

Protect Water

to Preserve your Plant Protection Tools
and Meet Society's Needs

Practical Advice for
Water Protection in Agriculture

BASF Product Stewardship October 2011

 **BASF**

The Chemical Company

Why is water protection important?



Concentrations of pesticides occur from time to time in water bodies, which is a well-known fact from media coverage and reports from drinking water producers. Water bodies in the EU (surface water and groundwater) are regularly analysed for pesticide residues by environmental authorities, as well as drinking water producers.

As water is an essential resource for human beings and nature, it must be protected. In Europe, we have one of the strictest water protection legislation worldwide (EU Water Framework Directive), which protects both: drinking water resources and natural resources.

For drinking water resources and groundwater, a very low limit value for pesticides was established in the EU (0.1 µg/L, which is equivalent to a ratio of one square meter in one million ha). This value is not based on health data, but expresses the political will that pesticide residues in these water resources shall be near nil. Also for surface water bodies individual limit values were established for some pesticides (EQS: environmental quality standards), which however reflect the toxicity of a specific compound for organisms living in water. Usually, EQS are much higher than the drinking water limits, but in some rare instances, they can also be lower (e.g for some pyrethroids).

In case that surface water bodies are used for drinking water production, water companies are also interested to keep the pesticide concentrations there low, so that water treatment processes are able to reduce pesticides to <0.1 µg/L in finished drinking water.

The increasing pressure of legislation and by society to further reduce pesticide pollution of water bodies leads to more water monitoring and consequently more pesticide findings in water. Therefore good agricultural practice is essential to avoid an increasing number of crop protection products being banned because of water issues. The loss of many products will increasingly limit the means of resistance management and increases cost of production, which is not in the interest of a productive and sustainable agriculture.

Pesticides used in agriculture can reach water bodies through a variety of different routes – from spills on the farmyard to runoff from treated fields. This brochure is about raising awareness how pesticides reach water and it provides advice how water pollution with pesticides can be minimized in agriculture. Water protection in agriculture helps all of us: drinking water producers, farmers, nature, and society as a whole.

Dr. Volker Laabs
volker.laabs@basf.com
Phone: +49 621 60-288 44

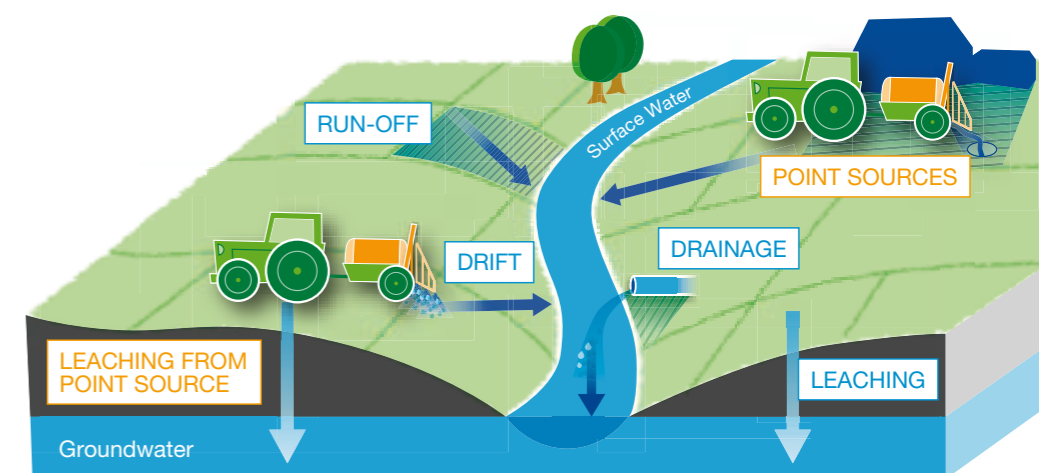


For further information and product-specific advice, please contact the Product Stewardship Team of BASF Agricultural Solutions.

How can pesticides get into water?

