for specific details and requirements.

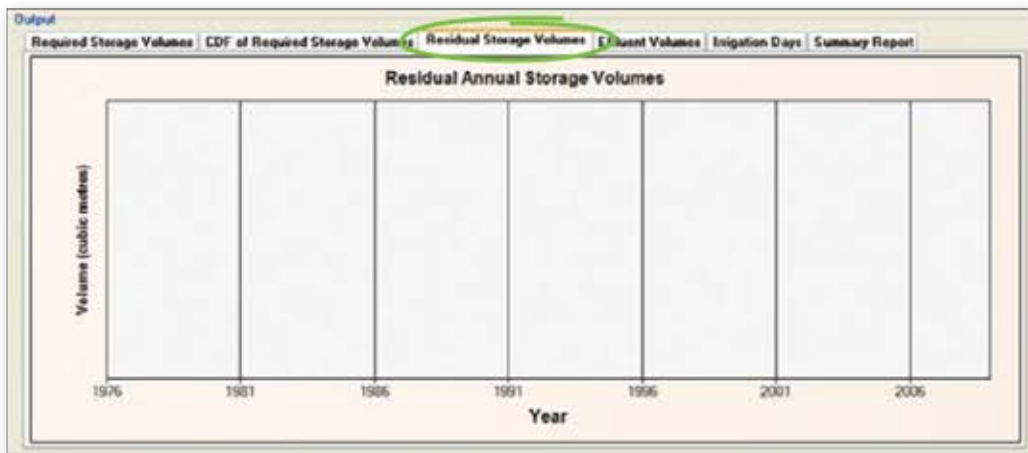


Output tab 3: Residual storage volumes

This graph shows the Residual Storage Volumes. This is the volume of effluent carried over from one season to the next. What it indicates is that the season was not started with an empty pond. Hence you are generating more effluent than you can pump out in any one year.

This should generally be zero other than the odd circumstances, where you may have an unusual year.

This graph should be used as a check that the ponds are emptied during the Summer/Autumn period.

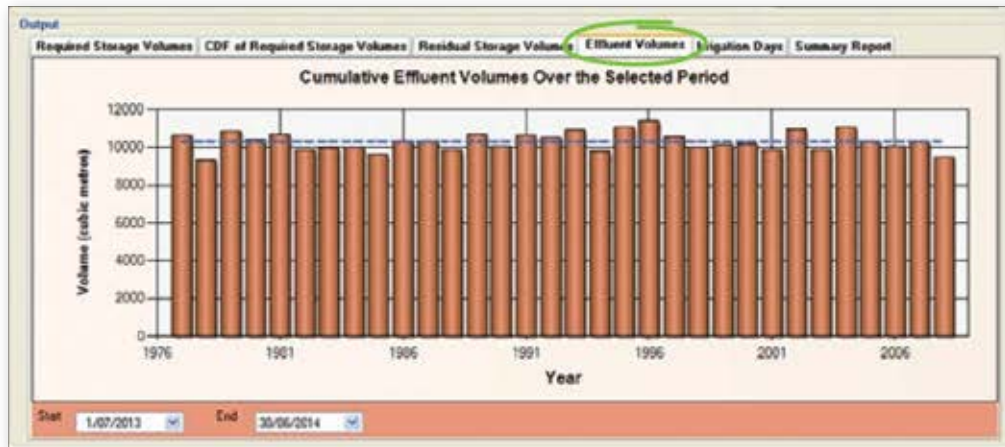


Output tab 4: Effluent volumes

This graph shows the total volume of effluent produced each year. That is effluent, plus wash water, plus rainfall.

The blue dashed line indicates the mean volume of effluent produced each year. If you hover over the blue dashed line it will show the actual figure for the mean annual effluent produced.

You can also adapt the graph to see the volumes of effluent produced over a specific period of the year by changing the Start and End dates underneath the graph. For example if you just wanted to know how much effluent was produced over winter, you could specify the graph to look at dates between 1 June and 30 August for a given year.



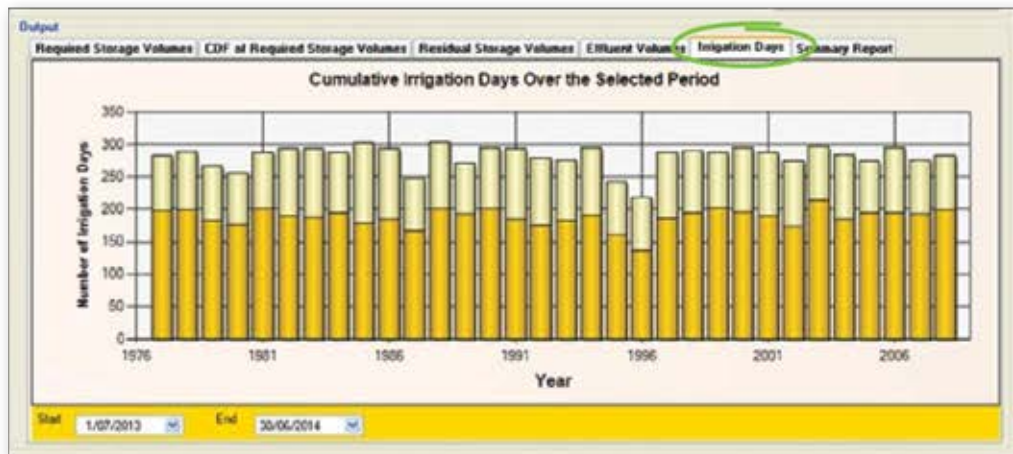
Output tab 5: Irrigation days

This graph shows the total number of days you will be able to irrigate FDE on to your effluent block.

