

Cremona, Sep 2026

VFSMOD – Joining the Path Forward?



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Where did we start?

JRC – SWAN Website (EFSA's open issue meanwhile addressed!)



The screenshot shows the JRC SWAN website. At the top, there is a header with the European Commission logo, the text 'JOINT RESEARCH CENTRE' and 'EUROPEAN SOIL DATA CENTRE (ESDAC)', and a navigation bar with links: 'EUROPEAN COMMISSION > JRC > ESDAC > PROJECTS > FOCUS DG SANTE > SURFACE WATER > SWAN'. On the right side of the header, there are links for 'Privacy statement | Legal notice | Cookies | Search'. Below the header, there is a search bar and a navigation menu with links: 'Home', 'About Us', 'Newsletters', 'Atlases', 'Events', and 'Vacancies'. The main content area is titled 'SWAN' and has two buttons: 'About SWAN' and 'Download SWAN'. Below these buttons, there is a section titled 'General Information' which contains two paragraphs of text. The first paragraph describes the SWAN software tool and its purpose. The second paragraph provides a note about the VFSmod model and its use in EU level assessments.

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SWAN

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General Information

The 'Surface Water Assessment eNabler' (SWAN) is a software tool to assist in assessing application of exposure mitigation processes based on a FOCUS Surface Water Step 3 calculation. SWAN allows the user to incorporate mitigation measures for spray drift and run-off and account for dry deposition of pesticides, producing FOCUS Surface Water Step 4 exposure refinements as described in FOCUS landscape and mitigation and FOCUS air guidance. When doing this it uses the waterbody configuration as specified in the FOCUS surface water guidance. SWAN implemented runoff reductions following the FOCUS landscape and mitigation recommendations as described in section 3.5.2 Volume 1 of the FOCUS landscape and mitigation report. In particular those set out in Table 7 of this report section, are relied on for use in EU level assessments.

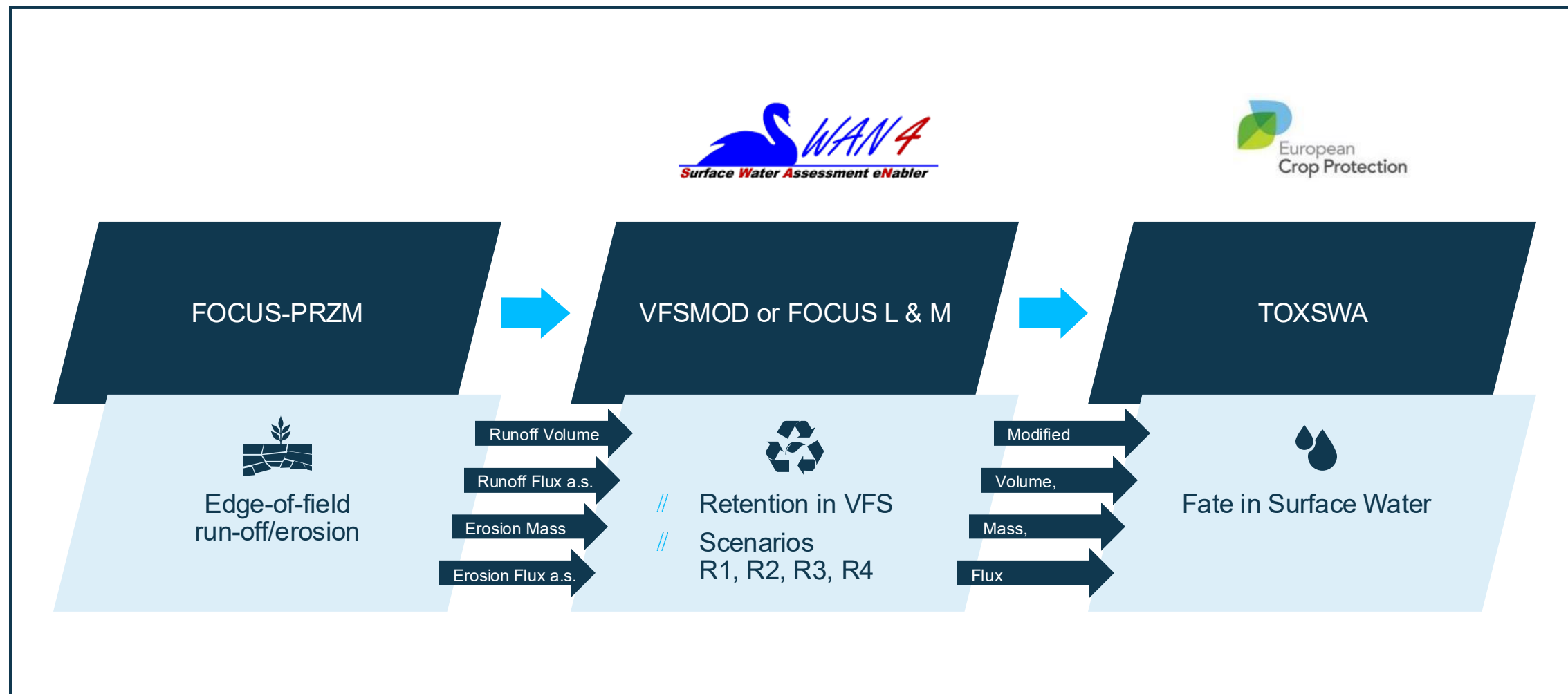
Note that SWAN also includes the option to apply mitigation implementing a mechanistic vegetative buffer filter strip model (VFSmod) that contains a topsoil texture as defined for each FOCUS runoff scenario. VFSmod considers hydrological, sediment and chemical dynamics for each run-off event, where the most sensitive parameters for pesticide trapping Ksat and theta_s were selected by the model developers to result in an overall 10th percentile trapping efficiency for all soils covered by the respective R scenario. VFSmod runoff reduction results differ conceptually from the approach described in the FOCUS landscape and mitigation guidance. As the uncertainty whether the mitigation being modelled with VFSmod is achieved for all the other soil textures that the FOCUS scenarios cover still has to be independently evaluated, VFSmod has not been accepted for use in EU level assessments and decision making. VFSmod estimated runoff reductions may be accepted by some national competent authorities, in assessments supporting national product authorisations. Applicants are advised to confirm the situation with each competent authority.

