Dairy Industry Farm Dairy Effluent Warrant of Fitness Standard Operating Procedure Manual

August 2015, Version 5

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- Dan Bloomer
- Debbie Care
- Sefton Lonsdale
- Shaun Hodson
- Nikki Kelly

Feedback and suggestions

While every effort has been made to ensure the accuracy of content covered in this Standard Operating Procedure, we welcome any feedback and improvements you may have.

Images shown in this document have come from a variety of sources, and are provided for demonstrative purposes only. They are not intended as design standards, nor do they substitute for the expertise of an Accredited Farm Dairy Effluent System designer.

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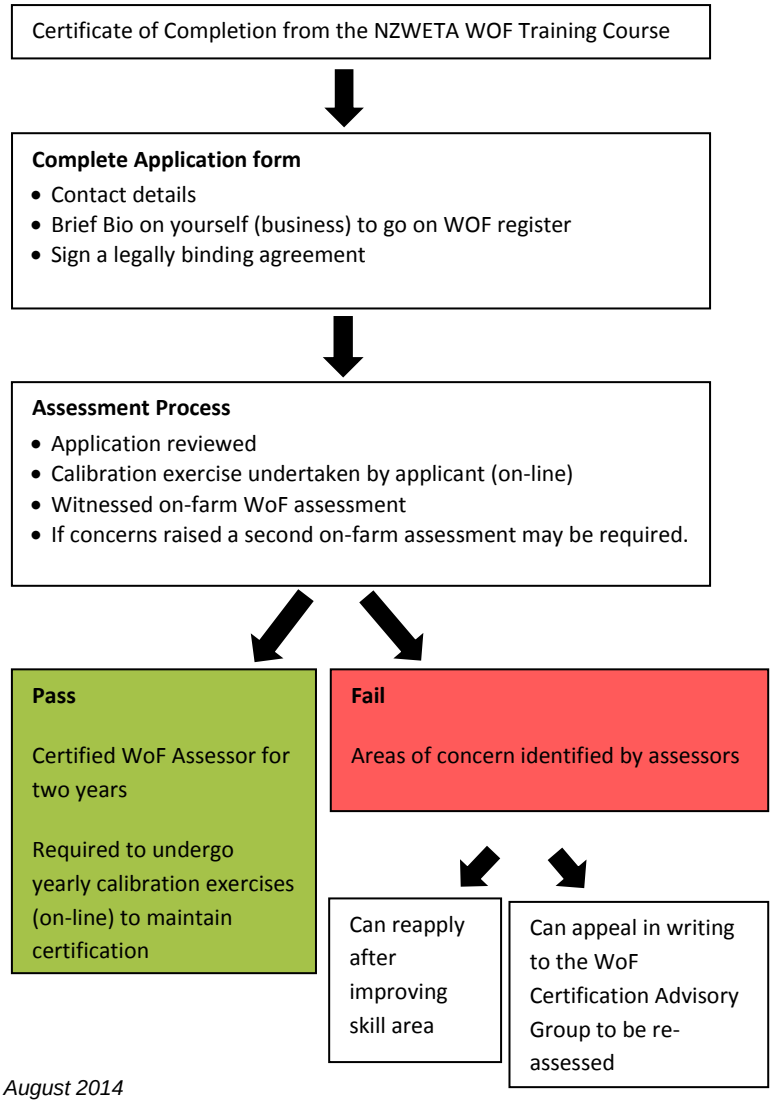

DAIRY EFFLUENT WARRANT OF FITNESS (WOF)

PROCESS FOR FARMER

Farmer requests a dairy effluent WoF assessment

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WoF website

- WoF assessment process
- Questions and Answers
- Bios on WoF assessors and contact details

↓

Select a WoF assessor. Terms of sale agreed between farmer and WoF assessor

↓

WoF conducted (electronic data capture) and information stored at QCONZ

↓

WoF Report sent to farmer with information on good effluent infrastructure viewed and also areas of concern, why and suggested actions

PRIOR TO THE ASSESSMENT

1. **Contact the farmer to ask if they interested in becoming part of programme. If yes, establish the following details on the telephone:**
   a. The time and date for the visit
   b. Benefits of the WoF Assessment
   c. All information collected during the WoF will be treated as confidential[1]
   d. That a risk assessment of, and feedback on, the system will be presented in a final WoF Assessment Report
   e. Who will be:
      i. paying for the service,
      ii. present at the time of the WoF,
      iii. present for the assessment debrief,
      iv. receiving copies of the final WoF Assessment Report.
   f. Contact details:
      i. Contact person/people
      ii. Site address and full postal address
      iii. Landline and mobile numbers
      iv. Dairy company supply number
      v. Email address for information and reminders.
      vi. Establish if farmer request feedback letter by email or in the post

[1] DairyNZ reserves the right to use the data for benchmarking and trend analysis

2. Establish the following details with the farmer:

a. For bio-security purposes, is the farm currently managing an outbreak of any contagious animal disease such as Salmonella or Yersinia (if yes, suggest the audit occurs once the disease has been controlled)

b. Who will be the on-farm contact to answer questions on the day

c. Test requirements
   i. That the irrigator needs to be at the furthest or most elevated paddock on the day of the testing
   ii. It is recommended that the irrigator is in good condition, greased, types pumped up, has good nozzles, drag line pulled up well and set on fastest speed
   iii. That the volume of effluent needed for the test will be available (especially if they pump directly from sump)
   iv. Whether the system can pump effluent at same time as milking.
   v. That a depth/rate test will be conducted on their irrigator
   vi. That flow rates and pressures will be measured

d. Background information needs
   i. Farm map with effluent areas known
   ii. The 'normal' set up on farm

iii. Nutrient budget (and Nutrient Management Plan if they have one) to be ready for viewing
iv. Resource consent available if applicable
v. Who designed and installed (or upgraded) the effluent system, and how long ago? (establish if there are any conflicts of interest between the auditor and the system designer/installer)
vi. The make and type of all major system components

e. That the farmer will provide a Health and Safety briefing/induction on arrival[2]
f. Send an email/letter to the farmer summarising the above points as discussed and confirming the date and time.

3. Immediately prior to the visit:

a. Call the farmer 1-2 days prior to the assessment to:
   i. confirm arrangements
   ii. remind them of any requirements for the day
   iii. Keep an eye on the weather forecasts

The Assessor must request permission to bring additional visitors, children or animals onto the farm, for farm policy, confidentiality, health and safety and biosecurity reasons.

Ensure have knowledge of regional council rules and permitted activities in the region where WoF undertaken.

[2] A simple one-pager can be created by the farmer on the Compliance Toolkit website. Search compliancetoolkit.co.nz > Create a form> Health and Safety> Visitors to the Farm- Hazard information guide.

ON THE DAY OF THE ASSESSMENT

BRIEFING

Meet the farmer at the dairy or the house and go over the plan for the assessment. This is also an opportunity to:

- Collect any paperwork/documents required for the assessment such as copies of Consents and nutrient budgets etc., and
- Be briefed on health and safety issues you may encounter during the visit.

This may be a good time to cover the questions in the Background Information in Section Two.

Discuss their level of input or attendance for the day. Consider doing the sections which require their attendance at the start or end of assessment to save their time. Plan the timing or communication for when pumps or power need to be turned off or on.

CLIMATE CHALLENGES TO COMPLETING THE WOF

If conditions are not satisfactory, the testing should be postponed. It is possible to provide a report without the depth and rate test, provided the physical assessment of the application system is thorough and a pressure test at the applicator is also measured. Additional disclaimers regarding the accuracy of the report must be provided.

Rain

Do not attempt to do the depth and rate test if there is more than a light drizzle. Include three containers as controls outside of the wetted area, and use to measure and subtract the depth of rain water collected, if measurable.

Wind

The application testing should be carried out in conditions representative of those commonly experienced in the field. Wind speed and direction must be measured and recorded.

Evaporation

In very hot, windy conditions evaporation from containers can be significant. Do not leave containers exposed longer than necessary. If unsure, run an evaporation test in parallel with the application test.

EQUIPMENT LIST

- NZ Safety Standard approved Life jackets
- High visibility clothing
- Hand cleaner/sanitiser
- Pressure gauge capable of measuring 0-200 psi, with ± 5 psi accuracy. A diaphragm-type gauge which will keep effluent from entering the gauge is best.
- A flow meter. These must be corrosion resistant, be accurate to ±3% or better, and have no moving parts.[3]
- Wind gauge (handheld, range 0-10 ms^{-1}, accurate to 1 decimal place)
- Containers x 60
- Weights for container ballast (e.g. palm-sized stones)
- 50 metre tape measure
- Electric fence standards or stock-spray paint (for speed test)
- Measuring cylinders (in a range of sizes 25ml, 50ml, 100ml, 500ml, 1000ml and 2000ml)
- Stop watches/ or smart phone timer system
- Camlock connectors (standard female to female and male to male 90mm, 64mm, 51mm to 75mm, male to female (x2) is helpful)

[3] *There are two main types used, both with pros and cons: An inline electromagnetic, which can cause some turbulence issues if trying to fit to a hose which is not 50mm, or ultrasonic wrap-around external meter. These require a perfectly round shape hose, and may encounter difficulty if the hose shape deforms.*

- Pry bar (opening the locking arms on the Camlocks when putting in the pressure gauge etc. can also be used for checking irrigator bushes, shafts , drive arms etc. for wear and play)
- Dead-blow hammer (soft face which avoids damage to Camlock faces etc. , it is also hollow and is filled with lead shot, wont bounce off when hitting objects, - is good to have for putting stubborn Camlocks together, conventional steel hammers may damage the Camlock.)
- Calculator
- Measuring wheel
- Vehicle for on farm to carry equipment (4WD recommended)
- Spade
- Tools for measuring pipeline and nozzle diameter- vernier-type callipers are ideal
- Clip board/s
- Pens / pencils
- Computer/tablet and printer
- Sun protection (hat, glasses, sunblock)
- Disposable gloves

Also suggested:

- Hand held radios
- Hand held GPS
- Smart phone apps such as clinometer

ASSESSOR HEALTH AND SAFETY

- A safety briefing from the farmer about any hazards present on the farm on the day of the visit is required before starting work.
- Follow all Health and Safety guidelines and policies set out in this document, and those provided by the host farmer.
- All WoF Assessors must wear High-Vis clothing while on farm, and use any appropriate safety equipment.
- Failure to take all proper precautions can result in serious injury, illness or death.
- Assessors should not be operating any PTO/tractor/stirrer or mechanical solids separation system (or any other machinery owned by the farmer)
- Assessors should not be working around effluent storage facilities alone, and under no circumstance try to access floating pontoons

Key messages about Health and Safety:

- Ask yourself- "What can go wrong here?" if in doubt, don't do it!
- **Eliminate** any potential hazards
- **Isolate** those which cannot be eliminated
- **Minimise** any potential hazards which cannot be avoided

This symbol indicates a part of the assessment may be particularly hazardous and caution is recommended. It is advisable to have at least two people present when assessing these areas in case of an accident.


Potential hazards of effluent irrigation
Hoses and wires in paddocks whilst riding/driving farm vehicles
Rotating boom on irrigator
Crush warning
Electricity at the pump
Falling into the effluent pond
Breaking the crust on the pond releasing gas
No heavy lifting
Unstable pontoons

Moving and rotating parts are a serious hazard.

- Failure to take all proper precautions may result in impact injuries, crushing or amputation of limbs, serious injury, or death.
- Ensure moving parts have guards in place where possible.
- Stay clear of tractor PTO shafts when near tractor driven pumps, stirrers, solids spreaders and slurry tankers.
- Loose clothing must not be worn when near moving parts and long hair must be tied back.

Using an ATV on farm

- Ideally complete a NZQA accredited training course to increase the driver's knowledge, awareness, and skill level. Visit nzqa.govt.nz for more information.
- Wear a helmet, and appropriate footwear
- Establish the safe routes and areas to ride an ATV
- Ensure that tracks and access-ways are maintained
- Avoid steep terrain
- Reduce speed to a safe and appropriate level for the conditions
- ATVs are not designed to carry passengers or cargo
- Children under the age of 12 are not permitted to drive an ATV, and those between the ages of 12-15 are not permitted without training, or if they are unable to control the vehicle.

Safe driving on farm

- Consider taking an off road driver training course. Assessors should have all required licenses
- Drive to the conditions; reduce your speed to a safe and appropriate level for the conditions (20 km/hr. on farm).
- Be aware of ground conditions and how they affect limitations.
- Select the correct gear for the situation.
- Engage four wheel drive before you require it.
- Farm races can be extremely slippery, be cautious.
- Frost / dew on grass, wet or very dry ground conditions can lead to loss of traction and vehicle control.
- Avoid steep terrain if possible. If unavoidable, drive straight up and down hills. DO NOT drive across the face of a hillside. Be careful going over the crest of hills.
- Drive within the limits of the vehicles capabilities. Be aware of the centre of gravity of the vehicle and the effect on the tipping/rolling point when travelling on hills. Be especially cautious if you are carrying an additional load on your vehicle, especially liquids which will change vehicle handling.
- Be aware of driving through long grass, which can hide drop-offs, holes, tree stumps and other sudden changes in terrain.

Ensure your vehicle is regularly maintained and serviced and tyres are suitable for off road use.

Pressure in effluent systems

- Pressure levels in effluent systems ranging from 0 to200 *psi* are possible; such pressures can seriously injure or kill people nearby and cause serious damage to property.
- Extreme care should be taken when working with hydrants, pipework and applicators to prevent impact injuries. Hydrant bridges if handled while under pressure can cause serious injuries especially to the hands, arms, head and face.
- Hydrants and pipes should only be disconnected with the pump turned off and the system depressurised.
- Ideally there should be a taps / valves on hydrants which should stop flow through the hydrant.
- There is risk of pipe rupture and debris being thrown under pressure.
- Be aware of risk of being sprayed with effluent, among more obvious things, it is a health risk (Leptospirosis is just one example).
- Before working near pumps, stirrers and solid extractors the power supply must be turned off and the power plug disconnected from the power point to prevent machinery from starting unexpectedly.
- When working on an irrigator, turn off the pump and disconnect the effluent supply line from the irrigator.

Beware of electrocution when working around electrically powered equipment.