Point Pollution Sources

Transport, Storage & Planning	
Sprayer Filling	
Spraying & Cleaning	
Remnants & Waste	



Diffuse Pollution Sources

Spray Drift	
Run-off	
Drainage	
Leaching	



Point Pollution Sources



Point Pollution Sources

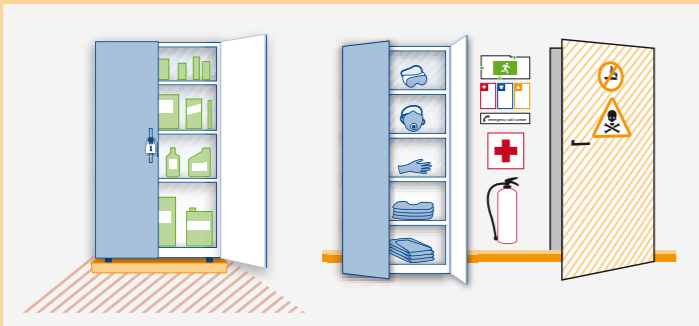
Transport & Storage

Plan your transport

- Use the delivery services of your supplier
- Use a loading area adapted to retain spills
- Carry a mobile phone and emergency telephone numbers in case of an accident
- In case of a spill have absorbent materials to hand (wood shavings, sawdust, cat litter)

Store pesticides in a fire-proof store located well away from water

- Store plant protection products in a lockable, clearly marked and bunded place (i.e. place where spills can be contained)
- Have emergency procedures and materials in place: emergency telephone numbers, fire extinguisher, absorbent material
- Retain and safely dispose of all spills immediately



Planning

Plan ahead

- Use a crop protection management plan to identify any risks to water from your activities
- Ensure operators receive regular refresher training from the national sprayer training programs

Products

- Decide which plant protection products are to be applied
- Identify sensitive areas and observe buffer zones
- Plan mixing, loading and cleaning sites in advance
- Read the product labels carefully and follow all instructions and recommendations
- Calculate the amounts of pesticide and water needed
- Avoid leftover spray by ensuring you calculate the exact volume of spray solution required for the job. If in doubt underestimate the volume

Equipment

- Set up and calibrate sprayer and ensure sprayer is tested annually under national sprayer testing schemes
- Check the sprayer for leaks or drips. Ensure nozzle non-drip valves are working correctly

Travelling to the field

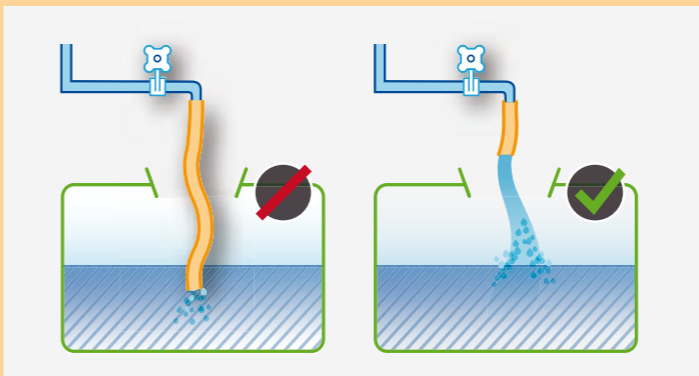
- Plan the best way to get to the field without posing risks to water. Avoid using fords to cross water courses
- Switch off pumps while travelling. Ensure all couplings are secured

Sprayer Filling

Water

- Make sure that the water supply and spray solution are never connected. Use buffer tanks or double check valves to protect main water supply.
- Fit alarms and cut-off valves to avoid sprayer over-filling
- Never leave a sprayer unattended when filling

Filling requires extra care, please mix and load carefully!