“As the uncertainty whether the mitigation being modelled with VFSmod is achieved for all the other soil textures that the FOCUS scenarios cover still has to be independently evaluated, VFSmod has not been accepted for use in EU level assessments and decision making.”

<https://esdac.jrc.ec.europa.eu/projects/swan>

Nexus of VFSMOD and SWAN

Automated FOCUS Step 4 Calculation

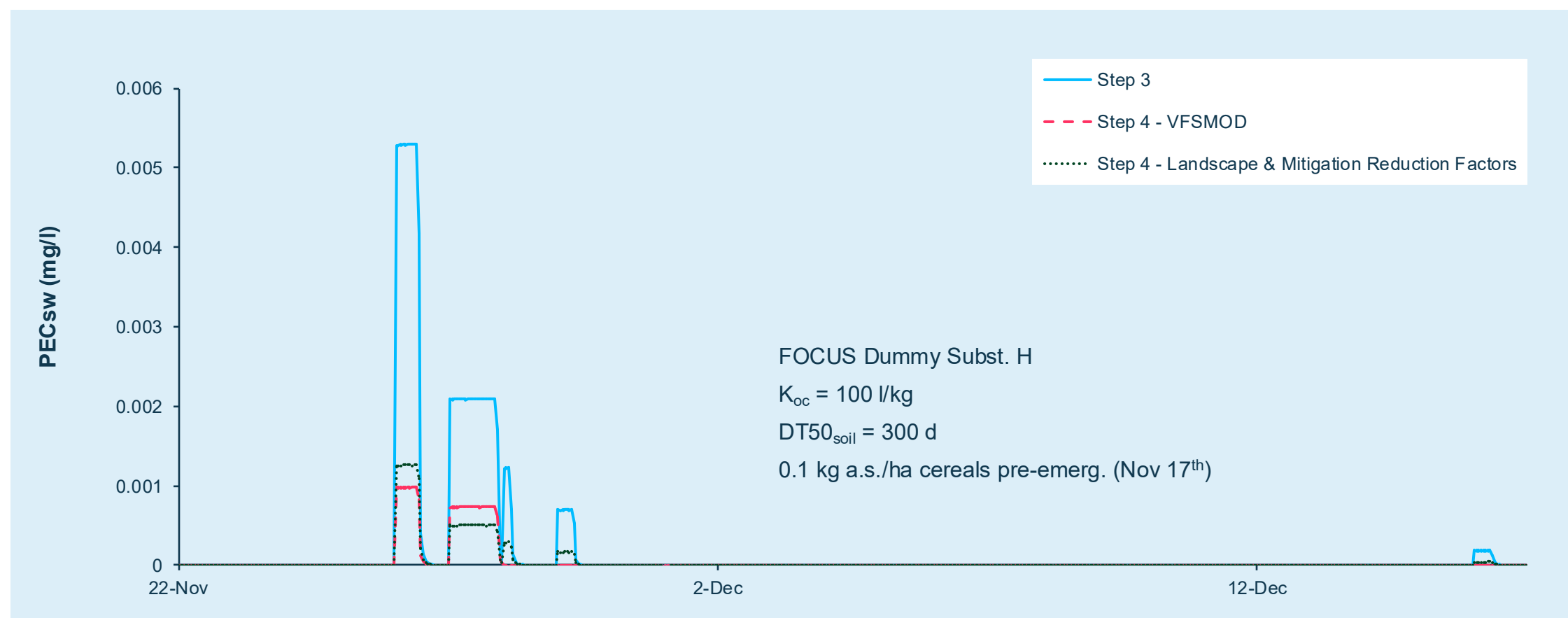


Nexus of VFSMOD and SWAN

Results FOCUS Step 4 Calculation



FOCUS R3-Stream Scenario with 20 m VFS



EU Assessment with SWAN and VFSMOD

Use of VFSMOD by EFSA in final EFSA conclusion

EFSA Journal 2017;15(6):4832

VFS – Vegetated filter strip: 5m VFS – run-off and erosion reduction calculated using VFS mod. 10m VFS – Run-off reduction 0.6, Erosion reduction 0.85. 20m VFS – Run-off reduction 0.8, Erosion reduction 0.95.
DRT – Drift reduction technology

Winter Cereals – Surface Water											
Step 4 Scenario	Max PEC _{sw} (µg/L)										
	5m NSBZ	10m NSBZ	5m VFS	10m VFS	20m VFS	50% DRT	75% DRT	95% DRT	5m NSBZ + 5m VFS	10m NSBZ + 5m VFS	10m NSBZ + 10m VFS