Effluent pond safety

- Wear a lifejacket when inside the effluent pond area.
- Do not work alone around ponds or sumps.
- Have a safety throw rope and life ring on hand.
- Beware of slip and trip hazards around effluent ponds. Failure to do so may result in drowning or serious injury.
- Pond liners can be extremely slippery which may lead to loss of footing and falling into the effluent pond.
- DO NOT attempt to access effluent pontoons for any reason as these can be unstable; present a trip, slip and entanglement hazard with risk of injury, drowning and death.
- Do not attempt to walk on pond crusting, and be aware that the pond edge can be deceptive due to growth of weeds and irregularities in pond shapes. Stand well clear of where you believe the edge to be.
- Thick crusts can form on pond surfaces, they can be 600mm thick, and a person falling through such a crust could result in entrapment beneath the crust and drowning.
- **Wash your hands after working with effluent and before eating.** Effluent is a health risk; diseases such as leptospirosis may result from failing to do so.

FARM VISIT BIOSECURITY PROCEDURES

Although diseases are most commonly introduced into a herd by the addition of animals, there is a risk of disease introduction by people traveling between groups of animals. This risk may vary considerably and is influenced by the specific disease agent, the extent of the animal contact, the time elapsed since the last animal contact, and the preventive measures used.

A basic cleaning kit can be made using a fish crate or similar which you may use to contain or carry equipment in the car, a long handled scrubbing brush and a basic disinfecting detergent. Giving testing containers a rinse is preferable, but may not be practical.

Pre-visit:

Check with the farm whether they have a biosecurity plan for visitors, or if they are currently experiencing an outbreak of contagious disease. For diseases such as Salmonella or Yersinia, postpone the visit until the farm is clear. Even if not required by the farm, rural professionals should, at a minimum, set the example by using measures that would seem prudent for a well-managed farm.

After the visit:

If you are traveling directly to another farm:

- Before leaving, dirty boots should be cleaned and disinfected, and overalls should be removed before re-entering the vehicle. Cleaning and disinfecting can be carried out at a non-farm location if not travelling directly from farm to farm. It is good practice to use a fresh set of overalls between farms.

- Hands should be washed with soap and water.

- If the vehicle or equipment is heavily soiled, give it a wash with a high pressure hose on the tanker pad if there is one available.

ENVIRONMENTAL COMPLIANCE

Every regional council has their own rules and interpretation of the Resource Management Act.

WoF Assessors **must** understand the Regional Council requirements for the farm they are assessing. Farms may have a combination of Consents, Permitted Activities on their farm.

For a rapid overview of the requirements in a region, download a Compliance Checklist from the DairyNZ website[4]. Copies of Regional Plans can be found on each council's website. References for the Regional plans and contact details are listed in the Appendix.

Resource Consents

View a copy of every consent the farmer holds for effluent related activities on their farm.

All breaches of Consent or Permitted Activity requirements must be noted during the audit, and areas of concern raised in the final report.

[4] *Search: Farming Resource Centre> Environment> Effluent> Compliance with Rules.*

SECTION TWO- BACKGROUND EFFLUENT SYSTEM INFORMATION

To save time on the day of the assessment, these could be covered over the phone or at a pre-visit.

Q. 2.1 Are there system risk areas which the farmer is aware of?
Examples could include but are not limited to evidence of: • Insufficient effluent storage • Leaking or inadequate sealing of any effluent holding or storage facility • High rainfall or high risk soils on effluent receiving area • Waterways in proximity to effluent receiving area • Artificial drainage including surface, mole and tile drains • Pump/pipe work, applicators, stirrers, solids separators or other infrastructure they believe is inadequate for workload • Poor condition of equipment/infrastructure • Any effluent escaping into environment/waterways/groundwater • Slope or elevation of effluent receiving area for land application • Siphoning from the effluent system resulting in over application • Ponding/runoff

Q. 2.2 Have there been any recent changes, or planned upgrades to the system?

Identify any improvements, modifications, replacements, or extensions to the system. Any change which will have an impact on effluent volume or management.

Examples could include, but are not limited to:

- Addition of a feed or standoff pad
- Additional effluent storage
- Change in type of effluent applicator (e.g. to low rate or high rate system)
- Addition of a solids separation system
- Extension of effluent application area
- Increase in herd size, or changes to the milking routine, or length of milking season
- Changed storm-water diversion, or covering and guttering roof water from buildings
- Green-water recycling or other water conservation measures

Q. 2.3 Were there any issues with the system in the past season?

These can be either management or infrastructure issues, for example:

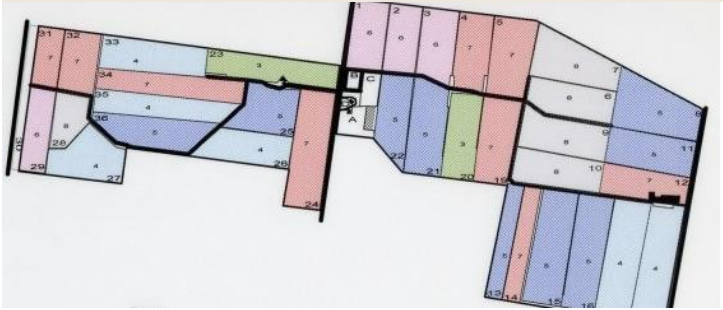
- Break-down of pumps, equipment failure, split hoses
- Maintenance demands
- Labour demands (complicated, time consuming, covers an extensive area etc.)
- Climate influences (very wet or dry season, short window of opportunity to irrigate, greater use of standoff facilities than normal)
- Staff training or management
- Lack of storage, overflows from pond/sump
- Regional council enforcement actions
- Issues raised by dairy companies
- Over-application, ponding or runoff of effluent towards or entering waterways

SECTION THREE- NUTRIENT MANAGEMENT

Section Three	Q.3.1 Are records kept of effluent application areas and run times?
Assessment	Sight evidence of regular records that cover: • Date of application • Application area/paddock/run • Duration of application (stationary/low rate applicators) • Effluent depth and rate test results throughout the season • Maintenance and service records, including date of replacement of parts and irrigator rubberware • Any issues related to the effluent system and corrective actions
Risk	Many councils impose an annual Nitrogen (N) limit and evidence of compliance is required. Factors that can lead to non-compliance include: • Irrigators applying more effluent than expected • Too many applications to one area
Mitigation steps	• Any records which demonstrate compliance. These may be kept at the dairy e.g. Dairy Diary, spread-sheet, DairyNZ run-sheet template, or effluent runs recorded on a farm map. • Depth and rate tests.
Comments	Records of effluent application areas and run times must be maintained. They are critical to ensure and demonstrate that over application of nutrients, particularly N, is avoided. These records are required in some regions as part of the Consent or Permitted Activity Rules, but they are good practice on any farm. General maintenance and application records may prevent over-application of nutrients, can make effluent planning more effective, and may prevent wear and tear or breakdown through proactive system maintenance.

Effluent application recording sheet example

Paddock	Date	Run number	Signature	Comment (e.g. signs of ponding or runoff)
1	*15/8/10*	*7*	*FNP*	
1	*16/10/10*	*8*	*FNP*	
1	*12/12/10*	*4*	*WJP*	
2	*6/9/10*	*10*	*WJP*	*Ponding at south end, too wet?*



Recording systems. Photo One: DairyNZ Effluent Application recording sheet. Photo Two: Farm map recording system.

Section Three	Q. 3.2 Is there a current nutrient budget? Does the effluent area meet regional nitrogen loading limits?
Assessment	Nutrient budgets (NB) can be 2-3 seasons old, (unless there have been significant farm system changes since the last budget was done). CHECK:Effluent Block nutrient budgets to ensure: • Nitrogen (N) inputs from effluent do not exceed the annual N limit stated by the regional council • N inputs from fertiliser plus effluent are within rule, plan and budget allowances for the effluent block area • Check that the size of the effluent block in the NB matches what is happening in the field.
Risk	Nutrient losses- particularly N and P to surface and groundwater, a high risk in sensitive catchments.
Mitigation steps	Risk management includes using a Nutrient Management Plan (NMP) and extending effluent area to meet: • Annual N limits, and • Maintenance Potassium (K) application rates. As a good practice rule, total N application from effluent and fertiliser shouldn't exceed 200 Kg N/ha/yr.
Comments	Significant savings can be made when fertiliser decisions are made using a NB and a NMP. Nutrient losses not only represent an environmental risk, but a financial loss to the farm. Although not an environmental concern, over application of K is a loss of valuable fertiliser, and can result in animal health problems. Good practice is to size the effluent block to meet maintenance K requirements.

Example of a Nutrient Budget for an under-sized effluent area

Nutrient budget

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na	H+*
Nutrients added								
Fertiliser, lime & other	200	0	0	17	0	0	0	0.0
Rain/clover N fixation	55	0	0	1	0	1	1	0.1
Irrigation	0	0	0	0	0	0	0	0.0
Effluent added	179	26	189	18	25	14	0	-5.2
Supplements fed on block	27	6	15	4	1	3	1	0.4
Nutrients removed								
As animal products	86	15	19	5	21	2	6	0.0
As supplements	0	0	0	0	0	0	0	0.0
Net transfer by animals	14	-1	24	1	3	1	-1	-0.8
To atmosphere	63	0	0	0	0	0	0	0.0
To water	69	7.0	66	21	56	5	56	-3.4
Change in block pools								
Organic pool	230	20	0	13	0	0	0	-0.7
Inorganic mineral	0	15	-3	0	-2	-1	-7	0.0
Inorganic soil pool	0	-24	99	0	-51	11	-51	0.1

This NB is from a farm in the Waikato.

N inputs from effluent are 179Kg N/ha which exceeds the Permitted Activity rule of 150 Kg N/ha/yr. on pasture for this region. The Combined fertiliser and effluent application is 379 Kg N/ha/yr., resulting in 69 Kg N/ha/yr. leaching losses.

The K input on this block is 189 Kg K/ha/yr. which is resulting in losses of 66 Kg K/ha/year.

Recommendation for this example: Increase size of effluent block to reduce losses, and no added N fertiliser on effluent block.

SECTION FOUR- FARM DAIRY WATER USE

Required for the Dairy Effluent Storage Calculator. Refer to the 'How to use the Dairy Effluent Storage Calculator' manual for detailed instructions on the requirements.

Section Four	Assessment	Details
Q. 4.1 Peak cow numbers	The max number of cows being milked	Influences the maximum daily effluent generation
Q. 4.2 Length of season	• Lactation start date • Lactation end date • Average number of days in the season	The number of cows generating effluent, length of season and time of year (in relation to soil moisture/climatic conditions).
Q. 4.3 Daily Milking time	• Length of AM milking (during peak) • Length of PM milking (during peak) • Once a day or 16hr milking during season	The length of time the cows spend at the dairy determines how much effluent is generated at the dairy.
Q. 4.4 Plant type	• Herringbone or Rotary • Number of sets of cups • Use of platform wash (rotary dairies)	Note the use of a platform wash on a rotary. The number of cups determines volume of fresh water required for plant wash.
Q. 4.5 Plant washdown water	• Number of cups/clusters • Vat capacity • Total volume of plant wash in Litres/day	Note: Water use is calculated as 40L of water/bail/milking plus 12-18% of the vat capacity, per vat wash (after pick up, assuming daily collection). Note weekly wash cycle routine, typically there will be two alkali washes per week which will add an additional 10L per set of cups and 2% of vat capacity for each alkali wash.

Q 4.6 Milk Cooling	• Water volume used through plate cooler • Fate of water used after milk cooling	Plate cooler water use is typically 2.5 x the peak milk flow rate. E.g. 40 bail dairy with an average peak milk flow rate of 3L milk per minute/cow, could have a cooling water demand of 300L water per minute. *** Note what happens to this water after it is used for cooling.** It is typically re-used for plant wash and other cleaning, but in some dairies may be going to waste in effluent system.
Q. 4.7 Other water use around the dairy	• Length of time spent washing the yard (minutes/milking) x (milking/day) • Water-use in yard wash in L/minute for a daily yard wash (L/day). • Other general hosing within dairy, i.e. platform, vat room, platform wash, teat washing etc. • Total Litres/day on other wash • Note any continuously running, leaking hoses or water sources in the dairy • Any water saving technology such as green-water recycling, dung-busters, chains etc.	• Average daily wash water volumes can be entered on a monthly basis. • 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. Measure the actual water use on farm and adjust the default value in the DESC using accurate information for this farm. • Wash water volumes may change throughout the season as milking routines and cow numbers vary, however there is generally not enough of a variation to warrant changing volume figures throughout the season, as the plant wash stays the same and yard wash will only have a minor reduction.

SECTION FIVE- FARM DAIRY INFRASTRUCTURE

CATCHMENT AREAS

Measure any catchment areas- i.e. any surface area which captures stormwater, which is then directed into the effluent system.

NOTE: This is required by the Dairy Effluent Storage Calculator. It determines how much rainfall is being collected or directed into the effluent system, hence the contribution that rainfall is having to the overall effluent storage volume.

Determine whether a stormwater diversion system is in place for any of these catchment areas, and the duration and frequency of use. For example is fresh clean water diverted from the yard area all winter? Is there effective guttering and spouting in place on all buildings within the catchment to direct rainwater away all year round.

NOTE: Active stormwater diversion throughout the milking period must only occur when the surface is clean.

What is considered a catchment area	**What is not a catchment area**
Any area where water is collected and directed to the effluent system • Yards and concrete races • Solids bunkers /storage area • Shed roof (if water not diverted) • Feed pad • Weeping wall bunkers • Sumps • Tanker aprons and	For all covered structures the roof water must be diverted from the FDE system • Tanks • Covered solids bunkers • Covered Feed pad area • Covered animal shelters /houses • Dairy roof (if roof water diverted) • Ponds (built into the

uncovered vat stands • Underpass, silage pit	calculator)

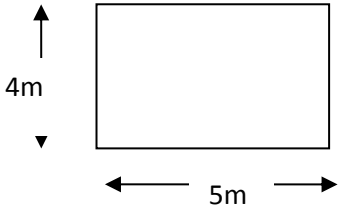
IMPORTANT NOTES ABOUT CATCHMENT AREAS

- Any area that collects rain that is directed to the effluent system is considered a catchment area
- A covered area from which runoff water does not enter the effluent system is not considered a catchment area
- Storage ponds and tanks are not considered catchments - these are considered under the Storage Tab in the Dairy Effluent Storage Calculator
- Weeping walls and solids bunkers are considered to be catchment areas
- A covered feed pad is not considered a catchment area as long as the roof runoff does not enter the effluent system. If a covered feed pad roof runoff does enter the effluent system then it is considered a catchment area.
- Include the tanker apron, vat stands, concrete races and underpass areas if they flow into the effluent system.
- Look out for unintended catchments, for example if the tanker pad is un-bunded, it may be draining the whole tanker loop and wider yard area. Or, if a pond is below ground level, stormwater from the surrounding area may also be draining into the effluent pond if there are no stormwater barrier drains in place.