- Filling sprayers with undiluted pesticides poses significant risks to water
- Locate all filling areas well away from water
- Take extra care when pouring pesticides to avoid even tiny drips and splashes
- Use induction bowls and closed transfer systems wherever possible
- Filling on concrete surfaces in the farmyard can result in direct run-off of pesticides into drains and water courses

Filling in farmyard

- Farmyard filling needs to be carefully managed
- Either use a plastic tray or a portable bund which enables you to collect any spills
- Fill in a bunded area where spills and washings can be collected for treatment in a lined biofilter or via a waste disposal contractor
- Have absorbent materials ready to clean up any spills immediately

Filling in the field

- Use a secure lockable transport box to transport product containers to the field
- Ensure filling area is situated at least 10m away from any ditch or water course.
- Vary the location selected for mixing and loading in the field
- Use a spill tray to collect any accidental spills or splashes



Induction hopper & Container cleaning process



Sprayer on biobed on experimental Farm



Point Pollution Sources

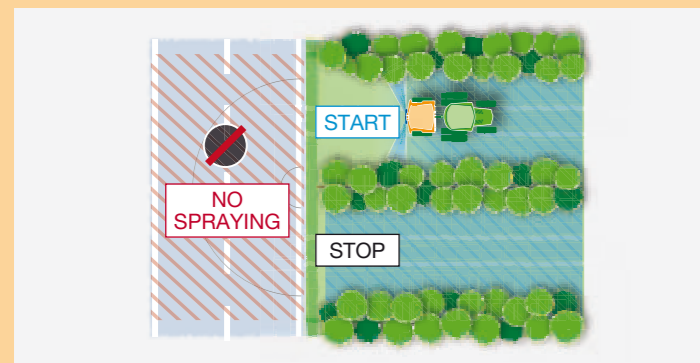


Point Pollution Sources

Spraying

Avoid direct contamination

- Do not spray directly onto equipment
- Only spray when the sprayer is moving
- Shut off sprayer when turning
- If you notice any leaks: stop spraying immediately and repair
- Do not overspray water courses, wells and drains



Avoid drift

- Do not overspray buffer zones
- Select proper nozzles according to the product label and the target. Whenever possible use drift reducing nozzles

Avoid run-off

- Do not spray when there is a risk of surface run-off
- Do not spray on frozen or water-logged soil. Spray headlands last to avoid driving over sprayed ground

Advice

When buying a new sprayer ensure that the design minimises the volume of the non-sprayable solution and enables sprayer cleaning in the field. Check available information sources for technical solutions to minimize point pollutions risks (e.g. the website of the ECPA EOS project: <http://prototype.topps-eos.org>).

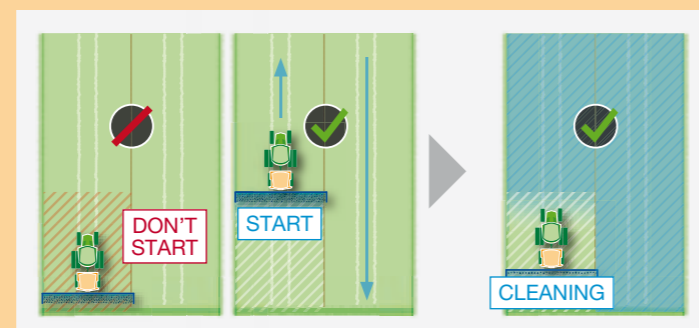
Cleaning

Advice

Whenever possible clean your sprayer in the field. Take clean water with you for inside and outside cleaning of the sprayer and tank. Follow manufacturer instructions and ensure the sprayer is thoroughly cleaned; the tank may require rinsing up to three times

Inside

- Fit internal tank rinsing nozzles to increase cleaning efficiency
- Dilute the remnant spray with water and spray the solution over the area of the field where you started to spray
- Dilute the remnant solution at least two more times and spray it out again
- Only take the diluted and non-sprayable portion of spray solution back to your farm



Outside

- Use spray lance to clean spraying equipment in the field
- Clean mud from tyres before leaving the field
- Clean sprayer every day to avoid build up of deposits. Pay special attention to the booms and the back of the spray tank as most residues are deposited here
- If you clean the sprayer in your farmyard, select a place where rinse water can be collected for treatment or disposal
- After use, park your sprayer securely under a roof to protect it from rain

