Mitigation of PPP losses through runoff / erosion Diagnosis concept

This presentation was compiled
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Diagnosis is first and key to propose Best Management Practices (BMP) to reduce losses of PPP to surface water

Diagnosis

Determines runoff situations for landscape + specific field

- Low risk
- Medium level
- High level
- Very high level

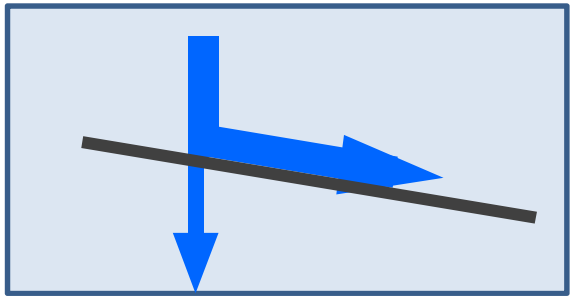
Toolbox of mitigation measures

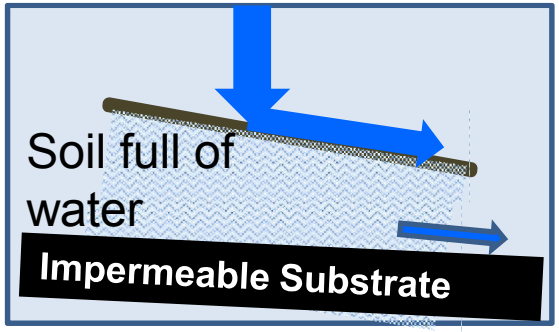
- Soil management
- Cropping pattern
- Vegetative buffers
- Retention structures
- Cropprot practices

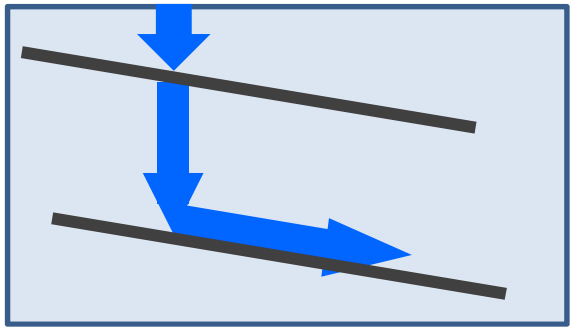
BMPs = Diagnosis + set of measures
(specific to runoff situation)

Typs of runoff

- Surface runoff
  - a) **Infiltration ecxess:**
    volume of rain > than soil infiltration
  - **b) Saturation excess (mainly winter)**
    water holding capacity is full
- Subsurface runoff
  - **Lateral soil drainage**
    impermable layer / artifical drainage

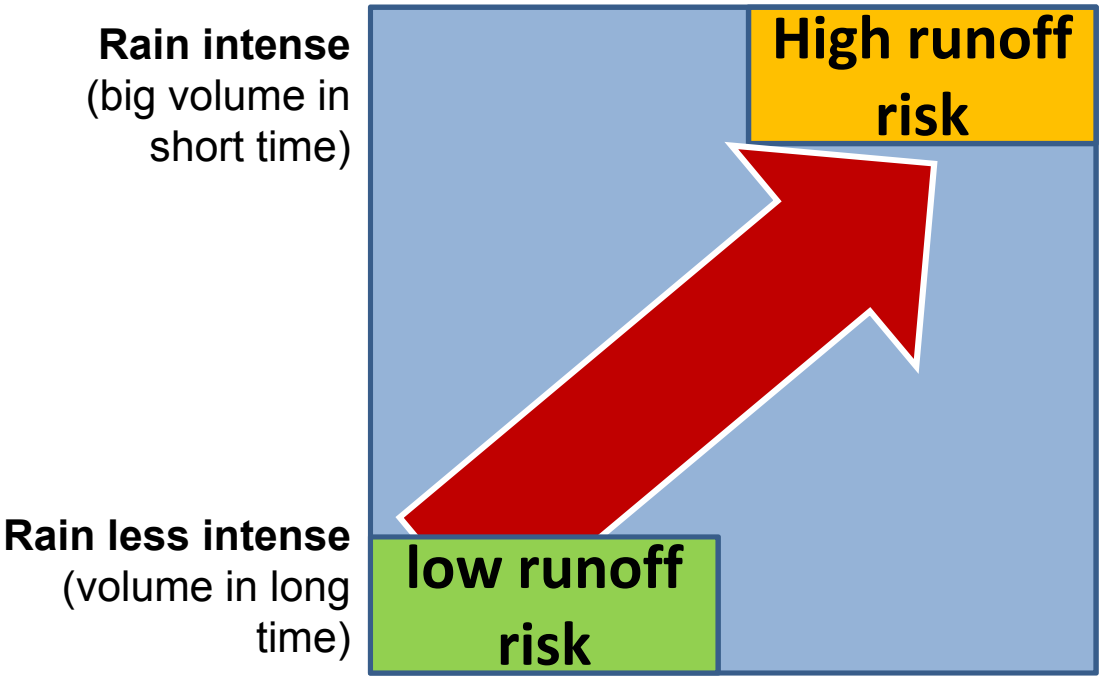






SURFACE RUNOFF / EROSION MOST CRITICAL FOR PPP WATER ENTRY
-FAST, LITTLE CONTACT WITH SOIL (LOW DEGRADATION!)

