Water quality protection note no. 19

February 2018

Hydroponic plant growing

Scope

This note applies to the operation of closed (Figure 1) and open hydroponic (Figure 2) watering systems for growing plants. Hydroponic systems consist of a soil-free plant growing system, where a controlled nutrient-rich solution supplies plant roots with nourishment. These systems may be installed outdoors with overflow safeguards, contained in greenhouses or within buildings with artificial lighting to supply essential ultraviolet radiation for plant growth.

Plants may be supported in porous media, pots, perforated tubes or channels. Water with nutrients and other garden chemicals in solution is recycled and replenished until harvest or build-up of contaminants (such as salts or pathogens) requires the solution to be replaced.

This note is not intended to cover systems where plants are grown in contact with the soil or where chemical contaminants can leach into the environment, but may offer some useful guidance on potential risks to the environment and good practice.

Standard information to be read in conjunction with this note can be found in WQPN no. 3: *Using water quality protection notes*.

Hydroponic systems

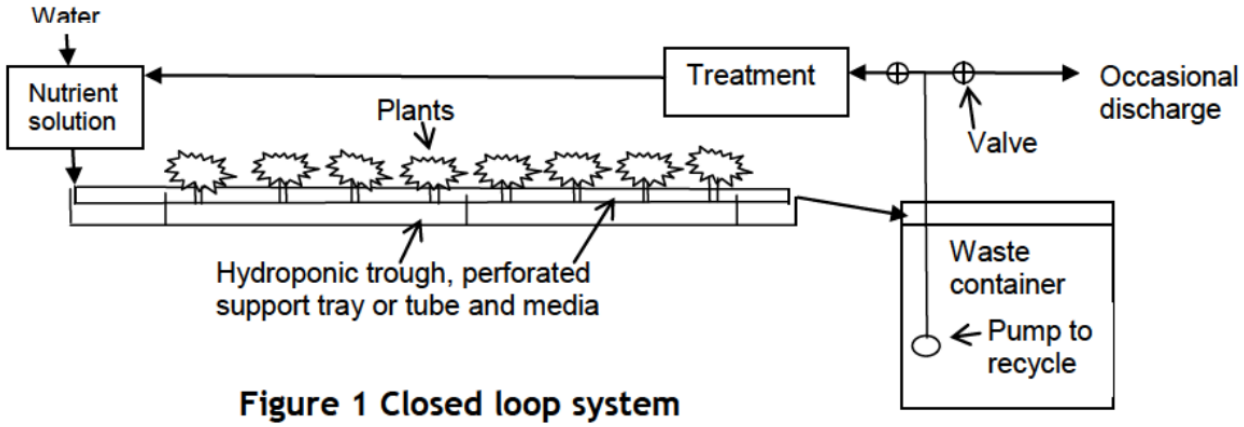

Figure 1 Closed loop system

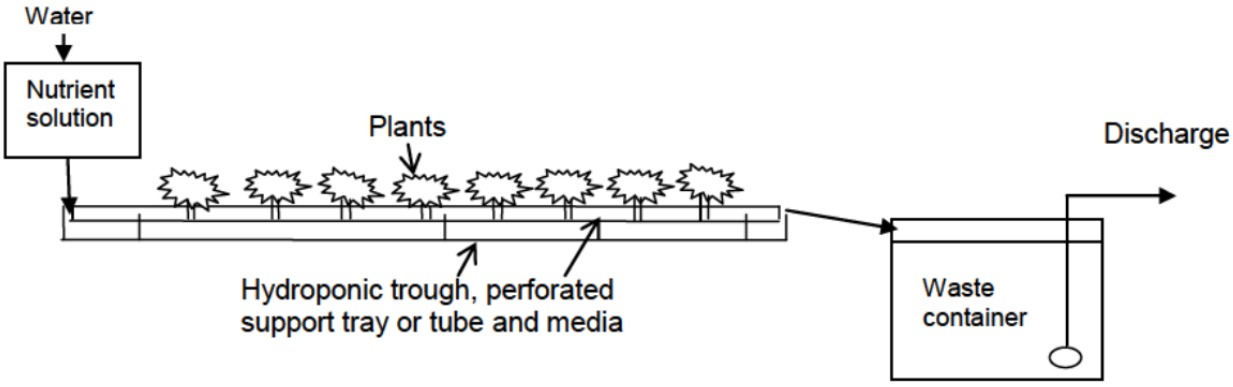

Figure 2 Open system

- Hydroponic systems consist of artificial plant-growing media watered with a controlled nutrient solution. Closed-loop and open systems are the two main types of hydroponic plant cultivation.
- Open systems (Figure 2) are frequently referred to as 'run-to-waste systems'. The plant root zone is either continuously supplied with solution or input is controlled by an irrigation timer or a drip system. Alternatively the water may be static with regular top up to match transpiration losses. A discharge weir often allows a proportion of the applied solution to drain from the media which is then used outside the system to support growth of turf, gardens or crops. Closed-loop systems (Figure 1) are similar in design, although the solution that drains from the media is collected, treated and then recycled a number of times.
- Perforated tubing or resilient porous media are generally used to support plants within both systems. Growing media may include coco peat, perlite, vermiculite, glass fibre or rock-wool (inert, soil-free growing medium consisting of thin strand-like fibres), charcoal, pumice, stone chips, peat, gravel or a mixture of materials.
- Coco peat is a regularly used plant support medium, as it is economical, performs as well as other media and has no harmful environmental disposal problems. It is a natural fibre made out of coconut husks. This medium can be reused if it is disease free, which decreases the need for replacement for up to five years.

Water quality contamination risks

Hydroponic systems can cause the following impacts on water resources:

- Pathogens from animal faeces can wash into surface water or infiltrate into groundwater. Pathogens pose a health risk to anyone that may consume or come into contact with that source of water. For more information about pathogens, see our brochure *Risks from pathogenic micro-organisms in public drinking water source areas*.
- Nutrients from fertilisers can cause eutrophication of surface water bodies, which can kill aquatic life. Nutrients can also infiltrate into groundwater, making it unsafe to drink.
- Contamination with pesticides.
- For general information about protecting water quality, see WQPN no. 8: *Further reading*.