D1 (Ditch)	158.3 72	158.3 72	N/A	N/A	N/A	158.3 72	158.3 72	158.3 72	158.3 72	158.3 72	158.37 2
D1 (Stream)	98.80 1	98.80 1	N/A	N/A	N/A	98.80 1	98.80 1	98.80 1	98.80 1	98.80 1	98.801
D2 (Ditch)	184.2 78	184.2 78	N/A	N/A	N/A	184.2 78	184.2 78	184.2 78	184.2 78	184.2 78	184.27 8
D2 (Stream)	116.4 38	116.4 38	N/A	N/A	N/A	116.4 38	116.4 38	116.4 38	116.4 38	116.4 38	116.43 8
D3 (Ditch)	2.055	1.090	N/A	N/A	N/A	3.792	1.896	0.522	2.055	1.090	1.090
D4 (Pond)	0.273	0.204	N/A	N/A	N/A	0.198	0.154	0.119	0.273	0.204	0.204
D4 (Stream)	2.308	1.236	N/A	N/A	N/A	3.154	1.607	0.370	2.308	1.236	1.236
D5 (Pond)	0.272	0.197	N/A	N/A	N/A	0.189	0.125	0.073	0.272	0.197	0.197
D5 (Stream)	2.208	1.177	N/A	N/A	N/A	3.020	1.526	0.330	2.208	1.177	1.177
D6 (Ditch)	2.586	1.638	N/A	N/A	N/A	4.327	2.450	1.105	2.586	1.638	1.638
R1 (Pond)	0.674	0.609	0.262	0.402	0.315	0.602	0.545	0.499	0.273	0.208	0.349
R1 (Stream)	19.59 9	19.59 9	5.030	8.866	5.030	19.59 9	19.59 9	19.59 9	1.837	1.829	8.866
R3 (Stream)	44.15 2	44.15 2	7.039	20.08 2	10.51 9	44.15 2	44.15 2	44.15 2	2.571	1.363	20.082
R4 (Stream)	1.830	0.971	5.012	5.012	5.012	2.506	1.253	0.251	1.830	0.971	0.971