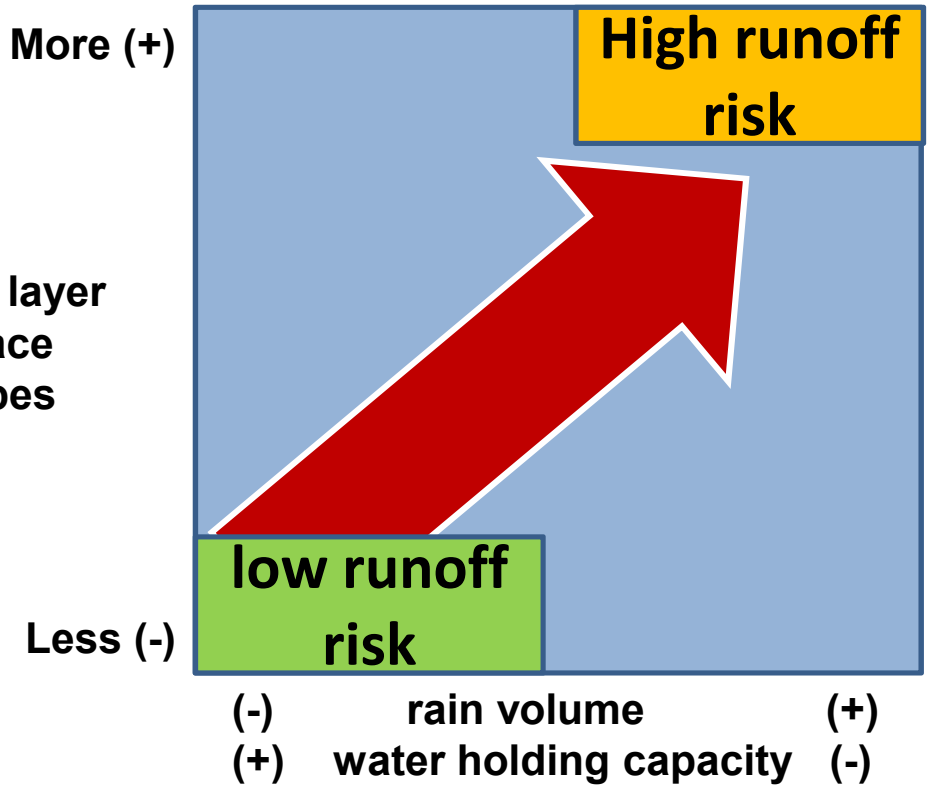
Basic runoff risk -Infiltration excess



…. More a rain intensity problem (spring summer)

Basic runoff risk-Saturation excess

- Shallow soil
- impermeable layer close to surface
- Concave slopes



…. More a rain volume and water storage capacity problem (winter)

Key factors determine runoff risk

1. EFFECTIVE PROXIMITY TO SURFACE WATER

(definition is subject to catchment / field diagnosis).

Scenario far away from surface water
Field producing runoff / erosion is far away , means low risk for PPP entry
If a river / ditch is far away , runoff water / eroded soil will not reach the surface water

Scenario close to surface water
Field producing runoff / erosion is close to surface water, means risk for PPP entry.
It is not only a question of distance, but also a question of distance from channeling structures (speed to reach surface water - e.g. concentrated runoff, fast drainage e.g.talweg, road)

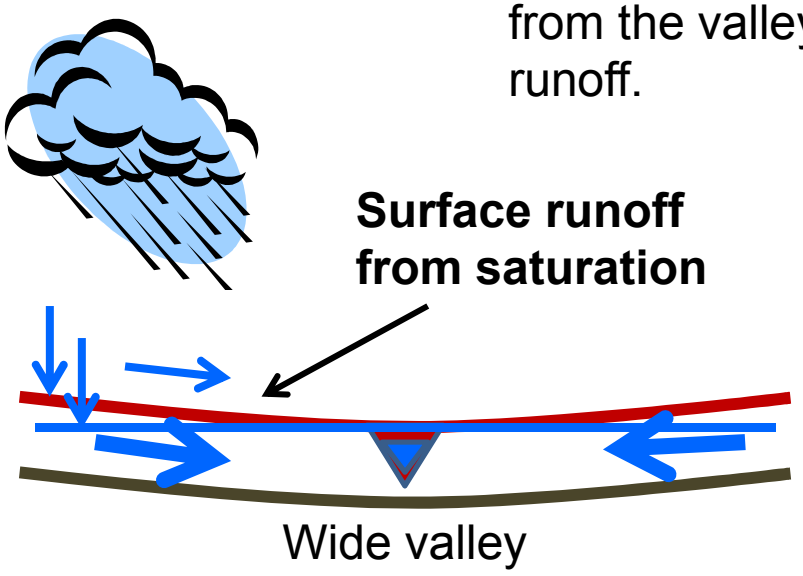
Key factors determine runoff risk

2. Valley form and slope and shape of the slope

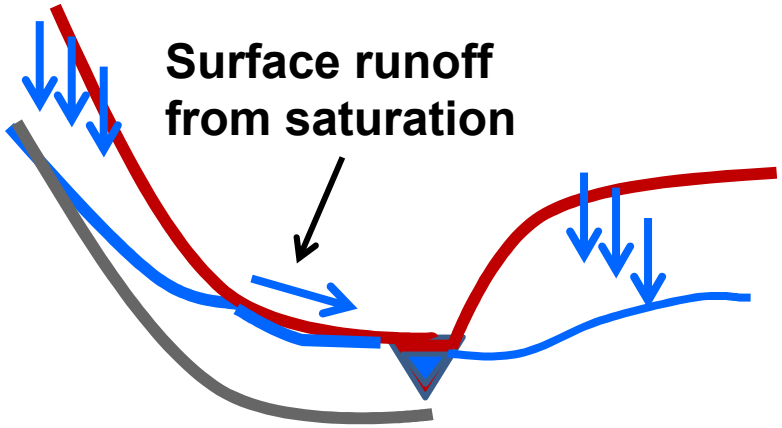
(definition is subject to catchment / field diagnosis).

Infiltration excess: slope steepness, slope length and surface roughness influence the rate of infiltration of water into the soil

Saturation excess: the valley form is an additional factor to consider as the impermeable subsurface layer will fill up the soil from the valley bottom upwards and create surface runoff.