Recommendations

Location

Within public drinking water source areas

- Hydroponic systems are *incompatible* within priority 1 (P1) areas.
- Hydroponic systems are *compatible with conditions* in priority 2 (P2) and priority 3 (P3) areas. This means they can be supported, provided best management practices are undertaken to address water quality contamination risks. This note outlines those practices.
- Special constraints apply for chemical storage and use in wellhead protection zones (WHPZs) and reservoir protection zones (RPZs) (buffer zones around production bores and reservoirs). Refer to this department's WQPN no. 25: *Land use compatibility tables for public drinking water source areas* for further information.

For more information on public drinking water source areas, see Strategic policy: *Protecting public drinking water sources in WA* and WQPN no. 25: *Land use compatibility tables for public drinking water source areas*.

Near other sensitive water resources

- Closed-loop hydroponic systems (Figure 1) should pose a low contamination risk to sensitive water resources provided waste discharges are prevented from entry to the environment and facilities are well located, constructed and managed. In most locations, excluding land subject to flooding, these systems should be environmentally acceptable provided effective measures deal with plant wastes and spent hydroponic waters.
- Open systems may be accepted near sensitive water resources, subject to the location restrictions mentioned above and waste solutions are managed to prevent harm to surface or ground waters.

Development and expansion approvals

- If your development is located in an area proclaimed under the *Rights in Water and Irrigation Act 1914*, you will need to apply for a licence to abstract groundwater or surface water. For more information, please visit www.dwer.wa.gov.au.
- Please refer to WQPN no. 14: *Statutory approvals* for a list of approvals that you may need to obtain before commencing your development or activity, and which agency is responsible for them.
- If your development or activity is located in or near a sensitive water resource, you may need to submit it to the Department of Water and Environmental Regulation for advice. Please refer to WQPN no. 4: *Sensitive water resources* and WQPN no. 18: *Information the Department of Water requires to assess a proposed development or activity.*

Operation and management

- Recycling of nutrient solutions in closed-loop irrigation systems can cause a build-up of salts due to evaporative and transpiration loss of water. Excessive salt can harm plants,

block irrigation drippers and allow the growth of unwanted microbes. To reduce these problems, the systems will normally be flushed periodically with fresh water and then the nutrient solution replaced. The spent nutrient-rich solution may contain phosphates, sodium nitrate, magnesium, sulfate, potassium chloride, pathogens, pesticides and silt. Appropriate management of hydroponic water is necessary to prevent discharges that could result in contamination of ground and surface water resources.

- If an open system is approved within a PDWSA, the hydroponic solution should be fully contained prior to waste discharge to a sewerage system or exported for disposal outside any PDWSA.
- Hydroponic systems should be operated and maintained to prevent leakage or overflow of watering solutions into the environment. Tanks and pipework should be double contained or installed within secondary fluid containment areas.