Remnants & Waste

Container disposal

- Follow label recommendations or official instructions for disposal procedure
- Participate in authorised recycling schemes
- Never burn or bury packages

Unwanted stocks

- Separate out-of-date plant protection products from the others and contact the distributor/manufacturer disposal services
- Never wash left-over products down the drain, and never bury them



Leftover spray solution

- Reuse diluted plant protection product liquid if legally permitted
- Store diluted plant protection product liquid safely
- Never dump liquids or solids containing plant protection product where they can reach surface or groundwater

Solid remnant

(e.g. as a result of processing diluted liquids, cleaning of filters, managing spills)

- Biodegradable solid remnants can be stored for further degradation if legally permitted and adequately secured
- Non-biodegradable remnants must be disposed of as waste

Did you know that...

...in Europe typically 50 to 90 % of pesticide residues in water bodies origin from point sources?

...ca. 60 to 90 % of pesticide contamination from farmyards can be avoided by cleaning of sprayers in the field?

Be a good water steward: Avoid point pollution sources!

Find more material on how to avoid point sources at: www.topps-life.org under „Expert materials“

Diffuse Pollution Sources



Spray Drift

Why can it be a problem?

During application, pesticides can be transported to nearby water bodies or sensitive areas by spray drift. This can lead to short-term but high concentrations in water

What factors influence spray drift to water bodies?

Factors	Higher Risk	Lower Risk
Wind speed / Tractor speed	High	Low
Wind direction	Directed towards sensitive area	Directed away from sensitive area
Distance to water / Sensitive areas	Short	Long
Crop type	Orchard / Vineyard	Field crops
Air humidity	Low	High
Droplet size	Small ($\varnothing \leq 200 \mu\text{m}$)	Large ($\varnothing > 200 \mu\text{m}$)
Air support	Not easy to adjust	Adjustable
Spraying distance to target	Large	Small

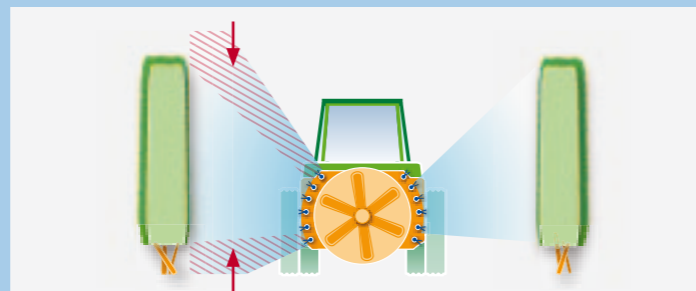
What solutions do we have?

Direct drift reduction measures

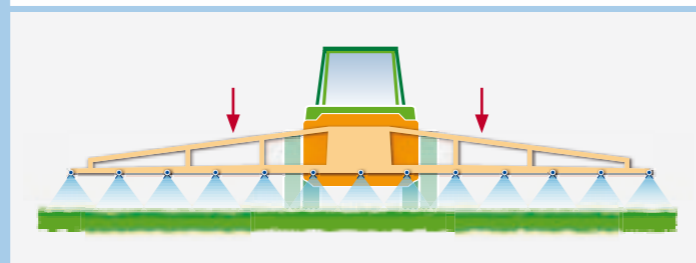
- Use drift reduction nozzles whenever possible (if needed, consult advisor/manufacturer for product-specific advice), especially on headlands and field margins
- Adjust sprayer:
 - Minimize boom height and reduce tractor speed
 - Orchard sprayer: adjust air flow rate & direction and spray profile

Indirect measures: Minimize drift impact

- Do not apply when wind blows in direction of water body
- Keep a minimum distance of 5 m between treated fields and water bodies (check local regulations and product labels for more stringent requirements)
- Plant hedges to reduce spray drift to water / protected zones, if buffer zones are small.