Wide valley



Narrow valley

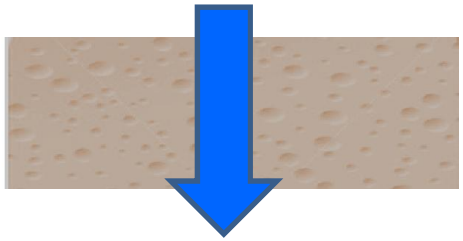
Key factors determine runoff risk

3. Permeability of topsoil (infiltration excess)
Transmissivity of topsoil (saturation excess)

(definition is subject to catchment / field diagnosis).

PERMEABILITY

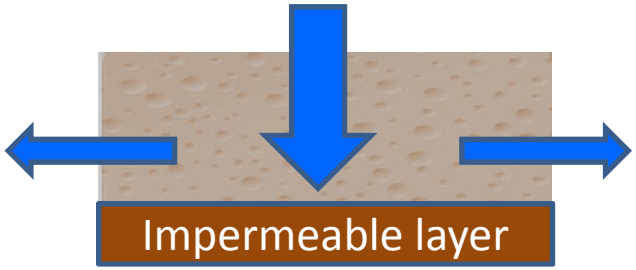
Rain volume infiltrated in soil



- Permeability high
- Infiltration high
- No surface runoff

TRANSMISSIVITY

Capacity for storage in soil and lateral transport rate (depends on soil depth)



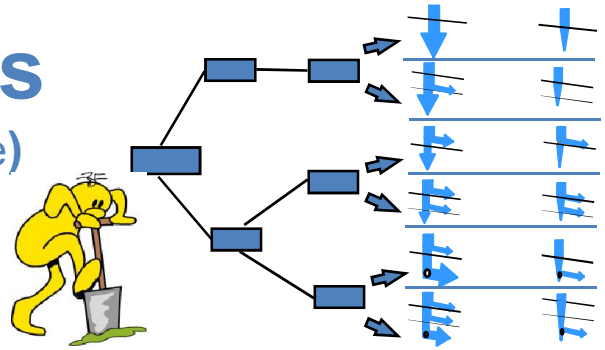
- Transmissivity high
- Water holding capacity high
- Surface runoff risk low

Dashboard concept reduce complexity

- **dashboard information helps to make decisions simpler**
- **using a dashboard does not mean that all functions of the engine need to be understood**
- **using a dashboard needs a trained and educated driver**

Diagnosis + BMPs

(Diagnosis based on Arvalis methode)



1

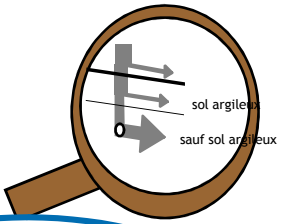
Diagnosis preparation: Identification of landscape, of the type of soil,climatic data, field maps

2

Field diagnosis:Diagnosis of soil water flow regime , agronomic practices, landscape factors

Link diagnosis and mitigation measures based on risk situations

3



Define risk situations with the dashbords

4

Diagnose, locate , design buffer zones

5

Propose BMPs

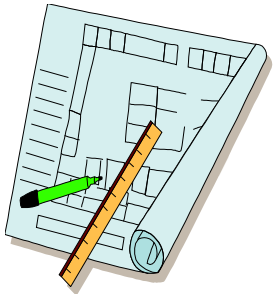
Step 1 : Preparing the diagnosis

Information on farm practices and landscape

Maps on:

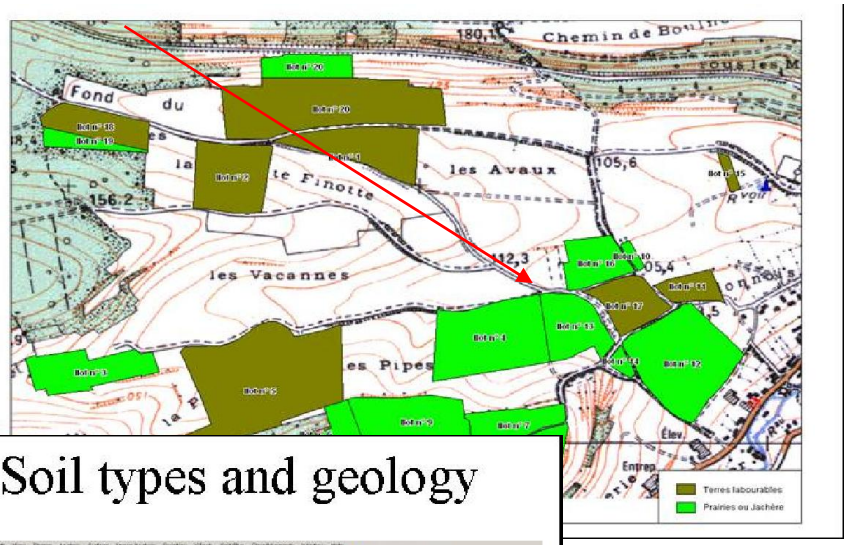
- **Pedology,**
- **Geology,**
- **Slope**
- **Hydrology,**
- **Hydrography,**
- **Crop rotation.**