NSBZ - No spray buffer zone
VFS – Vegetated filter strip: 5m VFS – run-off and erosion reduction calculated using VFS mod. 10m VFS – Run-off reduction 0.6, Erosion reduction 0.85. 20m VFS – Run-off reduction 0.8, Erosion reduction 0.95.
DRT – Drift reduction technology

Recap VFSMOD Workshop Piacenza 2024

- // 70 participants (Regulatory, Academia, Industry)
- // Draft Resolutions were prepared during the WS
- // Later a draft Resolutions Report was distributed with a 3-month commenting period
- // Comments received from
 - // 8 Member States (AT, DE, ES, HR, IR, IT, NO, PL)
 - // 2 Private sector companies (Corteva, RifCon)
- // Comments by the SC and related revisions and new actions were shared again with respondents
- // Final resolutions (Zenodo): <https://doi.org/10.5281/zenodo.17942850>
- // Technical report (Zenodo): <https://zenodo.org/records/17400444>
- // Scientific peer-reviewed paper (STOTEN): <https://doi.org/10.1016/j.scitotenv.2026.181906>



VFSMOD for Pesticide Regulatory Risk Assessment

Q Records

VFSMOD Workshop Resolutions, Piacenza, Spt. 2024
DOI: 10.5281/zenodo.17942850

Resolutions from the VFSMOD Workshop, Piacenza, Italy, September 2024¹

Synthesis

VFSMOD (Muñoz-Carpena, 2021; Muñoz-Carpena et al., 1999, 2010) is a mechanistic model that simulates vegetated filter strips (vegetation buffer zones) of given characteristics and quantifies their effectiveness in reducing sediment and pesticide loads, including plant protection products, transported by surface runoff from adjacent treated fields. In regulatory practice, VFSMOD supports higher-tier environmental risk assessments (ERA) by evaluating VFS as a mitigation measure for pesticide runoff into surface waters.

Initial guidance for VFSMOD parameterization in EU FOCUS Step 4 scenarios was provided by Brown et al. (2012) and integrated that year into the Surface Water Assessment eNabler (SWAN) tool. SWAN is a user-friendly interface to assist in assessing application of exposure mitigation processes based on FOCUS Surface Water Step 3 SWASH-PRZM-TOXSWA calculations (SWAN - ESDAC - European Commission).

VFSMOD was evaluated and recommended for use in SETAC MagPIE (All recommendations to replace its semi-empirical pesticide trapping algorithm updates addressed these concerns by incorporating: a) a mechanistic (Reichenberger et al., 2019); b) dynamic sediment property calculations (Reichenberger et al., 2023); c) consideration of shallow water tables (Muñoz-Carpena et al., 2018; Lauvernet & Muñoz-Carpena, 2018); d) partial remobilization of pesticides subsequent runoff events (Muñoz-Carpena et al., 2015, 2018a; Ritter et al., 2018) assessment of VFSMOD use long-term FOCUS scenarios (Reichenberger et al., 2018).

Despite these improvements, VFSMOD remains rarely used in EU regulatory practice and is not yet accepted in zonal evaluations. The Southern Member State Steering Committee (SMS-SC, 2021) agreed that VFSMOD may be used by applicants in the reports to calculate PEC_{sw} at the state level when proposing risk mitigation measures at the zonal level for the authorization of plant protection products. However, the Landscape & Mitigation (L&M) Guidance remains mandatory. When the member state includes risk mitigation measures calculated using both VFSMOD, the acceptance of these proposed measures for product authorization remains at the discretion of each member state. The committee also emphasized the need for assessors to advance the implementation of such models at the zonal level, harmonization of risk mitigation measures—an area that currently lacks consistency at the national level, FOCUS Step 4 simulations with SWAN-VFSMOD are explained by Poland (per national guidance; Polish Ministry of Agriculture and Rural Development, 2025), Bulgaria (Southern Zone Member States, 2023), and Malta (Pitaro, 2025) occasionally used to support dossiers in Hungary, Italy, and Portugal.