Key
Height- H
Width- W
Radius- r

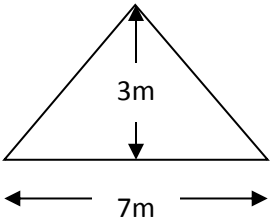
MEASURING CATCHMENT AREAS

Rectangles



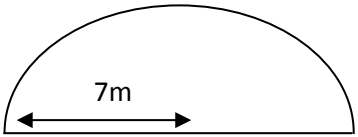
Formula	W x H	=	Total Area
Example	5m x 4m	=	$20m^2$

Triangles

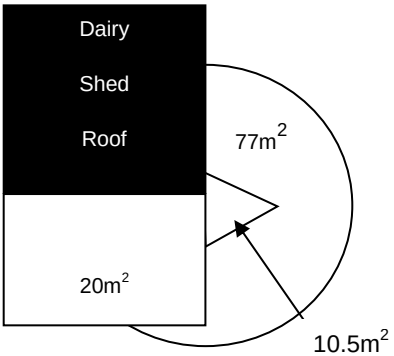


Formula	0.5x W x H	=	Total area
Example	0.5 x 7m x 3m	=	$10.5m^2$

Half circles



Formula	r x r x 3.14 x 0.5	=	Total area
Example	7m x 7m x 3.14 x 0.5	=	$77m^2$



Formula	Square + Half Circle - Triangle	=	Total area
Example	$20m^2 + 77m^2$ $– 10.5m^2$	=	$86.5m^2$

To calculate the catchment contribution of rainfall falling on the yard, multiply the annual rainfall by the surface area of the catchment areas.
E.g. 1200mm/yr. x $250m^2 \div 1000 = 300m^3$
($1m^3$ = 1000 litres)

Section Five	Q. 5.2 Assess gutters and spouting on the dairy and buildings in yard catchment
Assessment	Evidence of: • Leaking or broken spouting • Covered areas without spouting where water drains into the effluent system • Surface water around facilities draining into effluent system unnecessarily
Risk	Unnecessary increase in effluent volume to manage
Mitigation steps	Effective guttering on covered areas with diversion away from effluent system. Rainwater captured and used for yard washdown or other use
Comments	Although not directly a compliance or environmental risk, unnecessary water entering the effluent system can significant increase storage requirements, and labour requirements.
Photo One: Ineffective guttering-spouting with no downpipe.	 Example: 600mm of rain on a 400m^2 roof is equivalent of 240m^3 of additional water being added to the effluent system. If pumping from the effluent pond at 15m^3/hour, there would be an additional 16 hours of pumping costs, labour, wear and tear on equipment.

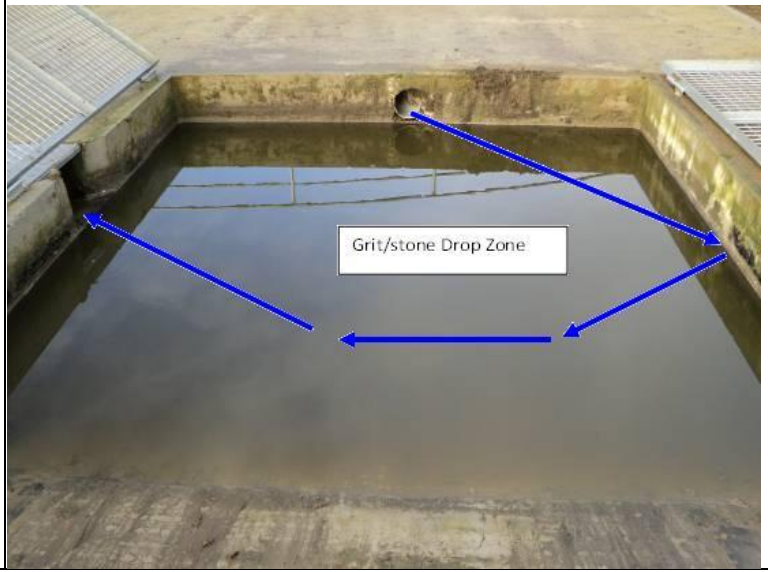
Section Five	Q. 5.3 Assess the tanker pad
Assessment	Evidence of: • Milk entering freshwater via runoff from tanker area, or drain, or not being captured by the effluent system • Fresh surface water from yard area draining into tanker pad drain and entering effluent system.
Risk	• Milk entering freshwater. • Excessive freshwater from tank track and yard entering effluent system.
Mitigation steps	If a concrete tanker pad is present, it is fully sealed with drainage to effluent system (milk company requirements vary). Pads should be bunded to prevent water from yard and track area running onto tanker pad.
Comments	Freshwater entering the effluent system increases the storage requirements and labour in effluent management. Concreting of tanker pads may be a milk company requirement, these vary between companies.
Photo One: Water from tanker loop and yard area can drain into effluent system. **Photo Two: Raised tanker pad.**	 

Section Five	Q. 5.4 Assess the yard area
Assessment	**Evidence of:** • Sealing faults in concrete yards, i.e. major cracks or holes, absence of bunding and nib walls around edges to prevent overflow • Any effluent, not being directed to effluent system
Risk	Leaching and overflow to environment
Mitigation steps	• No cracks or holes in concrete
Photo One: Effluent entering a paddock at the end of a nib wall section. **Photo Two: Cracked and unsealed yard concrete.**	 

Section Five	Q. 5.5 Assess the entry/exit points
Assessment	**Evidence of:** • Inadequately sealed entry and exit points • Excessive effluent, slurry or mud in high use laneway areas • Runoff of effluent slurry from raceways towards or into freshwater drains
Risks	• Leaching and overflow to environment • Animal health issues (lameness, mastitis, teat hygiene)
Mitigations	• Concreted and fully sealed with no major cracks or holes • Fully bunded around edges to prevent overflow • Drains to effluent system • Nib wall to prevent stones being kicked onto concrete areas by stock • Geocell matting
Comments	Cow flow issues which may result in more effluent generation in the yard or on raceways: • Uneven surfaces, • Large stones kicked onto concrete, • Large puddles, • Exposed sharp stones or rock, • Deep mud, • Yard entry point narrower than the raceway

Section Five	Q. 5.6 Assess the sump area
Assessment	The sump shows no evidence of: • Overflowing or leaking • Construction from permeable materials, or showing faults or damage • Potential for overflows to reach waterways
Risk	• Leaching and overflow of effluent to the environment • Safety hazard
Mitigation steps	• Correct capacity for herd size • Regularly maintained • Stirred or agitated as required • Provision for containment of overflow • Float switches or alarms • Safety provisions such as escape ladders, fencing, signs, ropes etc.
Comments	 Hazardous area: safety measures such as escape ladders, fencing and signage around the effluent system are important, and may be required to meet Department of Labour requirements. It is recommended that for any inspection on any effluent storage facilities/ pumps/agitators, they are firmly secured, and at least two people are present at the time in case of an accident. Assessors should not attempt to access pontoons

	while in the pond area at any time.
Section Five	**Q. 5.7 Assess the stone trap**
Assessment	Evidence of: • Effluent by-pass due to being too full of sediment, or having the inlet too close to the outlet • Leaking/leaching due to cracked or damaged structure, or not constructed from impervious materials • Overflow, leachate or runoff which is not captured within the effluent system • Solids from stone trap emptied onto unsealed surface
Risk	• Leaching and overflow of effluent • Inadequate entrapment of sediment, leads to increased wear and tear on pump and equipment • Full stone traps appear deceptively shallow, and pose a drowning or entrapment risk to stock and people.
Mitigation steps	• Correctly designed inlet and outlets in stone trap (see photo) • Maintenance programme in place • Solids stored on a sealed pad which drains back to effluent system • Correctly sized for herd • Fully sealed construction • Provision and containment of overflow • Effective design to slow water velocity

	• Health and safety provisions
Comments	Wear and tear on pumps and equipment from an ineffective stone trap may increase the likelihood of an equipment failure, which is a compliance risk. Stone traps are a hazardous area: safety measures such as fencing and signage around the effluent system are important, and may be required to meet Department of Labour requirements.
Photo One: A stone trap should be designed to allow for maximum decrease in water velocity; allowing for sediment to settle out before the water exits the stone trap.	

Section Five	Q. 5.8 Assess the effluent system drains/channels/pipes
Assessment	• All channels/pipes containing effluent are sealed and directed to the effluent system • No evidence of uncontained effluent
Risk	Seepage, run-off and leaching of effluent
Mitigation steps	Use of impermeable materials for the construction/lining of effluent channels.
Section Five	**Q. 5.9 Assess sludge piles and effluent solids bunkers**
Assessment	Sludge and solids are stored in a suitable place (e.g. not in a paddock or near a waterway). No evidence of: • Sludge stored on an unsealed/ uncontained surface • Leachate or runoff which is not captured by the effluent system
Risk	Seepage, run-off and leaching of effluent. Risk is proportional to the size of the sludge pile and proximity to waterways
Mitigation steps	Sludge stored on a sealed and contained area, with runoff and leachate directed back to the effluent system.

Photo One:
Effluent stored on an unsealed earth surface with no cover.

Photo Two:
Effluent stored on concrete surface which drains back into the effluent system. This effluent is also being stored under a covered area.

Section Five	Q. 5.10 Assess the solids separation area
Assessment	The solids separation facility shows no evidence of: • Overflowing onto land • Being constructed from permeable materials, or showing faults or damage • Potential overflows can be contained within the effluent system
Risk	• Leaching and overflow of effluent to the environment • Safety hazard
Mitigation steps	• Sealed and contained • Drains back into effluent system • Adequately sized for volume of effluent stored or processed • Separators maintained and functioning effectively • Safety provisions to protect people and animals from entering a weeping wall type storage facility; escape mechanisms, fencing, signs etc.
Comments	 Hazardous area: safety measures such as fencing and signage around the effluent system are important, and may be required to meet Department of Labour requirements.

Photo One: Slope screen separator.

Photo Two: Screw press separator and sealed concrete receiving area.

Photo Three: Weeping wall with central liquid sump

Section Five	Q. 5.11 Effluent solids spreading
Assessment	How are effluent solids managed? If applied to land, how? Solids should not be: • Applied in such a way that there is runoff to waterways • Applied too deep to cause nutrient loading problems • Dumped or piled on an unsealed surface (such as under trees, over a bank, in a rubbish pit, down a tomo etc)
Section Five	**Q. 5.12 Assess the available effluent storage**
Assessment	• Effluent storage volume available Record the following measurements for any storage facilities (m): • Length, width, depth, batter (i.e. 2:1, 1:1, 3:1 etc.)
Risk	Having insufficient emergency storage is a major environmental risk as effluent may have to be applied at unsuitable times such as during high rainfall.
Mitigation steps	Portable or temporary tanks or bladders.
Comments	 Required for the Dairy Effluent Storage Calculator. The depth may only be an estimation given by the farmer.

Section Five	Q. 5.13 Assess the effluent storage facility condition
Assessment	The effluent storage must effectively contain the effluent. No evidence of: • Storage facility being too full (within 400mm of the top) or having previously over-topped • Dark green lush grass, boggy areas on or near the pond which may indicate a leak • Cracks in the walls of the pond or slumping of walls, rabbit holes or tree roots or any other indication of poor structural integrity • Signs of crusting, vegetation growth on the pond
Risk	• Leaching and overflow of effluent to the environment • Pond or storage collapse if above ground • Safety hazard, for service access as well as staff, children and animals
Mitigation steps	• Sized in accordance with the DESC • Well designed (meets the Code of Practice, and IPENZ Practice Note 21) and constructed from impervious materials and fully sealed • Maintained to prevent crusting, weed growth, stock access etc. • Agitated or stirred as required • Surface storm water diverted away from effluent storage facility • Safety provisions to protect people and animals from entering the storage facility; escape mechanisms, fencing, signs, ladders buoyancy aides etc. Pontoon securely anchored- with safe access for servicing.

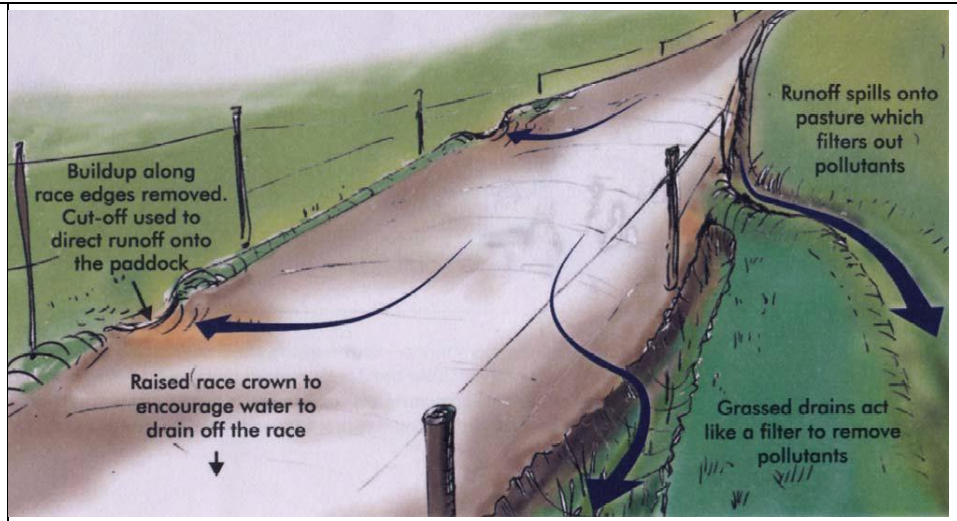
	• Water level alarms/float switches/anti-siphon valves • Green water recycling to reduce effluent volumes to be managed
Comments	Hazardous area: safety measures such as escape ladders, fencing and signage around the effluent system are important, and may be required to meet Department of Labour requirements. Assessors are advised not to attempt to inspect anything in the pond (i.e. pontoons) unless it has been removed from the pond or firmly secured against a stable and safe viewing area. It is recommended that during any inspection or works on effluent storage facilities that at least two people are present at all times.
Photo One: Concrete lined pond with safety fence. **Photo Two: Compacted earth pond with stock fence.**	 

Photo One: Severe crusting on pond.