Step 1 : Preparing the diagnosis

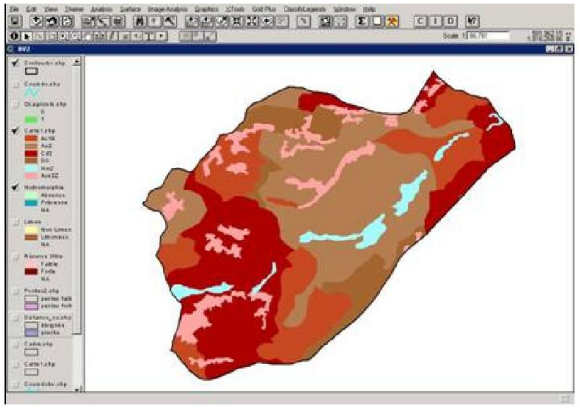


Topograpy maps useful to understand water flow

Fields localization



- Soil types and geology

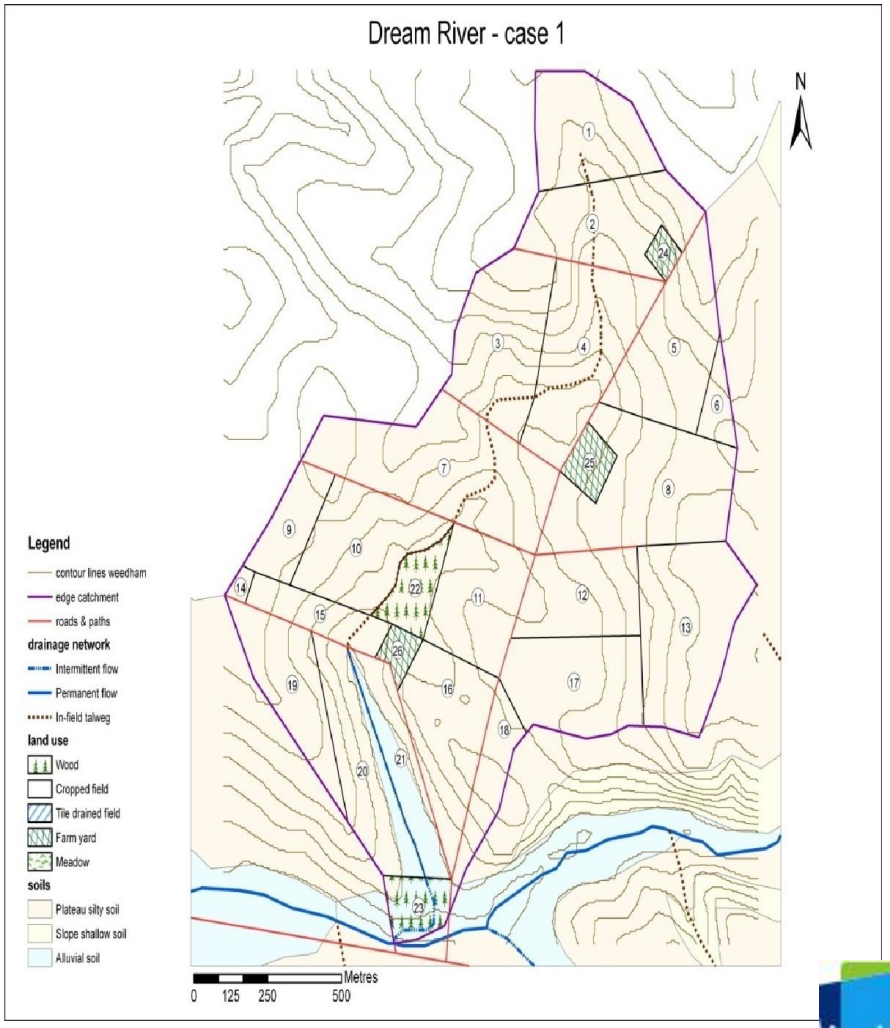


Soil and geological maps are necessary

Step 1 : Preparing the diagnosis

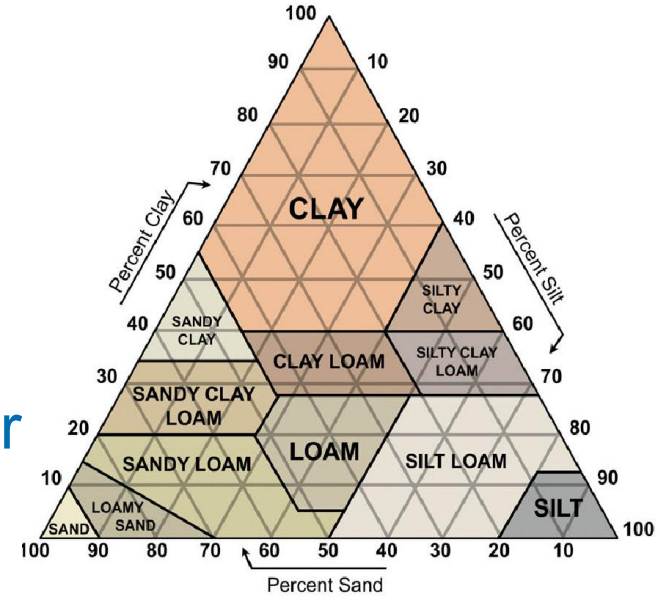
Example

- Topographic information of landscape
- Hydrologic network (streams/ditches
- Water flow and direction in the landscape
- Field map / sizes / orientation (Agriculture use)