Limited adoption stems from uncertainty regarding its performance across FOCUS scenarios, as noted on the JRC website (SWAN - ESDAC - European Commission, 2021):

"As the uncertainty whether the mitigation being modelled with VFSMOD is achieved for all the other soil textures that the FOCUS scenarios cover still has to be independently evaluated, VFSMOD has only rarely been accepted for use in EU level assessments and decision making. VFSMOD estimated runoff reductions may be accepted by some national competent authorities, in assessments supporting national product authorisations. Applicants are advised to confirm the situation with each competent authority."

¹ Steering Committee members:

- Academia: Rafael Muñoz-Carpena, Roger Holten, Nicoleta Suciuc
- Industry: Robin Sur, Stefan Reichenberger, Horatio Meyer, Peter Rainbird, Bernhard Jene, Amy Ritter, Andrew Bailey
- Regulators: Elena Alonso Prados, Igor Kondzielski

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journal homepage: www.elsevier.com/locate/scitotenv

ELSEVIER

Update of vegetative filter strip scenarios for pesticide risk assessment in Europe

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Update of the definition of vegetative filter strip scenarios for Europe

Report number
120333-1

Project number
120333

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Date
March 19, 2025

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Resolutions and Actions from the Workshop

	Resolutions	Action Items
1.	VFSMOD's mechanistic approach for incorporating VFS mitigation in regulatory environmental exposure assessments is superior to a simplistic, fixed efficiency factors approach.	a) Clarify and explain the concept of the upstream catchment used in SWAN and in conjunction with VFSMOD. The scenario assumption for the upstream catchment with VFSMOD should be the same as with the reduction factors according to FOCUS L & M. Follow-up: The same scenario assumptions of SWAN apply to both classical SWAN (FOCUS LM reduction efficiencies) and SWAN-VFSMOD, and they are identical to the assumptions formulated in FOCUS LM report (Ter Horst et al., 2009). Ter Horst et al. (2009) also analyzed the aspect of dilution by the untreated area of the upstream catchment. This was further expanded upon by Reichenberger et al. (2014). See references below. Ter Horst MMS, Adriaanse PI, Boesten JJTI (2009). Mitigation of runoff in the FOCUS Surface Water Scenarios. Note of the fate group of the Environmental Risk Assessment team of Alterra on the interpretation of the mitigation of runoff in the FOCUS Landscape and Mitigation Report (2007). AlterraRapport 1794, ISSN 1566-7197. 35 p. Reichenberger S, Bach M et al. (2014). Impact of step 4 scenario assumptions and VFSMOD parameterisation on the effectiveness of vegetative filter strips in reducing PEC in surface water. 7th European Modelling Workshop, 21-23 October 2014, Vienna, Austria; oral presentation <u>Caretaker:</u> steering committee¹
2.	VFSMOD input parameters related to the FOCUS scenarios must be well documented and published in a peer reviewed journal and technical report	a) Prepare a peer-reviewed paper describing the new VFS scenarios for the four FOCUS R scenarios (as presented in the workshop). b) Within the paper, describe the protectiveness of the four new VFS scenarios for the different soil texture classes (as presented in the workshop). c) Include a comparison to the fixed reduction factors as provided in the FOCUS Landscape & Mitigation report. d) In addition, a technical report for earlier access and covering the same aspects as the paper and model inputs will be prepared to be published on the JRC (where SWAN is available for download) and Zenodo websites. e) Details of VFS scenarios and parameterization are also being added to the technical document for SWAN 5.2. Follow-up: The peer-reviewed paper will be ready for submission by 01/2026. The report has been completed on 03/2025, forwarded on 07/2025 to EFSA and the EU Commission, and published on 10/2025 (Reichenberger et al., 2025).

Clarify role of upstream catchment with VFSMOD: Done!