Photo Two: Old style earth pond, possibly too small for current operation, and difficult to demonstrate that it meets sealing requirements.

Photo Three: Dark grass patches at base of pond wall and lush grass in paddock below pond indicating seepage problem.

Section Five	Q. 5.14 Assess lanes and races
Assessment	Laneways should be constructed in a way that surface water is directed off them to protect the track surface, and contaminated water is not fast tracked into freshwater. Laneways should not show evidence of effluent entering waterways.
Risk	Effluent run-off or direct deposition in waterway, sediment, N, P and pathogens
Mitigation steps	Directing water off raceways into adjacent paddocks and away from drains and waterways. Use of grassy swales, soak holes, sediment traps etc. Use cut outs prior to low lying areas and/or plantings to absorb and filter effluent
Section Five	**Q. 5.15 Assess bridges and frequently used culverts**
Assessment	Are bridges nibbed to prevent effluent reaching waterway, is there any evidence of effluent entering waterways.
Risk	Effluent run-off or direct deposition in waterway
Mitigation steps	Timber bunding or nib walling to prevent effluent running off the side of the bridge. Drainage channels to soak holes on either side of the bridge
Photo One: A bridge with nib walls on edges to prevent effluent and sediment overflow into waterway.	

Image Two: Race with drains cutting into grassy swales/pasture to filter out sediments and contaminants. ***Image courtesy of New Zealand Farm Environment Award Trust 2003.***	

Section Five	Q. 5.16 Assess underpasses
Assessment	Underpasses may have to meet both district and regional council rules. Underpasses should not show any evidence of: • Excessive surface or groundwater entering the underpass, or pooling of water on the floor of the underpass • Effluent entering surface or ground water • There should be an effluent system in place to manage effluent from the underpass
Risk	• Leaching and overflow of effluent to the environment • Excessive influx of ground or storm water, which needs to be pumped out and may be contaminated with effluent
Mitigation steps	• Well designed and constructed • Sealed to prevent seepage and run-off • Ground water, rainwater and storm water managed so it does not enter the underpass • All underpass effluent captured and managed as part of the effluent system • Designed for optimum cow flow, no pooling of water or effluent in the bottom of underpass, or large or sharp stones
Comments	Underpass design can have a significant impact on cow-flow, which influences the volume of effluent generated in the underpass.

Underpasses.

Photo One: Underpass with storm-water drain and sump.

Photo Two: Underpass with storm-water drain, effluent drain, sump and hose for cleaning occasionally.

Photo Three: Underpass showing pipework.

Section Five	Q. 5.17 Assess silage pad(s) and feed storage bunkers
Assessment	Ideally, silage pads should be a sealed pad with leachate captured and managed. There should be no evidence of: • Leachate escaping from the silage or feed bunker and entering surface water • Excessive leachate generation which is not being captured and treated in the effluent system • Any residue from a feed storage site reaching a waterway
Risk	• Highly toxic silage leachate reaching surface or groundwater • Silage pad requirements may vary depending on the type of silage. Grass silage produces more leachate than maize silage, and therefore poses a greater environmental risk.
Mitigation steps	• Stored on sealed and contained surface. Sealing requirements differ between regions, but a concrete pad is best practice, particularly for grass silage • Leachate drains into effluent system so it does not reach a waterway • Leachate is diluted and applied to land
Comments	Regional council rules regarding the sealing of silage pads varies from region to region.

Photo One: A grass silage stack with uncontained leachate. Ideally grass stacks should be on a sealed surface with a drain directed to a sump where leachate can be diluted and applied to land. This situation is a critical risk if the leachate/runoff is entering a waterway. **Photo Two: Feed storage bunkers on a sealed surface. Ideally these should be coverable, drain into the effluent system.**	 

Section Five	Q. 5.18 Assess standoff, feed pads and animal housing barns
Assessment	Standoff, feed pads and barns vary in their construction and use. The facility must be designed and constructed in such a way that it is sealed to prevent leachate losses. Leachate must be captured and managed via sub-surface drainage. **Look for evidence of:** • Effluent running off the pad and entering surface (or ground) water. • Ineffective sealing to prevent leaching losses **Estimation the following factors for each month of the year:** • Average Daily cow numbers on the pad • Average hours per day spent on the pad • Average daily wash volume
Risk	• Seepage, leaching and run-off Animal health and welfare risks
Mitigation steps	• Constructed from suitable material to maintain a durable surface underfoot in wet conditions • Constructed drainage and effluent leachate capture and management under standoff pads and areas which do not have a sealed surface
Comments	 Regional council requirements vary. Required for the Dairy Effluent Storage Calculator

Section Five	Q. 5.19 Assess the wash-down system on pads
Assessment	**Assess the following:** • How is the pad cleaned, • The frequency of cleaning • The method of cleaning (clean water, recycled effluent water or scraping) • Daily water volume used for cleaning
Risk	Pads can be a significant contributor to total annual effluent volumes. Pad effluent is typically very high in solids, which may block effluent irrigators if a solids separation system is not in place
Mitigation steps	Effluent water recycling can significantly reduce effluent volumes and conserve water The use of scrapers can also be an effective method of cleaning pads
Comments	 Required for the Dairy Effluent Storage Calculator

Section Five	Q. 5.20 Assess health and safety around the effluent system infrastructure
Assessment	• Examples could include but are not limited to evidence of: • Safety fencing or covers around or on sumps, silt traps, channels, effluent ponds to make them safe for children, stock and farm staff. • Appropriate safety signage is in place • Safety ladders, life buoys, safety ropes installed in ponds • All electrical work is done to industry standards • Access to pontoons, pumps, stirrers etc. is safe with appropriate safety measures in place • All moving parts are appropriately guarded where possible • All safety equipment used in the operation of the effluent system is fit for purpose • All equipment used in the operation of the effluent system is well maintained • That operation and servicing of the system can be and is carried out in a safe manner • Shut off valves fitted on hydrants • Pressures levels are within safe limits • Equipment required to safely shift applicators is available

Photo One: A fully fenced sump

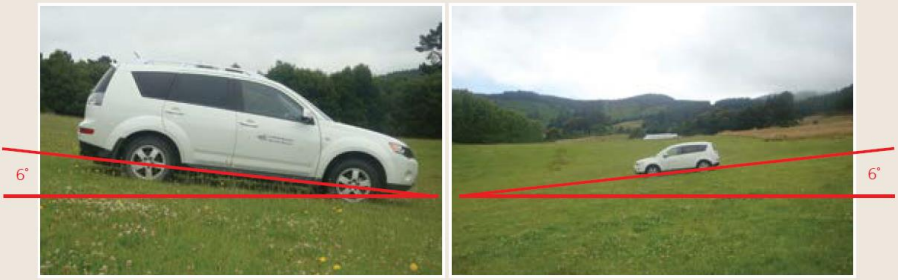
Section Five	Q. 5.21 Assess mole and tile drains in paddocks
Background	Tile drainage removes excess water from subsoil's. Tiles are most likely to be installed in poorly drained soils. They are a gravity passive fed system that carries excess water from sub soil's to a drainage ditch, wetland or waterway. Traditional tiles were solid and water entered between the gaps and drained away however flexible corrugated and perforated plastics are often now used. A lot of tiles were installed but no mapping record of them kept. Most farmers will know if they have tiles on their farm, however they may not know where all of them are as often the tile outlets can be 2-3 farms away.
Assessment	To help identify tiles you can look at the topography of the land. Tiles are normally placed under a swale (dip of low lying land) from higher to lower lying areas or waterways. Look for points where naturally water would flow to. Grass or crops are often lush in these areas, Wetland style plants often grow in swales. If you look along ditches and waterways you will often see tile outlets, sometimes they are buried under long grass but you may hear water running from tile to waterway.

Drains should not be showing any signs of dairy effluent	 
Swales can be identified by low lying areas and assessing wetland plant species present	

Wetland Plants include rushes, sedges and docks	   

SECTION SIX- SOIL AND LANDSCAPE CLASSIFICATION

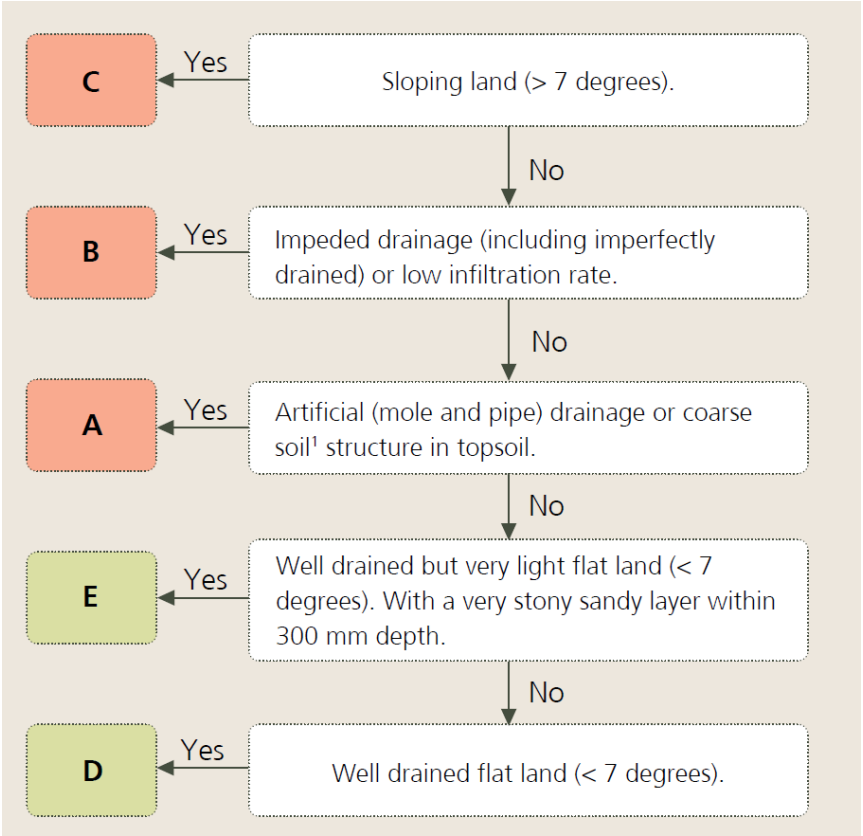
This classification system is used to determine the soil risk profile for the effluent application area. Soil and landscape features may be categorised into one of the five classifications listed on the following page. Use the methods described in the DairyNZ *Pocket guide to determine soil risk for farm dairy effluent application* to assess the soil risk on the farm. A smart phone with a clinometer may be helpful for assessing slope. The images below show a car parked on 6° and 14° slopes.



A 6˚ slope – this is the upper limit of what a traveller should be used on, to manage effluent runoff risks.

A 14˚ slope – this is too steep for irrigation with a travelling irrigator, a suitable low rate system should be used instead.

SOIL RISK CLASSIFICATION FRAMEWORK



	1. High risk soils for effluent management			2. Low risk soils for effluent management	
Category	**A**	**B**	**C**	**D**	**E**
Soil and landscape feature	Artificial drainage or coarse soil structure	Impeded drainage or low infiltration rate	Sloping land (>7°) or land with hump & hollow drainage	Well drained flat land (<7°)	Other well drained but very light flat land (<7°)
Risk	High	High	High	Low	Low
Application depth (mm)	< SWD[1]	< SWD	< SWD	< 50% of PAW[2]	≤ 10 mm & < 50% of PAW[2]
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
Max depth: High rate tool	10 mm	10 mm	10 mm[3]	25 mm[4] (10 mm at field capacity)	10 mm
Max depth: Low rate tool	25 mm	25 mm	10 mm	25 mm	10 mm

[1] SWD is the soil water deficit
[2] PAW is the plant available water in the top 300 mm of soil
[3] Only applicable when instantaneous application rate from the irrigator is less than the infiltration rate
[4] Suggested maximum application depth when a suitable SWD exists (≥ 15 mm).

High risk soil classifications:

Soil and landscape categories A and B:

Soils which drain very rapidly, i.e. mole and tile or artificial drainage. Includes very freely draining coarsely textured soils e.g. stony soils with a thin topsoil. The main risk on these soils is preferential flow (effluent bypassing the soil and making its way into ground and surface water quickly).
Impeded drainage or low infiltration rate soils are very slow to drain; these may be heavy high clay content soils which pug easily. The main risk on these soils is ponding and runoff.
These soils suit low rate application systems because of improved control over application rate and depth.

Soil and landscape category C:

Sloping land (>7°) or land with hump and hollow drainage. The main risk is runoff on these soils. A low rate application system is the only practical way of applying effluent without ponding and runoff.

Low risk soil classifications:

Soil and landscape category D:

Well drained flat land (<7°) refers to soils which are generally wet-weather-safe, with deep free draining subsoil. The main risk on these soils is over-application of nutrients.

Soil and landscape category E:

Other well drained but very 'light' flat land (<7°) refers to soils which drain well but may have a very thin topsoil. They don't typically have effluent or wet weather risks. The main risk on these soils is leaching of effluent past the root zone.