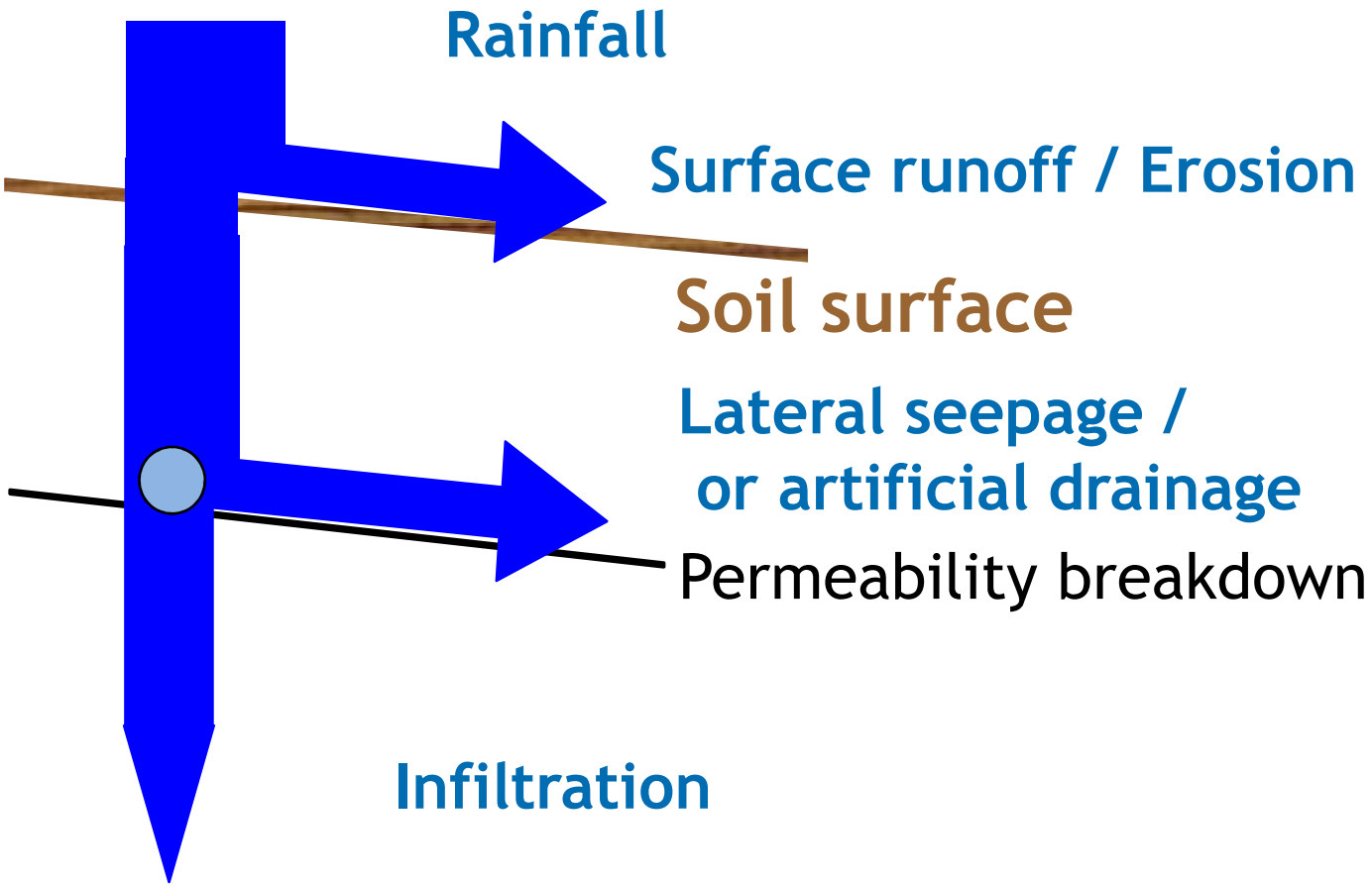
Step 2: Plot diagnosis

1. **Identify soil characteristics (field methods)**
   - Determine the substrate permeability
   - Determine the permeability of the surface horizon
   - Determine changes in permeability in soil profil
   - Determine the available water capacity in top soil
   - Observe evidence of capping or surface run-off / erosion



Step 2: Plot diagnosis

2. Identify the types of water flow in the soil and intensity (Runoff types)



Step 2: Plot diagnosis

3. Determine the effect of practices : soil management & cropping practice

Soil covering (crops and date sown)