Paper available:

<https://doi.org/10.1016/j.scitotenv.2026.181906>

Resolutions and Actions from the Workshop

	Resolutions	Action Items
		<u>Caretaker</u> : steering committee members ¹ and collaborators
3.	A remaining issue discussed in the workshop is the comment on the recent EC Compendium (March 21, 2024, Table pg. 29 Field Management Measures, “Tbd”) and on JRC website about the representativity and validation of the VFS scenarios in VFSMOD. The paper and report (Resolution 2 above) is considered as a prerequisite for regulatory acceptance of VFSMOD.	a) Following publication, the Compendium was updated on May 23, 2024 so that the comment related to (Table p 29, comment “Tbd” and “Is it possible to use the item to refine the risk assessment?”) is no longer related to the use of VFSMOD for quantitative mitigation but it now pertains to harmonization of field data (“Are harmonized exposure data available to be used in a risk assessment?”). The new column title only makes sense in the context of the use of field measured data (reduction percentage) to quantify mitigation rather than modelling tools like VFSMOD. b) Since wider public interest in the tool is increasing as a result of publication of the EC Compendium, a dissemination technical report should be prepared presenting in a simplified way the concept of VFSMOD, its implementation into SWAN and via this into tiered FOCUS SW assessment scheme as a part of Step 4 evaluation, and an analysis of the current and anticipated implementation into the regulatory scheme as a fully viable tool. c) Validation by EFSA and implementation into the EFSA FOCUS version control would further support the full regulatory acceptance of the VFSMOD tool. <u>Follow-up</u>: The initial question on the use of VFSMOD is now addressed in the ensuing Report prepared (Reichenberger et al, 2025), where the results of the VFS FOCUS scenarios for the different EU soil texture classes are shown to be more protective than the alternative empirical L&M coefficients. <u>Caretaker</u>: European Commission, JRC, zonal risk managers with support from academics and stakeholders as requested. The dissemination report will be prepared by the workshop organizers and will be submitted at the end of 2025.

Dissemination Report
(in prep)

Resolutions and Actions from the Workshop

	Resolutions	Action Items
4.	As SWAN allows application of VFS mitigation with both VFSSMOD and Landscape & Mitigation efficiencies, harmonization of the use of the tool must be developed.	a) In consultation with risk managers, a guidance needs to be developed to harmonize the use of the tool and define the appropriate one to apply. VFSSMOD mechanistic approach allows for specific scenarios conditions and produces a more realistic and transparent evaluation of the expected efficiency of the VFS in that context. As a result, there would be situations where VFSSMOD offers less or more conservative results than the empirical reduction factors. Consistency guidance on the use of both alternatives should be developed (no “cherry picking”!). <u>Follow-up:</u> A guidance will be developed in the first quarter of 2026. <u>Caretaker:</u> risk managers groups with support from academics and stakeholders as requested
5.	The adoption of VFSSMOD in the regulatory context should continue immediately without waiting for FOCUS SW repair tools.	a) As there is still no fixed release date for the FOCUS Surface Water Repair software tools and they will likely introduce their own issues, do not wait. The use of VFSSMOD is independent from the version of FOCUS SW and directly applicable to the new FOCUS SW repair. VFS scenarios were also developed in the new report with FOCUS SW repair assumptions (Reichenberger et al., 2025), so they are also compatible with the future release of the FOCUS SW repair when available. <u>Follow-up:</u> A new version of FOCUS SWAN for FOCUS SW repair is also under development that incorporates VFSSMOD with compatible parametrization and will be ready when the repair action is approved. <u>Caretaker:</u> Capgemini Engineering, with support from stakeholders as requested

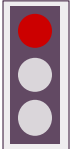
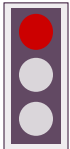
Guidance*:
Open action!

SWAN for
FOCUSswRepair:
Ongoing

*Key clarification for guidance:

VFSSMOD under SWAN operates within FOCUS SWASH R scenarios. It accounts for vegetated filter strip mitigation by modifying runoff-related inputs to surface water, while the underlying scenarios (e.g., pedo-climatic conditions and geometry) remain unchanged