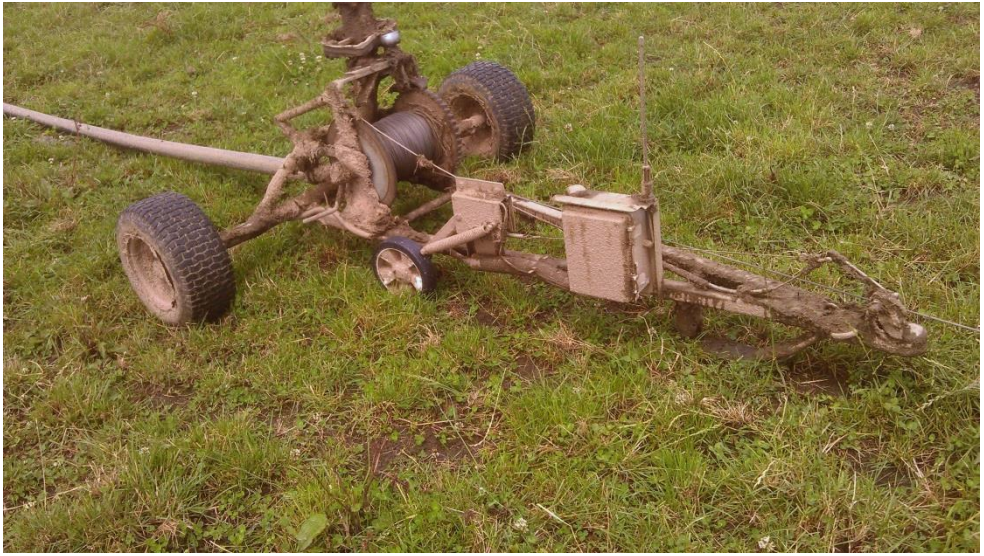
Section Six	Q. 6.1 Identify the soil types and soil risk on the effluent block
Assessment	Soil risk classified as 'Low Risk' or 'High Risk' using Soil Risk Framework. • High risk area Ha • Low risk area Ha • Total effluent area Ha? Also: • No effluent should be applied to waterways • High risk effluent application areas containing surface and subsurface drains are managed to prevent effluent entering them
Risk	Failure to recognise soil and landscape limitations can result in losses of effluent, nutrients and pathogens to surface and ground water.
Mitigation steps	Soil maps of the effluent application areas; identifying high and low risk soils, and other high risk features such as waterways and natural and artificial drainage. Some regional councils specify minimum distances to be observed for effluent application around sensitive features (e.g. waterways, geological features, property boundaries). Essentially no effluent (including odours) should be allowed to leave the property boundary. Match the effluent applicator and depth and rate of application to the soil and landscape characteristics and the soil moisture and climate parameters.
Comments	 Required for the Dairy Effluent Storage Calculator.

SECTION SEVEN- ASSESSING LAND APPLICATION SYSTEMS

Section Seven	Q. 7.1 Assess pipelines/hydrants/couplings
Assessment	• Sized appropriately for their function • Well maintained no sign of leaks or damage
Risk	• Breakdown, pressure blowout • Leaching and overflow of effluent to the environment
Mitigation steps	Pipes sized appropriately for their function, and made from suitable non-corrosive material (typically PVC, Alkathene or stainless steel). Pipes are inspected regularly for sign of leak or strain and repaired as required.
Comments	Long distances using an incorrectly sized pipe will impact on irrigation and pump performance due to pressure head loss
Section Seven	**Q. 7.2 Are effluent pipe joints or hydrants within 10m of a waterway?**
Assessment	• Visually inspect this while on farm where practical • Farm maps or aerial photographs with farm infrastructure mapped out
Risk	Leak or breakdown, uncoupling leading to direct entry of effluent to a waterway.
Mitigation steps	Joint or hydrant on a slope leading away from the waterway, or bunding or drain, physical barrier which would prevent effluent entering the waterway

Section Seven	Q. 7.3 Assess any 'fail-safe' technologies
Assessment	Evidence of 'fail-safe' devices fitted to the storage or application system
Risk	'Fail-safe' technology can be a risk mitigation strategy for preventing effluent losses to the environment
Mitigation steps	• Pressure gauge at the pump • Pressure gauge at the applicator • High/low pressure cut-off • End of run cut-off switches • Flow meter installed • Alarms and lights • Float/level alarms or switches on ponds and sumps • Soil moisture meters and monitoring • Automatic switch-off on pump • Anti-siphon on pond and or applicator indexing valve • Witness wells/drains under ponds • Some farm management software (i.e. recording, GPS, planning, monitoring etc.)
Comments	Some technologies may be required by a regional council, however most of them are good practice for management and compliance, and part of the Code of Practice.

Photo One: An example of a 'fail-safe' technology- a tracking system on a travelling irrigator



IRRIGATORS AND APPLICATORS

Facility	Assessment
Q. 7.4 What type of effluent irrigator/applicator is onsite	Note the following: • Type (and number if there are multiple units) • Age • Condition • Frequency of use
Q. 7.5 What type of pump(s) is in use	• Size (horse Power/Kilowatts) • Type (centrifugal, progressive cavity or piston pump)
Q. 7.6 Winter-Spring application depth	Use historical or current application depth tests available, or estimate if the rate is varied throughout the year (mm)
Q. 7.7 Spring- Autumn application depth	Use historical or current application depth tests available, or estimate if the rate is varied throughout the year (mm)
Q. 7.8 Winter- Spring volume pumped	• m^3/hour • Hours pumped per day • Total daily volume applied
Q. 7.9 Spring- Autumn volume pumped	• m^3/hour • Hours pumped per day • Total daily volume applied
Q. 7.10 Is the farmer able to irrigate all year around when conditions permit?	• List any times during the year when no irrigation occurs

OPTIMUM PRESSURE RANGES FOR COMMONLY USED EFFLUENT APPLICATORS

The tables on the following pages summarise the optimal operating pressure range for commonly used effluent applicators. Effluent pressure at the applicator can provide information on the following points:

If the pressure is sub optimal then:

- Pump may be too small or in need of service
- Pressure-head-loss in transit (pipe too long or too small, or elevation or distance too great for the pump)

Follow the manufacturer's specifications regarding the use of pressure gauges, including any calibration and maintenance requirements. Pressure gauges should be placed in-line as close as possible to the component (i.e. pump, hydrant, applicator) as possible.

Additional information about specific irrigators may be found at the manufacturer's website.

Travelling Irrigators	Optimum Operating Pressure Range psi/kpa	Flow expected at ideal pressure range	Wetted width at ideal pressure range	Website for more information
Williams GB Magnum	200 - 600 kpa	5 - 20 lps	51 -90 metres	williamsirrigation.com/online/GB_Magnum/
Williams Greenback Spider	200 - 600 kpa	5.5 - 8.4 lps	30 - 50 metres	williamsirrigation.com/online/greenback_spider/
Williams Spider Deluxe	150 - 600 kpa	4.4 - 7.2 lps	25 - 34 metres	williamsirrigation.com/online/spider_deluxe_travelling_irrigator/
Numedic Adcam® 750	200 - 600 kpa	5.5 - 8.4 lps	20 - 35 metres	numedic.co.nz/Presentation/Presentation1.aspx?ID=2919
Briggs 10	15-30 psi / 100-200 kpa	2 - 5.5 lps	Up to 25 metres	rainer.co.nz/effluent/spreaders/model-10/
Briggs 15	20 - 30 psi / 150-250 kpa	2 - 6 lps	Up to 35 metres	rainer.co.nz/effluent/spreaders/model-10/
Ecostream	20 - 100 psi / 70-750 kpa	3 - 8 lps	Up to 30 metres	ecostream.co.nz/shop/Irrigators/Travelling+Irrigator.html
Plucks LP35E	At 200 kpa	6 lps	Up to 33 metres	plucks.co.nz/eff_Irrigators/
Irrimax 16-14 (2 cams & 2 sprockets available)	200 - 350 kpa	4 - 6 lps	35-40 metres	irrimax.co.nz/images/one.jpg
Hi-Tech Cobra	45-60 psi / 300 – 500kpa	2.8 – 8.61 lps / 10– 31m3/hr	46-72 metres	hitechenviro.co.nz
Pumpn Torpedo	40-140psi	9-72m3/hr	10-102 metres	pumpn.co.nz

Sprinklers/pod Irrigators	Optimum Operating Pressure Range psi/kpa	Flow expected at ideal pressure range	Wetted width at ideal pressure range	Website for more information
Uni- Sprinkler 8mm nozzle	150 -400 kpa	.8 - 1.3 lps	31 - 41 metres	hitechenviro.co.nz/shop/Dairy+Effluent+Equipment/Uni+Sprinkler.html
Uni- Sprinkler 9mm nozzle	150 -400 kpa	1 - 1.6 lsp	33 - 42 metres	hitechenviro.co.nz/shop/Dairy+Effluent+Equipment/Uni+Sprinkler.html
Uni- Sprinkler 10mm nozzle	150 -400 kpa	1.3 - 2 lps	34 - 44 metres	hitechenviro.co.nz/shop/Dairy+Effluent+Equipment/Uni+Sprinkler.html
Uni- Sprinkler 12mm nozzle	150 -400 kpa	1.8 - 3 lps	34 - 47 metres	hitechenviro.co.nz/shop/Dairy+Effluent+Equipment/Uni+Sprinkler.html
Uni- Sprinkler 14mm nozzle	200 - 500 kpa	3.3 - 5.2 lps	45 - 58 metres	hitechenviro.co.nz/shop/Dairy+Effluent+Equipment/Uni+Sprinkler.html
K Line Std - Naan 5002	200 -300 kpa	.16 - .3 lps	22 - 25 metres (dependant on nozzle size)	rxplastics.co.nz/k-line-std-effluent
K Line Mid - Senninger 5023	200 - 300 kpa	.4lps - 1 lps	24 - 29 metres (dependant on nozzle size)	rxplastics.co.nz/k-line-mid-effluent
K Line Maxi 70 - Senninger 7025	250 - 300 kpa	.5 lps - 2 lps	40.2 - 43.6 metres (dependant on nozzle size)	rxplastics.co.nz/k-line-mid-effluent
K Line Max 80 - Senninger 8025 S	251 - 300 kpa	1.66 lps - 4.5lps	50m - 51m (dependant on nozzle size)	rxplastics.co.nz/k-line-mid-effluent
Uni- Sprinkler 8mm nozzle	150 -400 kpa	.8 - 1.3 lps	31 - 41 metres	hitechenviro.co.nz/shop/Dairy+Effluent+Equipment/Uni+Sprinkler.html
Uni- Sprinkler 9mm nozzle	150 -400 kpa	1 - 1.6 lsp	33 - 42 metres	hitechenviro.co.nz/shop/Dairy+Effluent+Equipment/Uni+Sprinkler.html

ASSESSING IRRIGATOR PERFORMANCE

A depth and rate test in combination with a maintenance check, speed test (for moving irrigators) and pressure test will provide a comprehensive assessment on the irrigator performance and fitness for purpose. If a depth and rate test is unable to be carried out on the day due, the combination of other assessments will provide a fair evaluation, however a disclaimer stating that an inconclusive assessment was carried out must be provided to the farmer, and if practical a return visit to complete the depth and rate test is advisable.

A rough estimate of depth applied from an applicator can be found if the flow rate and the wetted diameter and speed of the applicator are known.

To work out the area of a circular spray pattern use Πr^2

Then flow rate (L/sec) x time ÷ area = depth applied.

MAINTENANCE AND CONDITION CHECKS ON TRAVELLING IRRIGATORS.

There are at least 10 different commonly used types of Travelling Irrigator. Assess the irrigator for the following criteria if they apply.

Criteria	Assessment
Q. 7.11 Effluent block	Terrain (less than 7^{o} slope) and soil type (Low Risk soil classification) in effluent application area is suitable for this travelling irrigator.
Q. 7.12 Winch rope, anchor point, & auto stop clamp	• Appropriate rope diameter • Suitable anchor point connection • Auto-stop clamp fitted • Adequate wire rope length • No sign of fraying • No sign of rust
Q. 7.13 Tower / riser	• No evidence of leaks • No evidence of wear / play in bushes or bearings • Rotates smoothly
Q. 7.14 Axles and drive-shafts	• Straight (no damage/bends) • Shear/roll pins correct & intact
Q. 7.15 Bushes on axles, shafts	No excessive wear in bushes, check for play/movement
Q. 7.16 Drum teeth & ratchets / pawls	• Check for wear & damage on teeth • Rotate boom arm, check teeth are engaging correctly • Drive pawl clearances are correct

Q. 7.17 Drive cams & follower	No evidence of wear & damage • Check cam & follower for wear/ play • bushes/ bearings for wear/ play & turning freely
Q. 7.18 Drive chains & sprockets	• Correct alignment • Wear in chain / sprocket, bent teeth
Q. 7.19 Gear boxes	• Turning freely & smoothly • Drive shafts are not bent • Shear pins correct and intact
Q. 7.20 Winch drum brake	1-2 brakes, are present and adjusted
Q. 7.21 Auto stop	• Works correctly on stop clamp • Drive mechanism disengages correctly & fully
Q. 7.22 Automatic cut off valve	• Cuts off flow to irrigator completely at end of run • Pump also shuts down when valve closes
Q. 7.23 Electronic monitoring	If used or relied upon, is active, calibrated, maintained and effective
Q/ 7.24 Bracing rods / wires	Firmly secured & correctly tensioned
Q. 7.25 Boom arms	• Secure & undamaged • Hinge joints / locks in good condition
Q. 7.26 Nozzles	• Hole size (too large will decrease pressure) • Not cut/worn/split/perished/stretched/blocked • Clamped firmly (quick release fittings on nozzles such as camlock/bayonet will allow for easy nozzle removal. Nozzles should be changed at the same

	frequency as rubberware in the dairy)
Q. 7.27 Quick-locks	• Seals are not missing • Locking legs not broken
Q. 7.28 Wheels	• Optimum tyre pressure / condition noted
Q. 7.29 Drag hose condition	• Length • Splits/ leaks/crimped or kinked • Camlocks • Correct grade of pipework (pressure and size) • 150-200m is generally accepted as maximum recommended drag hose length
Q. 7.30 Camlocks	• No damage • Easily pull apart / fit together • Locking legs in place, not broken • Clamped firmly / correctly to pipe • Fitted in correct direction so locking legs are trailing (not facing direction of travel where they can catch and pull open)
Q. 7.31 Drag hose layout	• Laid correctly to minimise drag on irrigator • No more than 3m distance between guide wire and outgoing hose loop
Q. 7.32 Grease nipples	• All grease nipples are in place • Greased at all points regularly e.g. every time the irrigator is shifted

Q. 7.33 Siphoning	• No sign of effluent flowing from Irrigator after pump is shut off, or effluent puddles / signs of siphoning evident in paddock.
	• Anti-siphon options are:
	  ○ Air inlet valves usually at the pump, or
	  ○ End of run shut off valves, or
	  ○ Saunder's type fitted near irrigator
	  ○ Backflow prevention

Q. 7.34 Pressure at irrigator	• Check with inline pressure gauge as close as possible to the applicator.
Q. 7.35 Previous application	Look for any evidence of sub-optimal irrigation application in the past: • Blinding of pasture (heavy matting of effluent) • Ponding • Crop circles (dark circles or doughnuts)

MAINTENANCE AND CONDITION CHECKS ON LOW RATE (SPRINKLER AND POD) IRRIGATORS.