Optimize spray profile



Reduce boom height

Main Challenges

- Avoid small droplets
- Do not apply with wind
- Minimize distance between spray nozzle and target

Diffuse Pollution Sources



Run-off

Why can it be a problem?

After application, pesticides can leave treated fields in surface run-off water and via eroded soil particles. This run-off water can reach surface water bodies, leading to short to medium-term and sometimes relatively high concentrations in water.

What factors influence run-off to water bodies?

Key Factors	Higher Risk	Lower Risk
Precipitation conditions	Long / intense	Short / weak
Soil permeability	Low <ul style="list-style-type: none"> Heavy soil texture Capping/crusted soil Subsoil compaction 	High <ul style="list-style-type: none"> Sandy soils Well aggregated soils
Soil moisture	High	Low
Speed of run-off water	High <ul style="list-style-type: none"> High slope Smooth soil surface No barriers 	Low
Distance to water	Short	Long

- Climate, soil texture and distance to water define the basic run-off risk for a field
- Soil permeability and run-off speed/infiltration can be actively managed by mitigation measures

What solutions do we have?

In-field measures

- Adapt tillage practices to maximize water infiltration
- Break soil crusts/subsoil compaction
- Use conservational tillage or no-till
- Use contour ploughing/cropping
- Grow alternating crops in fields across a slope (i.e. broadcast vs. row crops)
- Maximize vegetation cover on fields at all times (i.e. use cover crops)
- Row crops: create inter-ridge/in-furrow soil barriers
- Perennial crops: establish vegetated strips between crop rows
- For long slopes: break slope by grassed buffer strips
- Establish hedges/bushland in critical locations (if spray drift protection and biodiversity are additional factors for consideration)



Contour ploughing/cropping



Diffuse Pollution Sources



Diffuse Pollution Sources

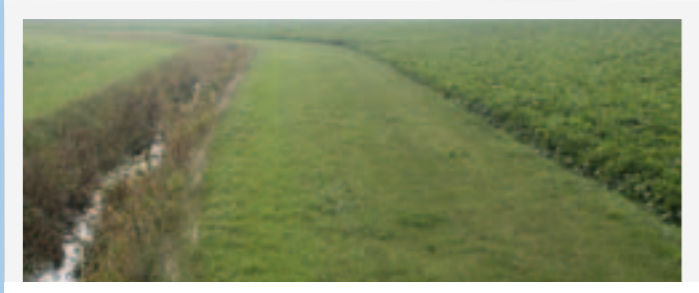


Kodešová, R., et al. 2010. Vadose Zone J., 213-225.

Run-off continued

Landscape Measures

- Establish vegetated buffer strips alongside water bodies (riparian buffer)
- Establish edge-of-field vegetated buffer strips (infiltrate run-off water, break long slopes, protect roads and other potential water ways)



Vegetated Buffer Strip



Strip Cropping



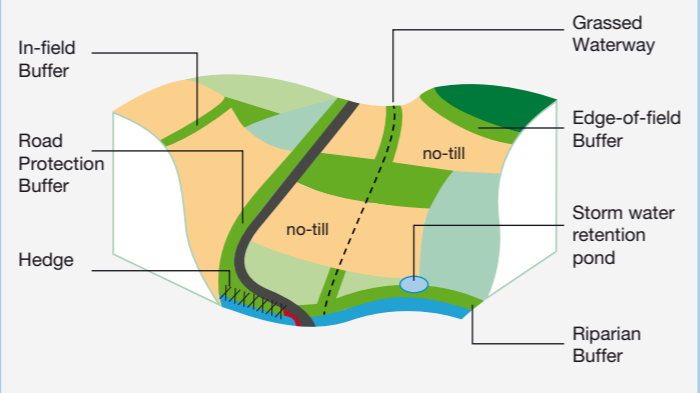
Water Retention Pond

EU Life Project ArtWET (LIFE 06 ENV/F/000133): www.artwet.fr

Remember

- If possible, conduct a catchment/farm risk diagnosis with a professional advisor
- Position buffers smartly in the landscape to achieve the most with minimum use of land
- Consult your advisors/authorities on how to establish and fund buffer strips/ponds
- Maintain buffer strips in good condition:
 - Mow grass to $\leq 25\text{cm}$
 - Remove/spread soil sediment
 - Minimize heavy machinery use on buffers
- Align with neighbors and advisors to set-up a catchment run-off management plan

Catchment management plan (example)



Main Challenges

- Increase infiltration of water in the field and in buffers
- Prevent linear flow of water
- Retain any run-off water before it enters water bodies

Drainage

Why can it be a problem?