This has been calculated using your customised input information, rainfall data, soil risk and critical deficit irrigation values. Irrigation is then determined by the size of the soil water deficit.

Effluent blocks that have high and low risk soils will display a bar with split colour showing the days available to apply effluent to each soil class. If you hover over the bars it will show you the actual number of days you can irrigate.

You can also adapt the graph to see how many days irrigation can take place over a specific period of time by changing the Start and End dates underneath the graph.



Output tab 7: Summary report

The DESC will produce a Summary Report, this includes:

- Regional authority
- Authorised agent name
- Client name
- Version No. of DESC
- Report date
- General description information
- Critical input information
- Legal declaration
- Key output values
- Required storage volume graph

Unlike the other output tabs of the DESC, which are updated automatically as input values are entered, the summary report is like a PDF and therefore needs updating/refreshing if input values are altered. To do this click on the View button at the top of the screen then select *Refresh Summary Report*.

It is recommended that you print out a copy of the Summary Report. It is best to save this as a PDF to ensure the information cannot be changed and to enable access to others who may not have the software.

Example Summary Report

Dairy Effluent Storage Calculator Summary Report

Regional authority:	Horizons Regional Council
Authorised agent:	Joe Smith- FDE specialists Ltd
Client:	Farmer Brown - Supply Number 12345
Program version:	1.46
Report date:	Thursday, 15 October 2015

General description:
This calculation was done for Farmer Brown to determine storage requirements on their farm near Marton.

A low depth irrigation system is to be used in the wetter months to achieve low application depths of 4mm and a traveller is able to be used during the spring-autumn period applying a maximum of 11mm depth.

Daily irrigation volumes used assume a pump rate of 5 litres per second for four hours per day in winter-spring and three hours per day for spring-autumn.

The proposed pond dimensions of 40m x 30m x 3.7m deep with 0.4m unpumpable volume and 0.3m freeboard. the pond will have a 2:1 batter. Any variation from these proposed pond dimensions will require a new DESC to be done.

Climate	
Rainfall site:	Marton
Mean annual rainfall:	1067 mm/year

Effluent Block	
Area of low risk soil:	0.0 hectares
Minimum area of high risk soil:	19.5 hectares
Surplus area of high risk soil:	0.0 hectares

Wash Water

Yard wash:

- Milking season starts: 01 August
- Milking season ends: 15 May

Month	Number of Cows	Hours in Yard	Wash Volume (cubic metres)
January	220	4.0	12.6
February	220	4.0	12.6
March	220	4.0	12.6
April	220	4.0	12.6
May	220	4.0	12.6
June	0	0.0	0.0
July	0	0.0	0.0
August	220	4.0	12.6
September	220	4.0	12.6
October	220	4.0	12.6
November	220	4.0	12.6
December	220	4.0	12.6

Irrigation

- Winter-spring depth: 4 mm
- Spring-autumn depth: 11 mm
- Winter-spring volume: 72 cubic metres
- Spring-autumn volume: 54 cubic metres
- Irrigate all year? Yes

Catchments

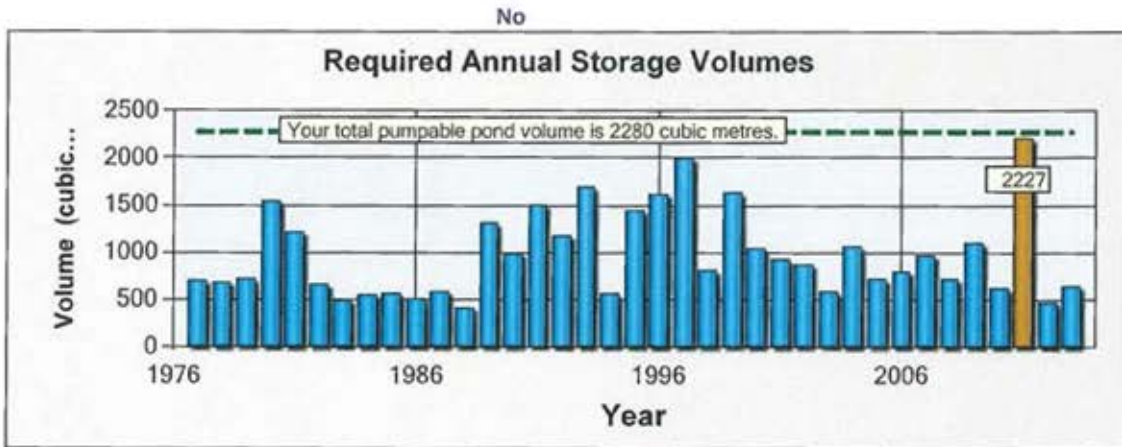
- Yard Area: 2151 square metres
 - Diverted? Yes
 - diversion start: 31 May
 - diversion end: 01 August
- Shed Roof Area: 246 square metres
 - Diverted? Yes
- Feedpad Area: 0 square metres
 - Covered? No
 - Diverted? No
- Animal Shelter Area: 0 square metres
 - Covered? Yes
 - Diverted? No
- Other Areas: 0 square metres

Storage

- Pond/s present? Yes
- No. of ponds: 1 pond/s
- Includes irregular ponds? No
- Pond 1
 - total volume: 2794 cubic metres
 - pumpable volume: 2280 cubic metres
 - surface area: 1200 square metres
 - width: 30.0 metres
 - length: 40.0 metres
 - batter: 2.0:1
 - total height: 3.7 metres
 - pumped? Yes
- Tank/s present? No
- Emergency storage period: 5 days

Outputs

Maximum required volume: 2227 cubic metres
90 % probability volume: 1575 cubic metres
During the period from: 01 July 1976
To: 30 June 2013



Notes

Notes

dairynz.co.nz