There are several sprinkler / pod manufacturers /sellers using impact sprinkler guns mounted in different ways. While the guns can be made from different materials such as metal alloys or plastics and mounted in various types of pods or on skids they all operate on the same basic principle.

Setup configurations can vary, for example: multi sprinkler / pod chains, permanently fixed sprinklers in paddock or long lateral multi sprinklers.

Sprinklers / pods size and specifications vary and can be used to achieve different aims:

- Nozzle opening sizes from 3.2 mm to 18 mm are common. Nozzle size has a large effect on application rate.
    - Small nozzle sizes result in a lower application rate, but may require a solids separation system to operate
    - Small nozzles increase pumping time
    - Large nozzle sizes result in a higher application rate and depth, and may not require a solids separation system

A low rate system with a timer allows pulse irrigation. Change in pump on and off times can be varied to meet the soil conditions at the time of irrigation.

Note: Application rate x application time = Application depth

Assess the irrigator for the following criteria if they apply.

Criteria	Assessment
Q. 7.36 Effluent block	Is the type of sprinkler/pod system suited to the terrain and soil type, based on the soil risk classification and the application depth/rate of the irrigator?
Q. 7.37 Tower / riser	• No sign of leaks • No sign of wear in bushes/bearing rotates smoothly
Q. 7.38 Sprinkler body	• Turns freely through full circle • Has acceptable amount of movement in bushes (10-15% from centre of bush)
Q. 7.39 Quick-locks	• Seals are not missing • Locking legs not broken
Q. 7.40 Impact arm	• Moves freely • Has acceptable amount of movement in bushes (10-15% from centre of bush) • Returns correctly • Jet breaker wedge is in good condition • Sprinkler turns through its full range correctly and smoothly
Q. 7.41 Mounting	Mounting / base is secure and stable
Q. 7.42 Automatic cut-off valve	• Cuts off flow to applicators completely at end of run • Pump also shuts down when valve closes
Q. 7.43 Pump Run timer	Recommended to control irrigation time and therefore application depth. If in place, is it used and effective?
Q. 7.44 Electronic monitoring	If used or relied upon, is active, calibrated, maintained and effective
Q. 7.45	• Hole size (too large will decrease pressure

Nozzles	and performance) • Not cut / worn / split perished/blocked • Secured firmly
Q. 7.46 Hose condition	• Length • Splits/ leaks/ damage • Camlocks • Correct grade of pipe (pressure and size)
Q. 7.47 Hose layout	• Pods/sprinklers are not overlapping
Q. 7.48 Camlocks	• No damage • Easily pulls apart / fits together • Locking legs in place, not broken • Seals are not missing • Clamped firmly / correctly to pipe • Fitted in correct direction so locking legs are trailing behind, not digging into soil.
Q. 7.49 Siphoning	• Effluent flowing from applicator after pump is shut off • Effluent puddles / signs of siphoning evident in paddock. Anti-siphon options are: ○ Air inlet valves usually at the pump, or ○ End of run shut off valves, or ○ Saunder's type fitted near irrigator.
Q. 7.50 Pressure at sprinklers	Check with an inline Pressure Gauge. Ensure gauges are fitted in place on main pipe not on lateral pipes
Q. 7.51 Previous applications	Look for any evidence of sub-optimal irrigation application in the past: • Blinding of pasture (heavy matting of effluent) • Ponding • Crop circles (dark circles or doughnuts)

MAINTENANCE AND CONDITION CHECKS ON CANNON IRRIGATORS.

Cannons can be mounted on various types of skids or on trailers.

Sprinklers / pods size and specifications vary and can be used to achieve different aims:

Nozzle opening sizes from 10mm to 18mm are common. Nozzle size has a large effect on application rate.

- Small nozzle sizes result in a lower application rate, but may require a solids separation system to operate
- Large nozzle sizes result in a higher application rate, and may not require a solids separation system

Pulse irrigation such as 1 hour on / 1 hour off / 1 hour on, may be required to avoid effluent ponding and run off. Alternatively, 15 minutes in one hour until required depths are met.

Note: Application rate x application time = Application depth

Assess the irrigator for the following criteria if they apply.

Criteria	Assessment
Q. 7.52 Effluent block	Cannons are often used to irrigate onto sidings and hillsides where there is high risk of runoff and ponding. There are often waterways at the bottom of these irrigated areas resulting in the possibility of effluent entering the waterway. It is important to ensure that the type of sprinkler/pod system is suited to the terrain and soil type, based on the soil risk classification and the application depth/rate of the irrigator.
Q. 7.53 Tower / riser	• No sign of leaks • No sign of wear / movement in bushes/bearing • Main body rotates smoothly • Grease nipples greased regularly (every time irrigator is shifted is a general rule)
Q. 7.54 Sprinkler main body	• Turns freely through full circle • Has correct amount of movement in bushes
Q. 7.55 Impact arm	• Moves freely and smoothly • Has correct amount of movement in bushes or bearings. • Returns correctly • Sprinkler turns through its full range correctly and smoothly
Q. 7.56 Jet breaker / wedge	• Jet breaker is in good condition • No sign of wear • Moves freely • Works effectively to move the impact arm as required to move the main body through its correct range of movement

Q. 7.57 Inversion Ring	• Controls application areas to full or part circle , • Check levers, arms & pins are free and working correctly
Q. 7.58 Mounting	Mounting / base is secure and stable
Q. 7.59 Quick-locks	• Seals are not missing • Locking legs not broken
Q. 7.60 Automatic cut-off valve	• Cuts off flow to cannon completely at end of run • Pump also shuts down when valve closes
Q. 7.61 Pump Run timer	Recommended to control irrigation time and therefore application depth
Q. 7.62 Electronic monitoring	If in place, is it used and effective?
Q. 7.63 Nozzles	• Hole size (too large will decrease pressure) • Not cut / worn / split Perished • Clamped firmly
Q. 7.64 Drag hose condition	• Length • Splits/ leaks • Camlocks • Correct grade of pipework (63mm Outside Diameter for alkathene pipes, and 110mm Inside Diameter for PVC pipes)
Q. 7.65 Camlocks	• No damage • Easily pulls apart / fits together • Locking legs in place, not broken • Seals are not missing • Clamped firmly / correctly to pipe • Fitted in correct direction so locking legs

	are trailing behind and not digging into the soil
Q. 7.66 Siphoning	• Effluent flowing from applicator after pump is shut off • Effluent puddles / Signs of siphoning evident in paddock Anti-siphon options are: ○ Air inlet valves usually at the pump, or ○ End of run shut off valves, or ○ Saunder's type fitted near irrigator.
Q. 7.67 Pressure at cannon	Most cannons require a minimum pressure of 30 psi to operate efficiently.
Q. 7.68 Previous applications	Look for any evidence of sub-optimal irrigation application in the past: • Blinding of pasture (heavy matting of effluent) • Ponding • Crop circles (dark circles or doughnuts)

MAINTENANCE AND CONDITION CHECKS ON PIVOT IRRIGATORS.

Pivot irrigators are often a combination of fresh and effluent irrigation. Either a 'shandy' where effluent is mixed into freshwater and applied through the same nozzles, or where effluent is carried through a separate hose.

Pivots performance can be assessed in a similar way to travelling irrigators, although the variance in travel speed along the length of the pivot must be taken into account, and therefore effluent tests carried out as close to the centre of the pivot circle as possible, where the greatest application potential is. In addition, if mounted guns are used on pivots, depth and rate tests should be done under these.

Consider if any sensitive areas are excluded for effluent application such as over waterways, tracks and roads etc. Look for signs of ponding or runoff occurring on pivot wheel tracks, especially on hill country.

Pivot systems do not need an application depth test completed if the pivot system passes the visual inspection below, the effluent is diluted with water through the main pivot system and the farmer has a 'Backflow Prevention Certificate'.

However, if using underslung nozzles and/or guns at the end of the pivot then an application depth test needs to be completed.

There are at several different commonly used types of Centre Pivots. Assess the irrigator for the following criteria if they apply.

Criteria	Assessment
Q. 7.69	Has the farmer a 'Backflow Prevention Certificate (needed for effluent mixed with water and under-slung systems)?
Q. 7.70 Effluent block	Is the centre pivot system suited to the terrain and soil type, based on the soil risk classification and the application depth/rate of irrigator?
Q. 7.71 Base of Pivot	• No evidence of leaks • No evidence of wear • Back flow prevention installed (if required)
Q.7.72 Automatic cut-off valve	• Cuts off flow to applicators completely at end of run • Pump shuts down when valve closes
Q.7.73 Pump Run timer	• Recommended to control irrigation time and therefore application depth. If in place is it used effectively?
Q.7.74 Electronic monitoring	• If in place, is it active, calibrated maintained and effective • Set to cut off around waterways and/or property boundary
Q. 7.75 Pressure at irrigator	• Check with inline pressure gauge as close as possible to the applicator.
Q. 7.76 Hose lines/ Span joints	• No evidence of wear & damage • No leaks/splits • Correct grade of pipe (pressure and size)

Q. 7.77 Sprinklers/Nozzles	• Turns freely through full circle • Hole size (too large will decrease pressure) • Not cut/worn/split/perished/stretched or blocked • Secured firmly
Q.7.78 Wheels	• Axles are straight (no damage/bends) • Optimum tyre pressure / condition • Rims not rusted/buckled etc. • Any indications of gearbox oil leaks (can lead to seizures and stoppages)
Q. 7.79 Previous application	Look for any evidence of sub-optimal irrigation application in the past: • Blinding of pasture (heavy matting of effluent) • Ponding • Crop circles (dark circles or doughnuts) • Tyre rut marks (potential for effluent to pool)

MEASURING DEPTH AND RATE OF EFFLUENT IRRIGATION

WIND GAUGES

Prior to starting the depth and rate test, take a wind speed assessment. Note the direction and strength of the wind. Do not attempt to do a depth and rate test if the wind strength exceeds 8 ms^{-1}.

Follow any manufacturer's instructions for use of the wind gauge, including calibration requirements.

TEST PREPARATION

Test location

Test the application depth at the location which puts the pump under the greatest work load, e.g. at the greatest distance from the pump, or at the highest elevation above pump station.

Collection containers

When testing you can use either rectangle trays or standard round buckets. You will need about 60 of these. You must use a different calculation depending on the type of collection container.

Step 1:

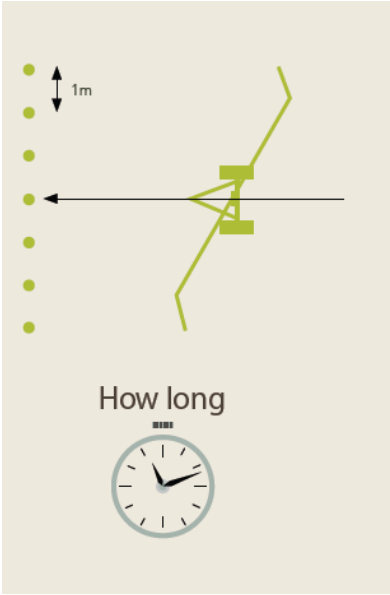
Containers

Before applying effluent, put containers in a line across the path of the applicator[5]:

1. 1-metre apart avoiding the line of the wheels or drag hose

2. Use enough containers across the spray width of the irrigator (up to 60), take into account wind drift

3. Put a stone in each container to stop it blowing over.



Step 2:

Run irrigator

Run the irrigator as normal:

1. Record the actual amount of time that effluent is falling in the containers.

Step 3:

Measure the depth of effluent in every 'wet' container.

[5] *The variance in travel speed along the length of pivots must be taken into account, and therefore effluent tests carried out close to the base, middle and end of pivot where effluent is irrigated. In addition, if mounted guns are used on pivots, depth and rate tests should be done under these.*

For RECTANGLE TRAYS:

1. Remove stone

2. Tip effluent into measuring jug record the volume (ml)

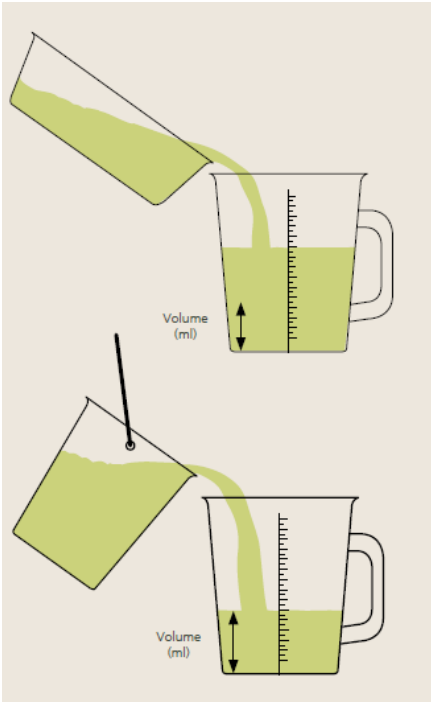
3. Write down volume for each container.

For ROUND BUCKETS:

1. Remove stone

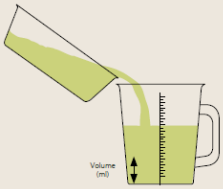
2. Tip effluent into measuring jug record the volume (ml)

3. Write down volume for each container.



Calculations

Rectangle containers



Record the depth from each container, e.g. on a sprinkler with a 40 m diameter wetted area, there may be 20-40 containers.

Container 1	+	Container 2	+	etc ...	+		+		+		+		TOTAL (ml)

TOTAL (ml)	÷	NUMBER OF CONTAINERS	=	AVERAGE VOLUME (ml)

CONTAINER WIDTH (mm)	X	CONTAINER LENGTH (mm)	=	CONTAINER AREA (mm^2)

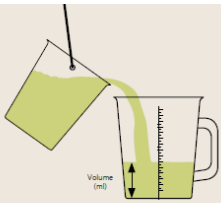
1000	X	AVERAGE VOLUME (ml)	÷	CONTAINER AREA (mm^2)	=	AVERAGE APPLICATION DEPTH (mm)

AVERAGE APPLICATION DEPTH (mm)	÷	TIME (hrs) (e.g 1hr 15 mins = 1.25 hrs)	=	AVERAGE APPLICATION RATE (mm/hr)

Note: Maximum application depth = The CONTAINER with the deepest measurement.

Tip: To convert seconds or minutes to decimal, divide by 60 e.g. 21 mins = 21 ÷ 60 = 0.35 hrs.

Round containers



Record the depth from each container, e.g. on a sprinkler with a 40 m diameter wetted area, there may be 20-40 containers.