Solid waste

- Any inert growing media that is used in open or closed-loop systems such as rock-wool and vermiculite needs to be disposed of periodically, along with any organic waste. Inert products should be disposed off-site at an approved class II or III (putrescible) landfill.
- Organic material such as green waste should be disposed of appropriately off-site or be composted under aerobic conditions on a hardstand containment pad. Any leachate should be collected in a grated holding sump for disposal as described in the preceding section. Effectively composted organic materials and raw coco peat may be spread over vegetated areas, gardens or pasture as mulch (when it is no longer useful as growing media) providing it does not contain any added contaminants or harmful substances.

Wastewater

- Low volume, high pressure water hoses should be used for wash down to minimise the amount of water used, which will reduce cost and the volume of wastewater required to be managed.
- The Department of Primary Industries and Regional Development can provide advice on crop nutrient needs if spent hydroponic solutions are to be used to irrigate site vegetation.
- Wastewater unsuitable to sustain vegetation (e.g. too saline) should be contained and evaporated, treated then reused or disposed of at a site approved for putrescible waste disposal.
- Disinfection of recycled water can be achieved effectively without chemicals using filtration, ozone or ultraviolet light (provided the water is not turbid or discoloured).
- For open systems, the effluent should be disposed of in a manner that prevents contaminants leaching into waterways or wetlands. The effluent may be discharged to a sewer, lined containment ponds for solar evaporation followed by residue export, passed through a reverse osmosis system or (unless in a PDWSA) diluted for reuse to irrigate other vegetation.
- Wastewater, if approved for application to land, should follow the guidance in our WQPN 22: *Irrigation with nutrient-rich wastewater* and WQPN 33: *Nutrient and irrigation management plans*.

Stormwater

- Stormwater from roofs and clean paved areas should be directed away from potentially contaminated areas.
- Stormwater that may be contaminated should be treated and reused in the operations if appropriate.
- Uncontaminated stormwater should be managed as recommended in our *Stormwater management manual for Western Australia*, available www.dwer.wa.gov.au.

Toxic and hazardous substances

- Any chemicals or waste products held on-site should be stored under secure weatherproof conditions on impervious pavement away from land subject to flooding.
- Storage and use of any chemicals, fuels, pesticides and fertilisers should be in accordance with WQPN no. 65: *Toxic and hazardous substances*.
- Contact the Department of Health for advice on the use of pesticides where they may contact people, food or water supplies.
- Chemicals used to control insects and plant diseases can pose a risk to sensitive water resources if spilt or discharged. In public drinking water source areas, the use of pesticides (i.e. insecticides, herbicides, or fungicides) should follow best management guidance as specified in the Department of Health's PSC 88: *Use of herbicides in water catchment areas* and *Using Pesticides Safely* as well as the manufacturer or supplier application recommendations should always be followed.

Monitoring and reporting

- Hydroponic plant growers should regularly monitor the quantity and quality of input water used to supply their operating system, as well as the physical properties (e.g. pH electrical conductivity and suspended solids) and chemical concentrations of their watering solutions.
- Prior to any on-ground irrigation of spent nutrient solution, a detailed analysis of the solution should be arranged and assessed for compatibility with site vegetation growth needs.
- Analyses of hydroponic waters should include pH, dissolved oxygen, suspended solids, salt content (measured as electrical conductivity), nutrients (total nitrogen and phosphorus), pathogens and the concentrations of any other chemicals likely to be present (such as trace metals or pesticides).
- Sampling should be conducted as recommended in the National Water Quality Management strategy, *Australian guidelines for water quality monitoring and reporting*. Any field testing equipment should be calibrated in accordance with the supplier's instructions.
- Sample preservation methods recommended by the analytical laboratory should be used. Analyses should be conducted by laboratories accredited by the National Association of Testing Authorities for the relevant testing parameters.

- Monitoring records should be maintained on-site for a minimum of two years to permit scrutiny by regulatory authorities.

Accidents and emergency response

- Any spills should be immediately cleaned up, with the solids disposed of appropriately in sealed containers for disposal offsite, and the residue should drain to a sealed collection sump, not into the environment.
- Any chemical spill or contaminated water that escapes containment should immediately be reported to the Department of Water and Environmental Regulation Pollution Watch Hotline, phone 1300 784 782. If the spill is within a PDWSA, the Water Corporation should also be advised immediately, phone 13 13 75.
- A contingency plan should be available to address emergency situations such as accidents, fires, chemical spills and vandalism that could impact on water resources. See WQPN no. 10: *Contaminant spills – emergency response* for more information.

References

Further reading is available in WQPN no. 8: *Further reading*.

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