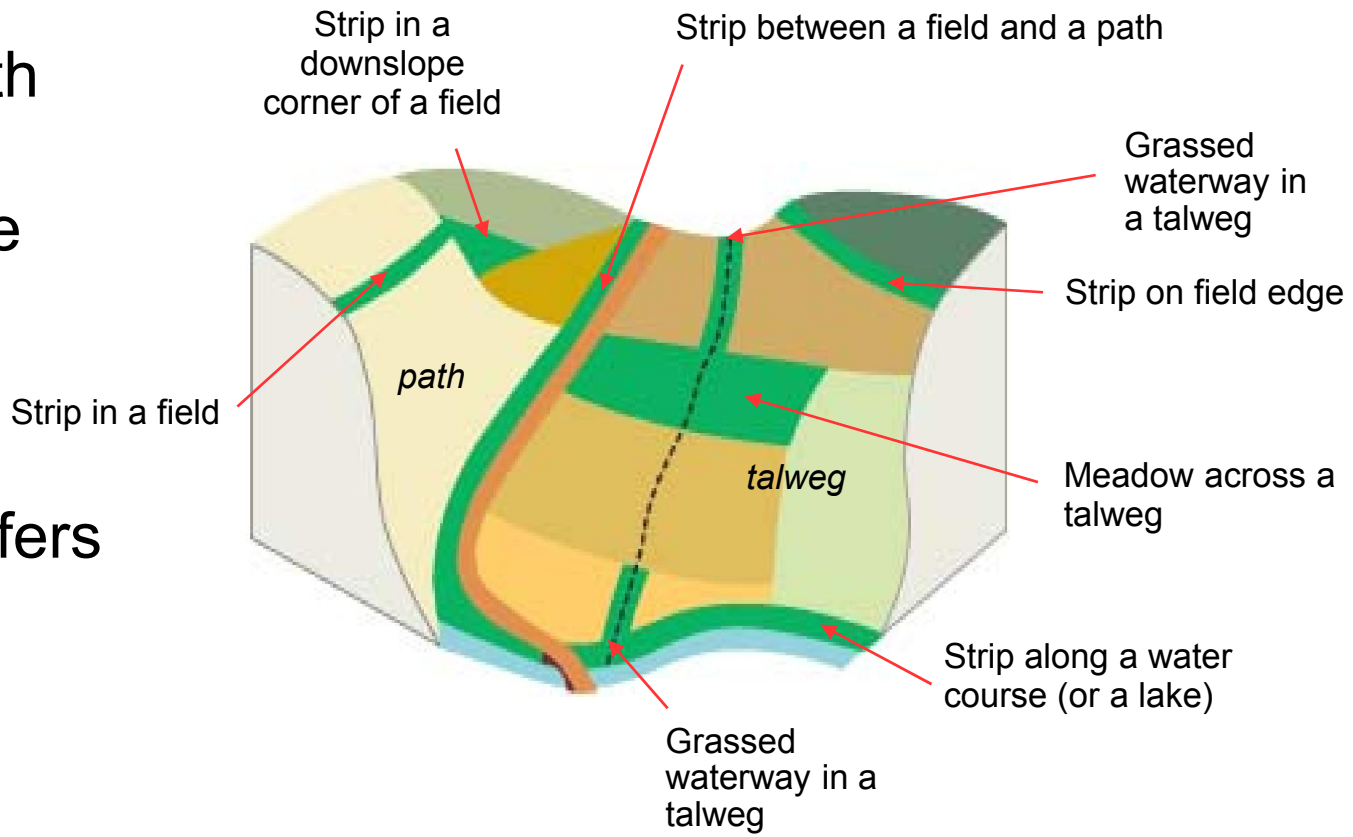
Soil cultivation

Crop rotation / Crop distribution

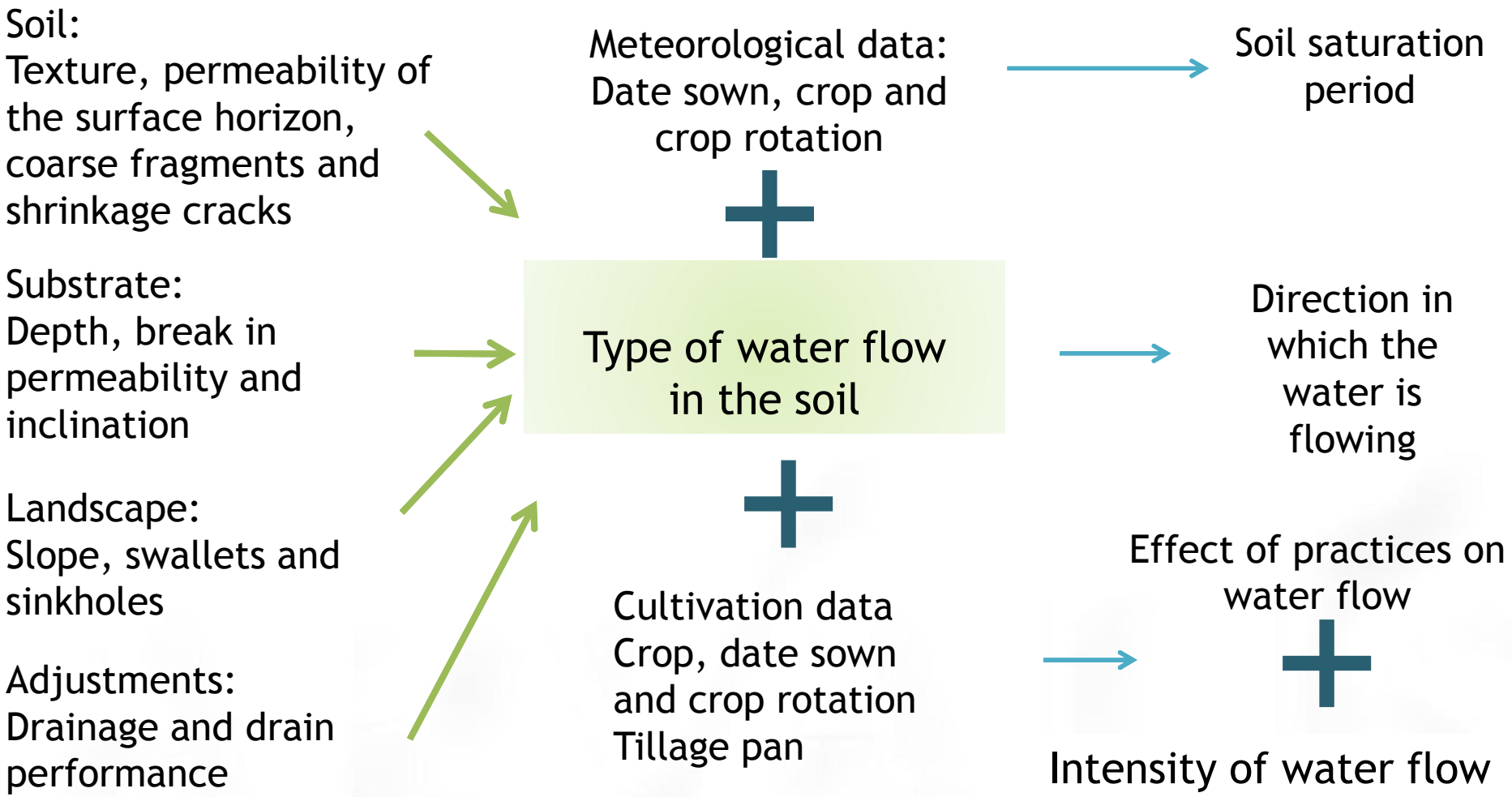
Step 2: Plot diagnosis

4. Determine the landscape factors

- Slope length
- Slope shape
- Talweg
- Natural buffers



Step 2: Plot diagnosis summary

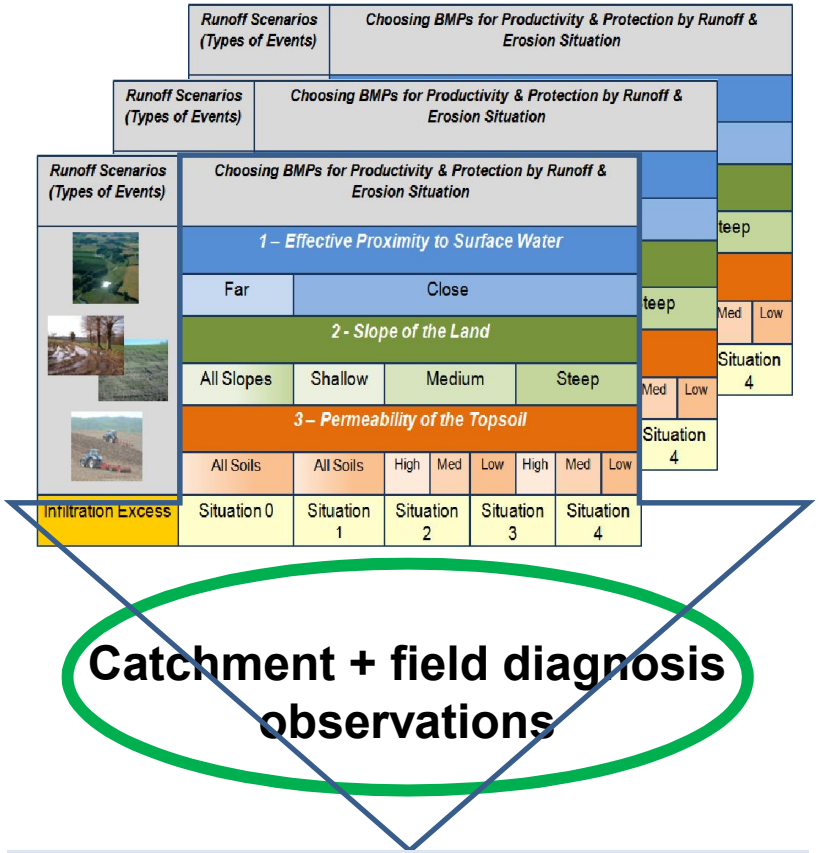


ARVALIS
Institut du végétal

Step 3: Define runoff risk situation with decision tree + dashboard

- Select the dashboard most appropriate fore the runoff situation
  Infiltration excess
  Satuartion excess

- Determine the risk situation entering diagnosis results into dashboard



DETERMINE RISK SITUATION

Step 4:Vegetative buffer zones

- Vegetative Buffers strips are effective measures to reduce PPP transfer into water from runoff /erosion (more details in the measures section)
- most critical is the first rain event after PPP application