Container 1	+ Container 2	+ etc ...						TOTAL (ml)

TOTAL (ml)	÷	NUMBER OF CONTAINERS	=	AVERAGE VOLUME (ml)

CONTAINER WIDTH (mm)	÷	2	=	CONTAINER RADIUS (mm)

3.14	X	CONTAINER RADIUS (mm)	X	CONTAINER RADIUS (mm)	=	CONTAINER AREA (mm²)

1000	X	AVERAGE VOLUME (ml)	÷	CONTAINER AREA (mm²)	=	AVERAGE APPLICATION DEPTH (mm)

AVERAGE APPLICATION DEPTH (mm)	÷	TIME (hrs) (e.g 1hr 15 mins = 1.25 hrs)	=	AVERAGE APPLICATION RATE (mm/hr)

NOTE: Maximum application depth = The CONTAINER with the deepest measurement.

Tip: To convert seconds or minutes to decimal, divide by 60 e.g. 21 mins = 21 ÷ 60 = 0.35 hrs.

For assistance and advice on testing application depths and rates on pivot systems, please contact DairyNZ.

SPEED TEST FOR TRAVELLING IRRIGATORS

The speed of a travelling irrigator can be assessed after starting a depth and rate test.

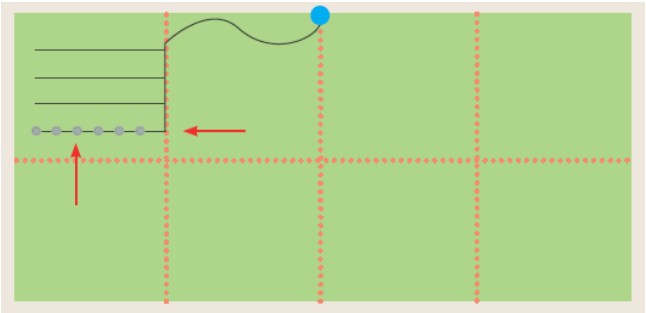
Using a straight piece of hose behind the irrigator, mark a set distance such as 5m along the drag hose. Mark this distance on the hose using spray paint (such as stock raddle) or electrical tape, and when you are ready to start recording, place a stationary marker on the ground (either a pig-tail fencing standard or again using spray paint on the grass).

Measure the time taken for the hose markers to move over time.

Distance/minute	**Result**
>1m/minute	Optimal
1m – 0.8m/minute	Good
<0.8/minute	Slow
<0.5/minute	Very slow

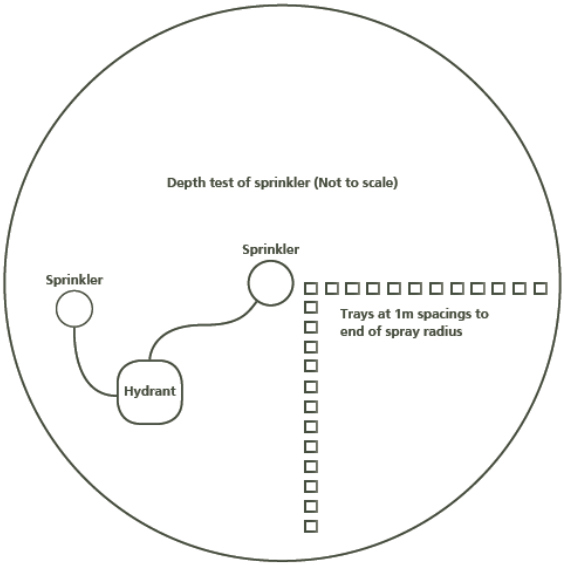
Step 1: Location

Go to the middle pod on the last pod line in the series (furthest away from the hydrant)



Step 2: Layup containers

Lay out collection containers out in an "L" shape from the middle pod. Containers should be spaced at 1 m intervals and cover right to the edge of the spray area of the pod. Put a stone in each container to stop it blowing over if needed.



Step 3: Turn on

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

Step 4: Measure how much

Measure the depth of effluent in every 'wet' container.

For RECTANGLE TRAYS:

1. Remove weight

2. Tip effluent into measuring jug record the volume (ml)

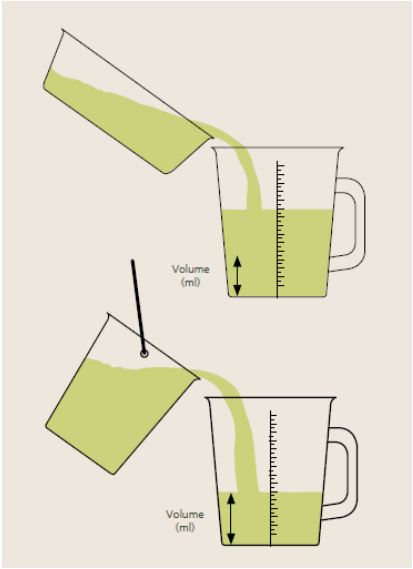
3. Write down volume for each container.

For ROUND BUCKETS WITH SLOPING SIDES:

1. Remove weight

2. Tip effluent into measuring jug record the volume (ml)

3. Write down volume for each container.



Matching the method of application of the pivot to the different type of tests required has been broken down into three different application tests.

Type 1: Injection Systems

An injected system is a system that injects the effluent into the water mainline of the pivot and irrigates it through the existing pivot nozzles. This can be as a mixture of effluent and water or raw effluent on its own. The pivot nozzles should be calibrated for an even distribution of water and effluent so that the same depth is delivered over the entire pivot span.

A visual inspection of the pivot nozzles applying effluent should be done to identify any issues or underperforming nozzles. If this is identified, then an application test using the same methodology as an underslung system (see below) should be done to identify any problems.

If there is no visual problem evident on the pivot (general condition, blocked nozzles), the application depth can be recorded from the control box on the pivot. This depth can then be put into the data capture form under application depth and no further application test is required for the pivot.

If the application depth is not displayed, then an application test along the same methodology as an underslung system would be required.

Type 2: Underslung Systems

An underslung system is a system that transports effluent to the pivot in a separate mainline to the water, and the effluent mainline is then “slung” under the pivot spans. The application test of this should be broken down into four main areas as described below.

We recommend that an application test be done at the beginning of the application area of effluent for the pivot, the middle of the effluent application area of the pivot and at the end of the effluent application area of the pivot. Also if the effluent is pumped through an end gun then this should also be tested.

Buckets should be placed evenly under the effluent nozzles out to the end of the wetted width, there may be some overlap, with the centre being the dropper position, and cover as much the span as possible.

Type 3: Tower Cannon systems

Pivots that use cannons at the towers should also be tested by following the same methodology as a travelling irrigator for the test for depth and rate.

The testing should be done on at least one tower and if only one is tested, the closest tower available to the centre of the pivot should be tested as this will give the greatest depth and rate as it will be the slowest moving tower available.

To Test Underslung Systems,

Step 1: Containers

1. Before starting the pivot and applying effluent make sure the fresh water is turned off to the pivot.

2. At each area of application test (beginning, middle, end and gun) put 5-10 containers evenly spaced from the centre of each span of the pivot.

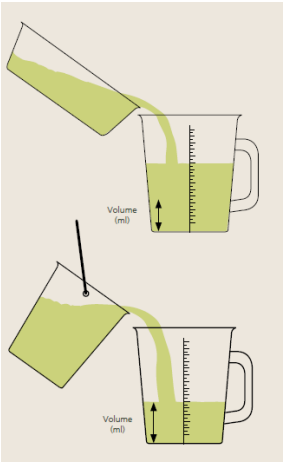
3. Make sure the containers are ahead of the pivot and the application area and in a line in front of the path of the pivot span (use a measuring tape to mark distance and get a straight line).

4. Put a stone in each container to stop them blowing over.

Step 2: Run pivot

1. Run the pivot as normal

2. Record the actual amount of time that effluent is falling in the containers. The variance in travel speed along the length of pivots must be taken into account as this will be different for each span measured and requires careful management.



Step 3: Measure the depth of effluent in every 'wet' container.

For **RECTANGLE** Trays:

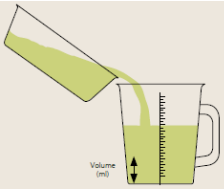
1. Remove stone
2. Tip effluent into measuring jug record the volume (ml)
3. Write down volume for each container.

For **ROUND** Buckets:

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

Calculations

Rectangular containers



Record the depth from each container, e.g. on a sprinkler with a 40 m diameter wetted area, there may be 20-40 containers.

Container 1 Container 2 etc ...

	+	+	+	+	+	+	+

TOTAL (ml)

TOTAL (ml)	÷	NUMBER OF CONTAINERS	=	AVERAGE VOLUME (ml)

CONTAINER WIDTH (mm)	X	CONTAINER LENGTH (mm)	=	CONTAINER AREA (mm^2)

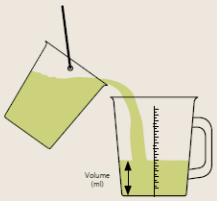
1000	X	AVERAGE VOLUME (ml)	÷	CONTAINER AREA (mm^2)	=	AVERAGE APPLICATION DEPTH (mm)

AVERAGE APPLICATION DEPTH (mm)	÷	TIME (hrs) (e.g 1hr 15 mins = 1.25 hrs)	=	AVERAGE APPLICATION RATE (mm/hr)

Note: Maximum application depth = The CONTAINER with the deepest measurement.

Tip: To convert seconds or minutes to decimal, divide by 60 e.g. 21 mins = 21 ÷ 60 = 0.35 hrs.

Round buckets with SLOPED sides



Record the depth from each container, e.g. on a sprinkler with a 40 m diameter wetted area, there may be 20-40 containers.

Container 1	+	Container 2	+	etc ...	+		+		+		+		TOTAL (ml)

TOTAL (ml)	÷	NUMBER OF CONTAINERS	=	AVERAGE VOLUME (ml)

CONTAINER WIDTH (mm)	÷	2	=	CONTAINER RADIUS (mm)

3.14	X	CONTAINER RADIUS (mm)	X	CONTAINER RADIUS (mm)	=	CONTAINER AREA (mm²)

1000	X	AVERAGE VOLUME (ml)	÷	CONTAINER AREA (mm²)	=	AVERAGE APPLICATION DEPTH (mm)

AVERAGE APPLICATION DEPTH (mm)	÷	TIME (hrs) (e.g 1hr 15 mins = 1.25 hrs)	=	AVERAGE APPLICATION RATE (mm/hr)

NOTE: Maximum application depth = The CONTAINER with the deepest measurement.

Tip: To convert seconds or minutes to decimal, divide by 60 e.g. 21 mins = 21 ÷ 60 = 0.35 hrs.

For assistance and advice on testing application depths and rates on pivot systems, please contact DairyNZ.

Planning irrigation timing for Low Rate systems

Irrigation timing

How often you need to move pods depends on your systems. When conditions are most suitable, irriagate as much of the time as possible. Move pods multiple times a day and get your pond right down.

mm	mm/hr	On Off
Maximum Application Rate in Resource Consent or in Regional Plan	Pod application rate	Running time

Once you know the above three numbers use the tables below to work out how long your pods can stay in one place before moving. Use 4 ml application rate if you have not had your system tested and do not know your system's specific application rate.

Time between moving pods to apply 15mm depth									
Minutes Operating		Your systems average application rate per hour (mm/hr)							
		2 ml	2.5 ml	3 ml	3.5 ml	4 ml	4.5 ml	5 ml	5.5 ml	6 ml
On	Off	Period of time between moves (hrs)								
15	15	15.00	12.00	10.00	8.50	7.50	6.50	6.00	5.50	5.00
15	30	22.50	18.00	15.00	13.00	11.25	10.00	9.00	8.25	7.50
15	45	30.00	24.00	17.25	20.00	15.00	13.00	12.00	10.75	10.00
20	20	15.00	12.00	10.00	8.50	7.50	6.50	6.00	5.50	5.00
20	40	22.50	18.00	15.00	13.00	11.25	10.00	9.00	8.25	7.50
30	30	15.00	12.00	10.00	8.50	7.50	6.50	6.00	5.50	5.00
60	60	15.00	12.00	10.00	8.50	7.50	6.50	6.00	5.50	5.00
On continuously		7.50	6.00	5.00	4.25	3.75	3.25	3.00	2.75	2.5

Time between moving pods to apply 20mm depth									
Minutes Operating		Your systems average application rate per hour (mm/hr)							
		2 ml	2.5 ml	3 ml	3.5 ml	4 ml	4.5 ml	5 ml	5.5 ml	6 ml
On	Off	Period of time between moves (hrs)								
15	15	20.00	16.00	13.50	11.50	10.00	9.00	8.00	7.25	6.50
15	30	30.00	24.00	20.00	17.00	15.00	13.50	12.00	11.00	10.00
15	45	40.00	32.00	26.50	22.75	20.00	17.75	16.00	14.50	13.50
20	20	20.00	16.00	13.50	11.50	10.00	9.00	8.00	7.25	6.50
20	40	30.00	24.00	20.00	17.00	15.00	13.50	12.00	11.00	10.00
30	30	20.00	16.00	13.50	11.50	10.00	9.00	8.00	7.25	6.50
60	60	20.00	16.00	13.50	11.50	10.00	9.00	8.00	7.25	6.50
On continuously		10.00	8.00	6.50	5.75	5.00	4.50	4.00	3.50	3.25

SECTION EIGHT – RISK ASSESSMENT

The risk assessment framework has been developed using principles of risk assessment derived from a number of other programmes reviewed. The numbering and weighting factors have been selected based on an AgResearch risk assessment modelling different scenario's to estimate the environment impact of various defects in infrastructure and on-farm management decisions.