Options for wider adoption of VFSMOD

Submit along with a.s. renewal/approval at EU level as recommended by the Compendium	Strengthen the endorsement of VFSMOD in the Compendium	COM mandates EFSA to develop guidance	Decision by individual Member State	SETAC initiative
+ • So far, Mecoprop-P is the only precedent, where VFSMOD appeared in the EFSA conclusion	+ • Preferred way by COM	+ • Ideal way	+ • MS free to decide on acceptance • Poland, Bulgaria, Malta • Others (case-by-case)	+ • Includes all stakeholder groups • Precedents available • Groundwater monitoring • SDLM
- • In 6 out of 7 submissions, VFSMOD was only assessed in the RAR, not in the final EFSA conclusion: • Not an EU-agreed or validated model • Some MS do not accept model • EU peer-review has been an ineffective means to evaluate VFSMOD • No ramifications on wider acceptance 	- • For MS too little information is provided in the Compendium 	- • No priority for COM and EFSA to assess VFSMOD • Very long process • Not viable to assess every single mitigation measure by EFSA 	- • MS may not have the resources to assess the model • No harmonized approach across the EU • Not chosen by many MS 	- • Long process • Still requires assessment by EFSA afterwards 

Options for wider adoption of VFSMOD

Member state-driven initiative to develop guidance



- Already successfully applied for TDS
- Includes different stakeholders
- Adoption via note-taking process by SCoPAFF



- Depends on willingness of MS to drive in this effort



Workshop w/ regulators followed by guidance development



- Includes most relevant stakeholders
- Group of interested regulators would steer the process
- Very focused activity
- COM could join as well



- Requires several engaged regulators
- No precedent
- Legal implementation?



View of Regulatory Zones – Central Zone (June 2026)

Special case of VFSmod *



- Industry criticism of the position in the CZ
- Clarifications on the position of the CZ:
 - The model is not ruled out by the MS/CZ, but reservations are expressed
 - VFSmod is accepted and used by a small minority of MS
 - The implementation and parameterisation is not endorsed in any EU guidance
 - No recommendations of use from EFSA are available at the EU level assessment
 - Model's scientific potential vs. regulatory reality: Authorities implement rules, even if not scientifically sound.

credit: Joachim Dayteg, Fresenius conference, Düsseldorf, June 2026

* Vegetative Filter Strips model - computer simulation model

View of Regulatory Zones – Southern Zone (June 2026)



PEC_{sw/sed} calculations

- ✓ FOCUS Step 1-2: calculations for Northern & Southern Europe required
 - ✓ Step 3: in case of extended application period, several simulations needed (rather than single with large application window)
 - ✓ Mitigation options:
 - Drift: no-spray buffer zones, drift reducing nozzles
 - Run-off: vegetated filter strips. Run-off mitigation factors from FOCUS 2007* to be used
 - Drainage: no application on drained soils
- ✓ Status of VFSMOD:
 - Calculations can be proposed additionally in Registration Reports. Assessed by zRMS
 - Acceptance of risk mitigation measures issued from VFSMOD = competence of each MS

credit: Emilie Farama, Fresenius conference, Düsseldorf, June 2026

* FOCUS (2007) "Landscape And Mitigation Factors In Aquatic Risk Assessment. Volume 1. Extended Summary and Recommendations". Report of the FOCUS Working Group on Landscape and Mitigation Factors in Ecological Risk Assessment, EC Document Reference SANCO/10422/2005 v2.0. 169 pp.

View of Regulatory Zones – Northern Zone (June 2026)



NZGD:
„The use of the VFSmod tool
is not accepted.”

State Plant Protection Service of the Republic of Latvia

Update from Northern Zone 2026

28th International Akademie Fresenius Conference:
Behaviour of Pesticides in Air, Soil and Water

Emīls Zariņš

Interim division head/Phys-chem expert

02/06/2026

credit: Emils Zarins, Fresenius conference,
Düsseldorf, June 2026



Conclusions and Outlook

- // Results of the Piacenza workshop 2024

- // Consensual resolutions

- // Additional scientific reports

- // Willingness to move VFSSMOD forward to regulatory acceptance

- // Science and regulatory capacity of the model were confirmed

- // Lack of EU-harmonised guidance limits acceptance of VFSSMOD in several Member States and remains a key concern at both zonal and EU level

- // MS-driven or multi-regulator initiative is recommended to develop EU-level guidance for VFSSMOD

- // Effort to be limited as plenty of scientific data and use cases are available

- // Engage all interested regulators and other stakeholders

- // Seek endorsement at SCoPAFF level

Thank you!
Any Comments?

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