After application, pesticides can be transported with infiltrating water in soil to the drain-flow system. Drainage water then enters surface water, leading to short to medium-term but significant concentrations in water bodies.

How to manage risks on drained fields?

- Avoid application of pesticides during drain-flow season (late autumn to early spring)
- Avoid application shortly before (>48 h) heavy rainfall throughout the year
- If possible, retain drainage water in artificial wetlands (e.g. retention ponds or ditches):
 - use vegetated systems, if possible
 - get information about set-up from local authorities/ advisors
- Do not apply **any** pesticides on drained fields with cracked and very dry soils

Reminder

Not all pesticides are equally susceptible to drainflow transport: Check labels and talk to advisors/manufacture when pesticide applications on drained areas are planned.

Main Challenges

- Avoid pesticide use when or shortly before drains are flowing
- If possible, retain drain-flow water in vegetated systems

Leaching

Why can it be a problem?

After application, some pesticides can be transported down to the subsoil and into groundwater by infiltrating water in soil. There, low but medium to long-term concentrations result, which sometimes may still breach the very low drinking water limits in the EU.

How to manage leaching risks?

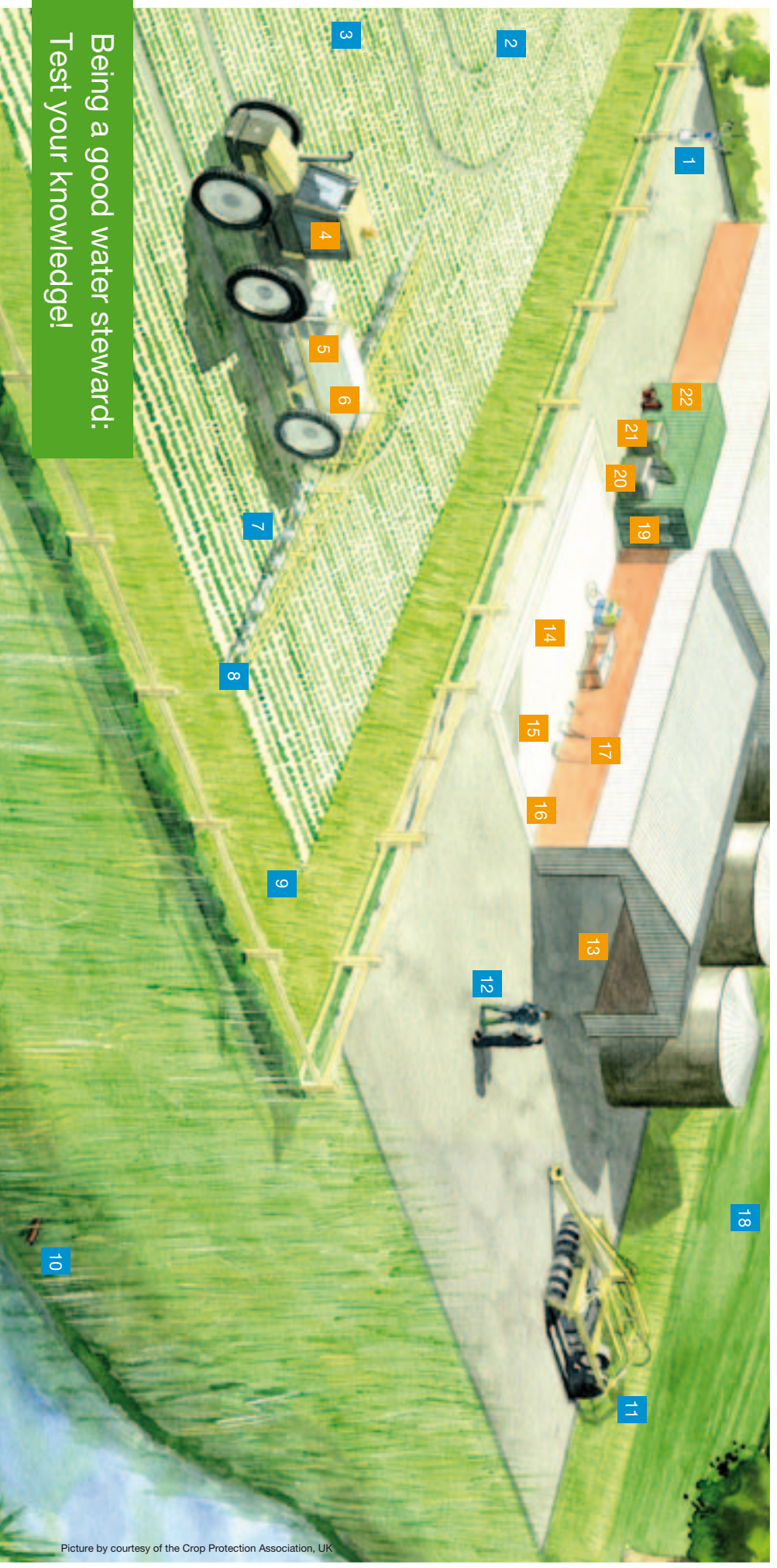
- Restrict use of indicated pesticides on identified vulnerable areas, which typically can be...
 - Soils of low organic carbon content (e.g. <1 % organic carbon corresponding to <1.7 % organic matter)
 - Shallow soils (e.g. <35 cm topsoil) in karstic areas (rendzina soils)
 - Soils with shallow groundwater (e.g. <1 m below soil surface): typically encountered in stream/river valley bottoms and lowland areas
 - Areas with sandy soils and high yearly groundwater recharge (high winter rains)
- Restrict use of indicated pesticides during the groundwater recharge phase (late autumn to early spring)