System component	Description	Component score
Shed infrastructure	All effluent contained	1
	Potential for occasional discharge	2
	Occasional but obvious discharge	3
	Minor and continuous trickle	4
	Obvious and considerable discharge	10
	Considerable direct discharge to water	C
Weighting		**X1**
System component score x weighting = final score for shed infrastructure		
C= Critical Issue seen during WoF		

System component	Description	Component score
Sand traps	All effluent contained	1
	Occasional but obvious discharge	3
	Obvious and considerable discharge	10
Weighting		**X1**
System component score x weighting = final score for sand traps		

System component	Description	Component score
Records	Appropriate records kept	1
	Incomplete records	3
	No records kept	5
Weighting		**X1**
System component score x weighting = final score for records		

System component	Description	Component score
Nutrient loadings for effluent block	Nutrient budget available and meets industry good practice (<150Kg N/ha for effluent block)	1
	Nutrient budget available and meets compliance for effluent block	2
	Nutrient budget not available	5
	Effluent block in nutrient budget within 25% of what required	5
	Effluent block too small	10
Weighting		X3
System component score x weighting = final score for nutrient loadings		

System component	Description	Component score
Sump	All effluent contained and alarmed	1
	Contained	2
	Minor and continuous trickle	4
	Obvious and considerable discharge	10
	Considerable direct discharge to water	**C**
Weighting		**X3**
System component score x weighting = final score for sump		

System component	Description	Component score
Farm Drains	No sign of raw effluent in drain	1
	Occasional but obvious discharge going into drain	3
	Obvious and considerable discharge of effluent to drain	10
	Considerable direct discharge to water	**C**

Weighting	**X2**
System component score x weighting = final score for channels and drains	

System component	Description	Component score
Effluent storage/capacity	Adequate (within 25% of DESC)	1
	Export off site	1
	Only 60% storage of what is required	7
	No adequate storage	**C**
Weighting		**X5**
System component score x weighting = final score for storage		
C= Critical Issue seen during WoF		
System component	**Description**	**Component score**
Effluent storage/leakage	Clay liner, no obvious leakage with supporting evidence that meets required standard	1
	Appropriate synthetic liner no obvious leakage	1
	No obvious leakage but synthetic liner choice questionable	3
	Clay liner used but no supporting evidence on methodology used for construction	3
	No obvious leakage no liner	5
	Evidence of obvious leakage	**C**
Weighting		**X4**
System component score x weighting = final score for pond leakage		
System component	**Description**	**Component score**
Effluent storage/integrity	no slumping or holes	1
	Straight batters (<2:1)	3
	Minor slumping or holes	5
	Major slumping and/or holes	10
Weighting		**X5**
System component score x weighting = final score for pond integrity		
Storage risk = storage volume + leakage + integrity		

System component	Description	Component score
Stone trap solids	All effluent captured and contained on sealed surface adequate size	1
	Effluent captured and contained unsealed surface	3
	Stored on unsealed surface- no surface discharge	4
	Obvious and considerable discharge	8
	Direct discharge to water	10
Weighting		**X1**
System component score x weighting = final score for stone trap solids		

System component	Description	Component score
Lanes and raceways	No obvious discharge to water	1
	Some mitigation options obvious	2
	Occasional discharge to water	5
	Direct discharge to water	10
Weighting		**X1**
System component score x weighting = final score for lanes and raceways		

System component	Description	Component score
Bridges and culverts	No obvious discharge to water	1
	Some mitigation options obvious	2
	Occasional discharge to water	5
	Direct discharge to water	10
	Direct discharge to water with daily use	**C**
Scale	**Rarely used**	**x0.5**
	Monthly	**x1**
	Daily use	**x1.5**
Weighting		**X1**
System component score x weighting x scale= final score for bridges and culverts		

System component	Description	Component score
Underpasses	Irrigated discharge to land	1
	No obvious discharge to water	2
	Some mitigation options obvious	5
	Occasional discharge to water	7
	Direct discharge to water with daily use	**C**
Scale	**Rarely used**	**x0.5**
	Monthly	**x1**
	Daily use	**x1.5**
Weighting		**X2**
System component score x weighting x scale= final score for underpasses		
C= Critical Issue seen during WoF		

System component	Description	Component score
Silage pads/feed bins	Directed to effluent system	1
	Irrigated discharge to land	1
	No obvious discharge to water	2
	Some mitigation options obvious	4
	Occasional overland discharge	10
	Direct discharge to surface water large volume of leachate	**C**
Scale	**Small**	**x0.5**
	Medium	**x1**
	Large	**x1.5**
Weighting		**X3**
System component score x weighting x scale= final score for silage pads		
C= Critical Issue seen during WoF		

System component	Description	Component score
Feed pad (compacted, confined feeding area)	Lined (synthetic, concrete, compacted clay), all effluent captured directed to an FDE system	1
	Unsealed all effluent captured directed to an FDE system	2
	Sealed and uncontained	4
	Unsealed and uncontained	8
	Potential discharge to water	10
	Direct discharge to surface water	**C**
Weighting		**X5**
System component score x weighting = final score for stone trap solids		
C= Critical Issue seen during WoF		

System component	Description	Component score
Stand-off /loafing area (constructed facility)	Lined (synthetic, concrete, compacted clay), all effluent captured directed to an FDE system	1
	Unsealed all effluent captured directed to an FDE system	2
	Sealed and un contained	4
	Unsealed and uncontained	8
	Potential discharge to water	10
	Direct discharge to surface water	**C**
Weighting		**X5**
System component score x weighting = final score for standoff		
C= Critical Issue seen during WoF		

System component	Description	Component score
Housed wintering facility (covered)	Lined (synthetic, concrete, compacted clay), all effluent captured directed to an FDE system	1
	0.5m depth organic bedding with no drainage	1
	Inorganic bedding with no drainage	3
	Unsealed all effluent captured	4
	Sealed and uncontained	5
	Unsealed and uncontained	7
	Potential discharge to water	8
	Direct discharge to surface water	**C**
Weighting		**X3**
System component score x weighting = final score for herd housing		
C= Critical Issue seen during WoF		

System component	Description	Component score
Solids storage (scraped or piled effluent solids) E.g. separated solids, feed pad or housed winter facility	All effluent captured and contained on sealed surface adequate size	1
	Effluent captured and contained on unsealed surface	3
	Stored on unsealed surface- no surface discharge	4
	Obvious and considerable discharge	8
	Direct discharge to water	**C**
Scale	**<1 m^3**	**x0.5**
	1-5 m^3	**x1**
	>5 m^3	**x1.5**
Weighting		**X3**
System component score x weighting x scale= final score for solids storage		

System component	Description	Component score
Liquid effluent irrigation-conveyance (pipes and hydrants)	No obvious leaks	1
	Potential for occasional discharge	2
	Occasional but obvious discharge	4
	Minor and continuous trickle	8
	Obvious and considerable discharge to surface water	**C**
Weighting		**X2**
System component score x weighting = final score for irrigation conveyance		
C= Critical Issue seen during WoF		

System component	Description	Component score
Liquid effluent irrigation-application depth and soil risk	Meets required application depth ie consent/permitted activity	1
	Depth OK but high rate system being used on high risk soils	5
	Does not meet application depth ie consent/permitted activity	10
Weighting		**X5**
System component score x weighting = final score for application depth and soil risk		
System component	**Description**	**Component score**
Liquid effluent irrigation-application to land	No sign of poor irrigation	1
	Poor irrigation observations	5
	Obvious runoff and ponding	10
	Obvious and considerable runoff entering waterways	**C**
Weighting		**X5**
System component score x weighting = final score for liquid land application		
Irrigation application risk = depth and land application		

System component	Description	Component score
Solids land application system (bedding, separated solids)	Evenly spread over paddock at depth appropriate for nutrient content of material	1
	Evenly spread inappropriate depths	5
	High risk of discharge to ground water or surface water	10
	Direct discharge to surface water of runoff	**C**
Weighting		**X5**
System component score x weighting = final score for solid land application		
C= Critical Issue seen during WoF		

System component	Description	Sighted
Effluent storage/safety	Safe fence around sump/ escape ladders	Y/N
	Safe fencing around storage pond/escape ladders	Y/N
	Safety egress from storage facilities	Y/N
	Safety signs and other mitigations in place	Y/N
Noted as observations and action points in final report **Fences but no ladders, buoys or signs present**		

Regional Council Compliance	Description	Sighted
Non-compliance of consent or Permitted Activity conditions	Note any deviation from consent condition	Y/N
	Storage	Y/N
	Application depth and rate	Y/N
	Other	Y/N
Any significant deviation = Critical issue of WoF		

SECTION NINE- ASSESSMENT DEBRIEF AND REPORTING

If unable to contact farmer for exit interview leave text message that off the farm

Thank the farmer for their time and assistance on the day, and provide a verbal summary of your findings either in person or via phone call later in the day. During the audit, it is important to make a note of key feedback to present to the farmer after the visit.

Provide a realistic estimation of timeframe required for you to return the formal audit report and recommendations to the farmer. The following table outlines some key points to cover:

What you liked on site	Point out areas which the farmer has done particularly well, including any mitigation or management strategies		
Action points	**Areas of risk**	**Suggested Action**	**Why of concern**
	Note key areas causing an immediate or potential environmental or compliance risk	Suggested mitigation strategies to minimise or eliminate risk noted	Brief explanation of why this risk area was raised as a concern, and the importance of rectifying it.

GENERAL POINTS ABOUT REPORTING

Be careful not to say something you may have to contradict in your written report, in case the farmer takes action between the audit and receiving the final report. If in doubt, leave it out of the verbal debrief.

Language

- keep language objective
- state assumptions clearly
- If an area was unable to assessed fully, state that in the report
- The final report should clearly outline the scope of the audit
- Encourage farmers to seek suitable professional advice if significant changes are necessary to their farm system

The final report should suggest that any modifications undertaken as a result of this audit should be done to meet the Code of Practice standards.

SECTION TEN- APPENDIX

USEFUL CONTACT DETAILS

Northland Regional Council	*www.nrc.govt.nz* *www.nrc.govt.nz/Environment/Farm-Management/Farm-Dairy-Effluent/* *Phone 0800 002 004*
Auckland Council	*www.aucklandcouncil.govt.nz* *www.aucklandcouncil.govt.nz/en/planspoliciesprojects/plansstrategies/districtRegionalPlans/regionalplans/auckland-regional-plan-farm-dairy-discharges/Pages/home.aspx* *Phone 09 301 0101*
Waikato Regional Council	*www.waikatoregion.govt.nz* *www.waikatoregion.govt.nz/Council/Policy-and-plans/Rules-and-regulation/Regional-Plan/Waikato-Regional-Plan/3-Water-Module/35-Discharges/355-Implementation-Methods---Farm-Effluent-Discharges/* *Phone 0800 800 401*
Bay of Plenty Regional Council	*www.boprc.govt.nz* *Effluent is covered under Rule 32 in the Land and Water Plan. Information about farming activities can be found under:* *www.boprc.govt.nz/media/31767/Publication-090528-GuideToRegionalPlansFarmingActivities.pdf* *Phone 0800 884 880*
Taranaki Regional Council	*www.trc.govt.nz/* *www.trc.govt.nz/Farm-dairy-effluent/* *Phone 06 765 7127*
Hawkes Bay Regional Council	*www.hbrc.govt.nz/* *Phone 06 835 9200*
Horizons Regional Council	*www.horizons.govt.nz* *Phone 06 9522 800*

Greater Wellington Regional Council	*www.gw.govt.nz* *Rule 4: www.gw.govt.nz/rule-4-agricultural-effluent-and-other-on-farm-processes/* *Rule 13: www.gw.govt.nz/Rule-13-Agricultural-effluent/* *Phone 0800 496 734*
Tasman District Council	*www.tasman.govt.nz* *www.tasman.govt.nz/policy/plans/tasman-resource-management-plan/resource-management-plan-volume-1-text/resource-management-plan-part-vi-discharges/* *Phone 03 543 8400*
Marlborough District Council	*www.mdc@marlborough.govt.nz* *Phone 03 520 7400*
West Coast Regional Council	*www.wcrc.govt.nz* *Phone 0508 800 118*
Environment Canterbury	*www.ecan.govt.nz* *Phone 0800 324 636*
Otago Regional Council	*www.orc.govt.nz* *www.orc.govt.nz/Publications-and-Reports/Farming-and-Land-Management/Dairy-farming/* *Phone 0800 474 082*
Environment Southland	*www.es.govt.nz* *www.es.govt.nz/media/5868/fde-dairy-booklet.pdf* *Phone 0800 76 88 45*

DairyNZ	*www.dairynz.co.nz* *Phone 07 858 3750* *email info@dairynz.co.nz*
Fonterra	*www.fonterra.com* *Phone 09 374 9000*
Tatua	*www.tatua.com* *Phone 07 889 3999*
Westland Milk Products	*www.westland.co.nz* *Phone 3 756 9800*
Synlait	*www.synlait.com* *Phone 03 373 3000*
Open Country Dairy	*www.opencountry.co.nz* *Phone 9 589 1372*
Miraka	*www.miraka.co.nz* *Phone 0800 647 252*
AgResearch	*www.agresearch.co.nz* *Phone 07 834 6600*
Lincoln University	*www.lincoln.ac.nz* *Phone 0800 10 60 10*
Massey University	*www.massey.ac.nz* *Phone 0800 627 739*

FOOD SAFETY MINIMUM DISTANCES

The Ministry of Primary Industries enforces the following minimum distances for food safety reasons. Any food safety aspects are covered under the scope of the annual on-farm dairy assessment audit; which is coordinated by the dairy company.

Distance from the farm dairy		
>10m	**>20m**	**>45m**
• Effluent sump (<22,000L) • Septic tanks • Grain silo if over concrete (must be 10m from milk vat)	• Effluent storage (22,500-100,000L) • Poultry/dog/cat housing • Livestock housing/loafing barns (concrete) • Hay barns/ other buildings • Stand-off pad/feed pads (impervious cleanable floor) • Fertiliser storage • Supplement feed storage • Pesticide storage and mixing	• Effluent pond (>22,500L) • Silage and balage • Pigs • Dead animals • Stand-off pads • Un-concreted feed pad/herd housing

TERMINOLOGY AND GLOSSARY

Best practice- carrying out activities in a way that minimises their environmental impact

Controlled activity- an activity requiring council consent but will be approved

Discretionary activity- an activity requiring consent which may be granted or rejected at discretion of the council, activity considered discretionary if it is defined as so in plan, or not defined in plan, or prohibited in an inoperative plan

Non-complying activity- an activity requiring consent, not considered compliant that will have a minor effect and isn't contrary to council plan objectives.

Permit- an authorisation document proving consent for a particular activity

Resource consent- the authorisation given to certain activities or uses of natural and physical resources required under the RMA

Restricted discretionary activity- an activity requiring consent that may or may not be granted with conditions imposed, authority considers restricted matters when making decision

RMA- the Resource Management Act 1991, the overriding legislative document governing the management of all New Zealand's resources

Territorial Authority- district or city council with governmental authority