- Buffers work mainly through their water infiltration capacity, which require appropriate location, size design and maintenance
- **THOROUGH DIAGNOSIS IS NECESSARY !!!**

Step 4:Vegetative buffer zones

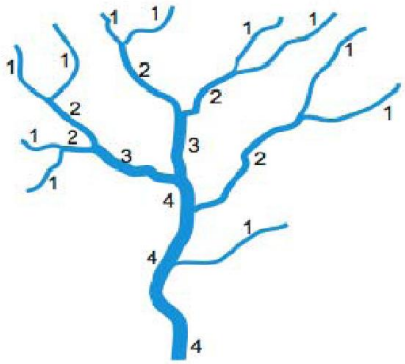
Two step diagnosis approach:

a) From the water body view (Riparian analysis)

Bank, existing buffer, vegetation of buffer, adjacent fields, hydromorphy, hydraulic connection between water course and slope ….

b) From the catchment view (Catchment analysis)

Water flow in catchment, riperian buffers sufficient, infiltration of soil, observation of runoff, field observations …..

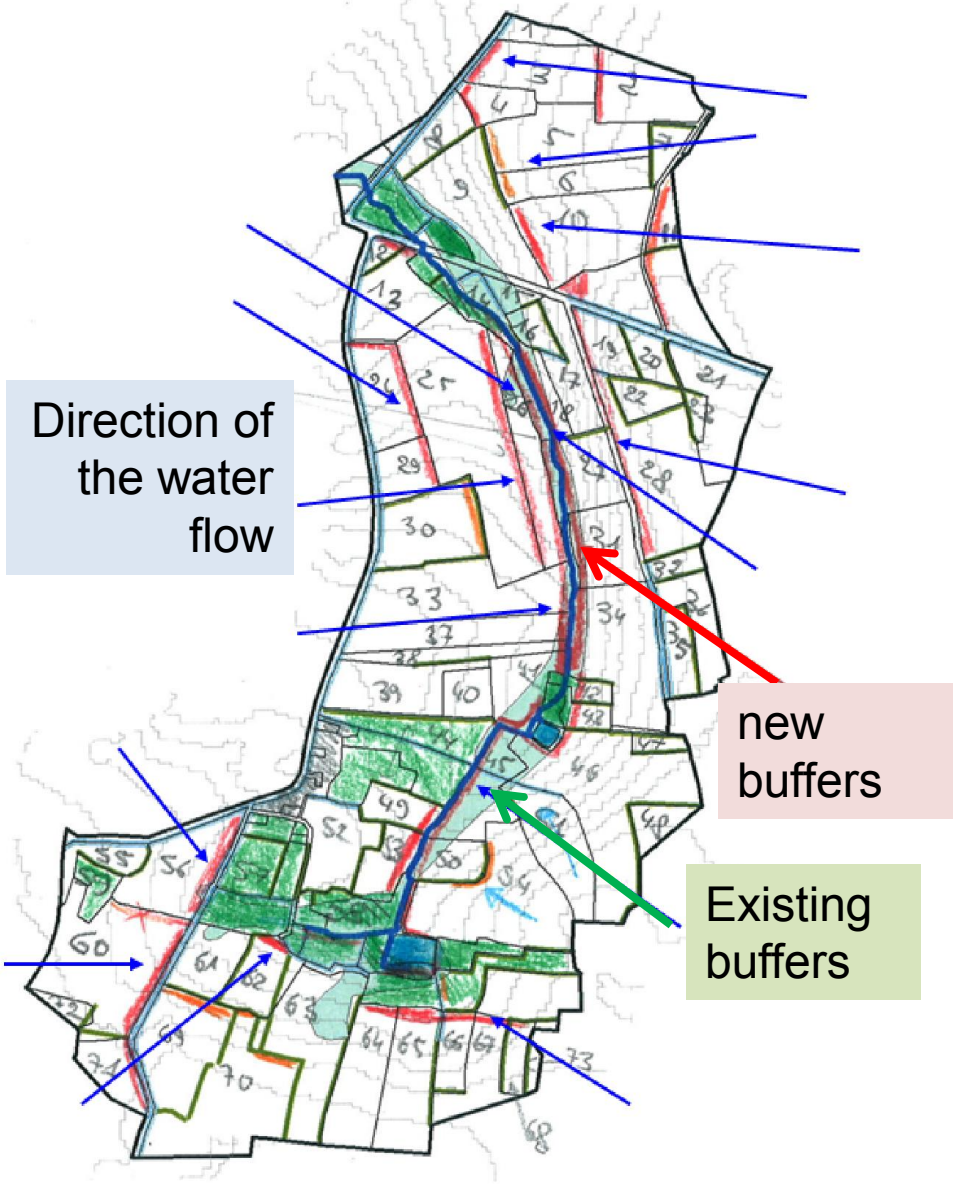


Focus on water courses of order 1 , max 2

Step 4 : Preparing the diagnosis

Example : Fontaine du Theil ; Bretagne, FR

- Topographic information of landscape
- Hydrologic network (streams/ditches
- Water flow and direction in the landscape
- Field map / sizes / orientation (Agriculture use)