Reminder

- Only some pesticides are susceptible to leaching
- Vulnerable areas may differ for each product
- Check labels/recommendations carefully and talk to advisors/manufacture when pesticide applications in vulnerable areas or seasons are planned.

Main Challenges

- Restrict use of indicated pesticides in vulnerable areas and seasons for leaching



Being a good water steward: Test your knowledge!

1	Have you checked the weather forecast?	6	Do you wash the outside of the sprayer in the field?	10	Have you checked if field drains are flowing before applications?	15	Do you collect and dispose/treat remnants and washing water in a safe way?	19	Is your pesticide store labelled and secure?
2	Do you spray headlands last to avoid travelling over treated crop?	7	Do you use drift-reduction nozzles whenever possible?	11	Do you use minimum tillage to help reduce soil erosion?	16	Are you sure that no water draining from your filling area can reach surface or ground water?	20	Are cleaned empty pesticide containers stored safely undercover?
3	Are you drilling across slopes to reduce soil erosion risk?	8	Do you keep the boom at the minimum height above the target to reduce drift?	12	Did you discuss crop protection practice on drained and vulnerable areas for leaching with your advisor?	17	Do you have a clean-up kit readily available in case of spills?	21	Is all pesticide waste disposed of through a pesticide waste recycling or disposal contractor?
4	Do you spray remaining spray liquid and washing water in the field?	9	Do you have at least 5 m of grass or set-aside strips adjacent to water?	13	Do you have a roofed parking area for your sprayer?	18	Did you diagnose your fields regarding vulnerability for runoff and leaching?	22	Do you have good fire prevention measures for your pesticide store?
5	Is your sprayer calibrated and inspected regularly?			14	Is your filling area bunded?				