Signs for runoff

(Pictures Cemagref)

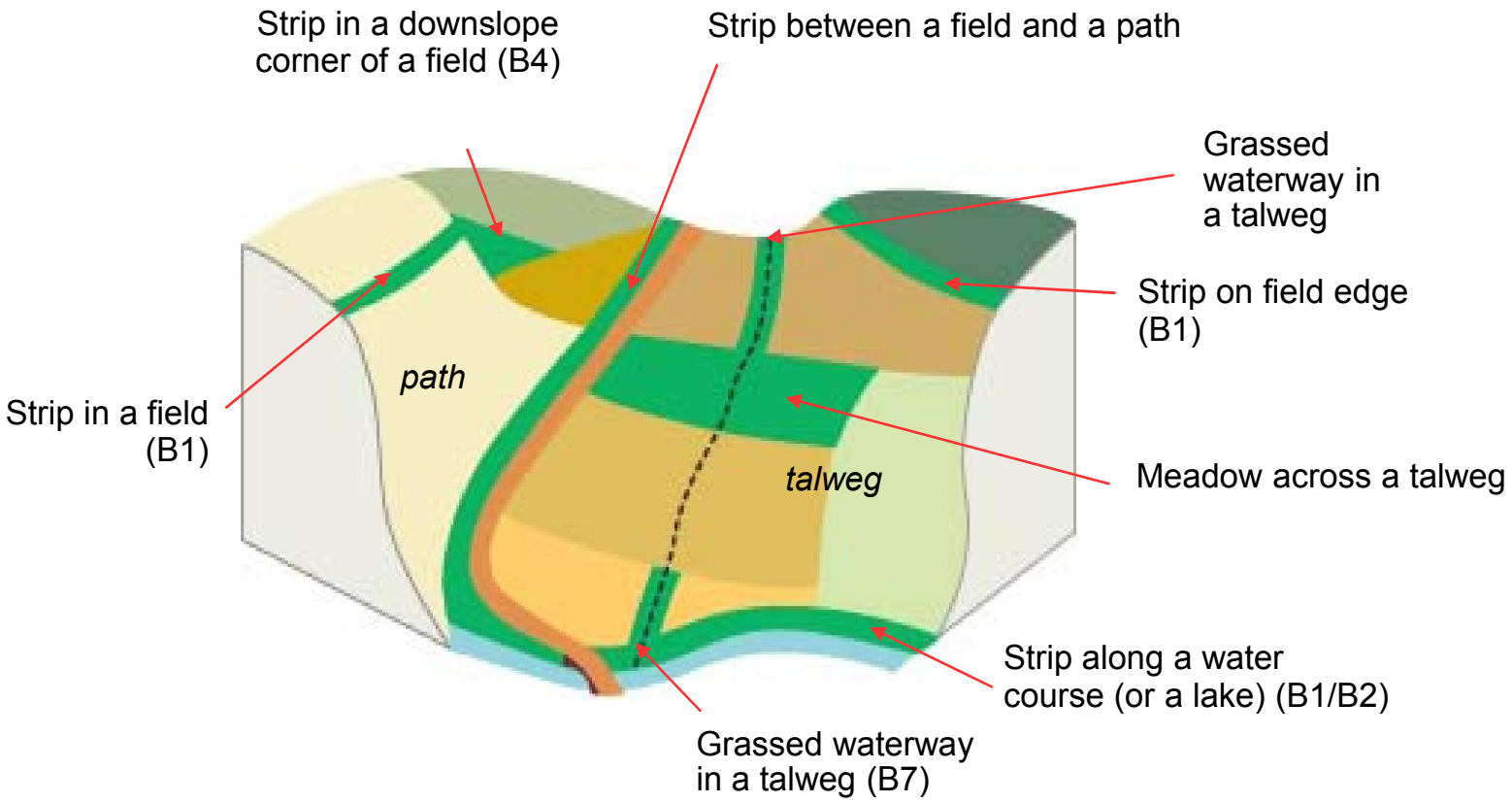
splash erosion

runoff in wheel tracks; furrow ditch

outwash and deposits

Open furrow in a talweg

Buffer positioning and sizing in the landscape important



Step 5: BMPs = diagnosis+measures

Concept

Risk situation 4

Scenario I	Scenario 2	Scenario 3
Proposed set of measures 1.3,4,7	Proposed set of measures 1,2,3,4	Proposed set of measures 3,5,6,7

BMP recommendation

Scenario descriptions intend to capture various farming situations to help define the BMPs in a most adapted way
(Farm productivity and orientation, crop rotation aspects, social and local aspects)

Conclusion

- Beside of point sources, runoff / erosion is the main diffuse entry route of PPP into surface water
- PPP losses via runoff / erosion can be reduced by site specific recommendations and implementation of mitigation measures. BEST MANAGEMENT PRACTICES (BMPs)
- A thorough diagnosis of relevant factors on catchment and field level and a toolbox of mitigation measures need to be linked for site specific efficient BMPs.
- Diagnosis and the description of various risk situations need to be supported by decision tools to support broad use (Decision tree / dashboard concept).
- Key success factor for such an approach is to create awareness, get full stakeholder support and provide necessary training and knowledge transfer.