WATER STEWARDSHIP TOOLKIT FOR MET PHOTOVOLTAIC CONSTRUCTIONS

Responsible planning and management of resources

Water stewardship is defined as using water in a way that is socially equitable, environmentally sustainable, and economically beneficial

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TABLE OF CONTENT

ANNEX 1: WATER STEWARDSHIP FORM

1 Foreword

Competition for land and water is fierce. The consequences of land use changes are complex. This Manual creates value and mitigates the consequences of land use changes in PV park developments.

It is also vital to understand the positive and negative impact of green investments, such as PV developments, on our environment. Developers have a great opportunity to make changes for a better environment for mankind.

This syllabus serves as a tool for the photovoltaic constructions of MET Group, aligning with universal values by providing fact-based decisions and science-proven solutions tailored to local needs.

Our goal with this syllabus is to empower developers to create a reliable plan for water developments in the future PV plans, based on widely accepted baseline data and solutions to water-related challenges, which have been set up by the competent local entities in line with the idea of water stewardship[1]. It acts as a compass for our Construction Contractual Partners across Europe, guiding them through a consistent sequence of steps that address the unique water-related circumstances of each location.

[1] Responsible planning and management of resources. Water stewardship is defined as using water in a way that is socially equitable, environmentally sustainable and economically beneficial.

https://www.unido.org/our-focus-safeguarding-environment-resource-efficient-and-low-carbon-industrial-production-industry-and-adaptation/water-stewardship

2 Understanding the concept of this syllabus

The primary objectives are the following:

1. Creation of a documentation based on widely accepted facts and data sets that is both trustworthy and non-questionable.

2. Creation of a comprehensive paper of documented evidence, including but not limited to the site-specific water-related challenges (risks and stress) that have either been documented or scientifically proven.

3. Creation of measures to address site-specific water-related challenges that have been either documented or scientifically validated.

4. The documentation should provide measures that are financially, socially and environmentally feasible, and which meet all relevant legislation.

5. The measures should all point to a better water stewardship of the concerned area.

6. The impact(s) should be quantifiable. In the initial section, recommendations will be provided concerning data sources that are both widely acceptable and comparable, concerning the present climatic and hydrological situation of the area in question.

We will provide suggestions on widely acceptable and comparable data sources, present and future aims and challenges of water management.

Finally, a set of ideas on applicable water-related measures will be provided, as well as an analysis of how our measures affect the surrounding area and how they can be estimated and reported in line with widely accepted standards.

3 Requirements on baseline data and suggested data sources

Baseline data is of the utmost importance in any assessment, and it is also the area where challenges are most likely to arise. For this reason, we recommend the use of internationally and legally accepted common data sources.

Within the EU and associated countries, the WFD (Water Framework Directive)[2] reporting framework provides reliable background information sources through the European Environment Information and Observation Network (Eionet)[3] and the JRC (Joint Research Centre)[4] for science-based information on the environmental state of the concerned countries.

It is important to note, however, that the evaluator will have access to site-specific and fact-based information that overrides the general information from the above-mentioned sources. The field investigation and measurements carried out by the water engineer on the ground will therefore take precedence over everything else. Consequently, these sources of information need to be carefully delineated in order to respect the principles of accountability.

[2] https://environment.ec.europa.eu/topics/water/water-framework-directive_en
3 https://www.eionet.europa.eu
[4] https://data.jrc.ec.europa.eu

4 Water-related benefits

There are several aspects in which a PV park could enhance the overall water management of its immediate and wider proximity. This statement applies to both agricultural and brownfield investments.

4.1 Achieving water stewardship without special measures

For brownfield investments, if the land has been previously tilled with heavy machinery (including such agricultural land), but **then left undisturbed for a longer period of time**, **the site structure and soil quality will recover on their own**, increasing its water retention capacity. The increased water retention capacity has numerous benefits, just as:

- Reduced flood risk
- Reduced soil loss (erosion, which reduces nutrient loads to waterbodies downstream)
- Larger pool (stored water in the soils) for potential evaporation, leading to lower heat stress for people, PVs, or higher yields if the area remains in agricultural production with no till and low soil compaction practices (*grazing, herb cultivation, etc*.)

PVs, with their extensive surface areas, facilitate morning condensation, which can be a vital water source in arid environments and in bio-solar city installations. In addition, the PVs' shading effect increases soil moisture. As outlined in the professional literature, the aforementioned effects increase soil moisture by 11-18%.

While floating PVs have a beneficial effect on reducing evaporation (up to 90%), algae production, they also increase solar yield by cooling the PVs (10%).

4.2 Achieving water stewardship by special measures incorporated into the Executive design phase

With appropriate measures, such as in-depth planning, cost-effective solutions can be achieved during the construction phase of a PV park.

The following are a few examples:

4.2.1 Incorporation of larger Water retention pond(s)

Picture 1: Water retention ponds and, to the extreme, when the PV park is on concrete legs in a water collection pond

It is suggested that consideration be given to the use of large reservoirs where:

1. **The general water management objective** is water retention, for:

    a) irrigation or ecological flows;
    b) flood alleviation;
    c) groundwater recharge;
    d) habitat in addition to the above.

2. **Slope considerations** shall be made: anything but flat areas could be considered. However, geotechnical considerations should be taken into account in sloping areas due to the risk of swerving and sliding. Furthermore, it is imperative to incorporate an overflow system.

3. **Soil considerations:** achieving optimal water retention for irrigation purposes and ecological flow can be successfully implemented in clay soils. In other soils, significant infiltration should be considered at the beginning, which will fade away due to colmatation[5] by time.

4. **Location:** The site should ideally contain a relatively large convex area, which will act as a basin for the future location of the site to minimise the cost of earthworks. In the event of only small convex areas being present, it is recommended that a greater number of smaller retention ponds be constructed (see 4.2.2). Furthermore, due consideration must be given to creating a suitable wet habitat in the vicinity of inhabited areas (within a 3-5 km radius). The creation of such areas may increase the population of mosquitoes, which may, in turn, be linked negatively to the future solar park.

Even areas with very low annual precipitation could provide extraordinary results in terms of flash flood prevention, groundwater recharge, and temporarily wet habitat area creation and erosion management.

[5] A process of progressive clogging of a porous medium by fine particles such as might occur in groundwater passing through, thereby reducing the medium's porosity and, accordingly, its permeability.

4.2.2 Small, but many water retention puddles

There are a number of water retention puddles, though their size is minimal. In areas with a paucity or abundance of potential water basins and a high prevalence of convexities, the implementation of this solution is particularly advantageous. In such instances, the presence of convexities can lead to the formation of minor puddles that may not be interconnected. The solution is recommended for implementation in all locations with water retention and water-management aims.

The presence of small puddles in these areas can be beneficial, as they:

1. Reduce the risk of flash floods;
2. Reduce the siltation of downriver reservoirs and improve the waterbodies' nutrient management (eutrophication management);
3. Increase groundwater recharge;
4. Increase the general biodiversity.

Major consideration must be given to the following: Water management goals of the region, only choose this option if there is no water shortage downriver of the area.

There are minimal soil, social, or topographic limitations associated with this measure.

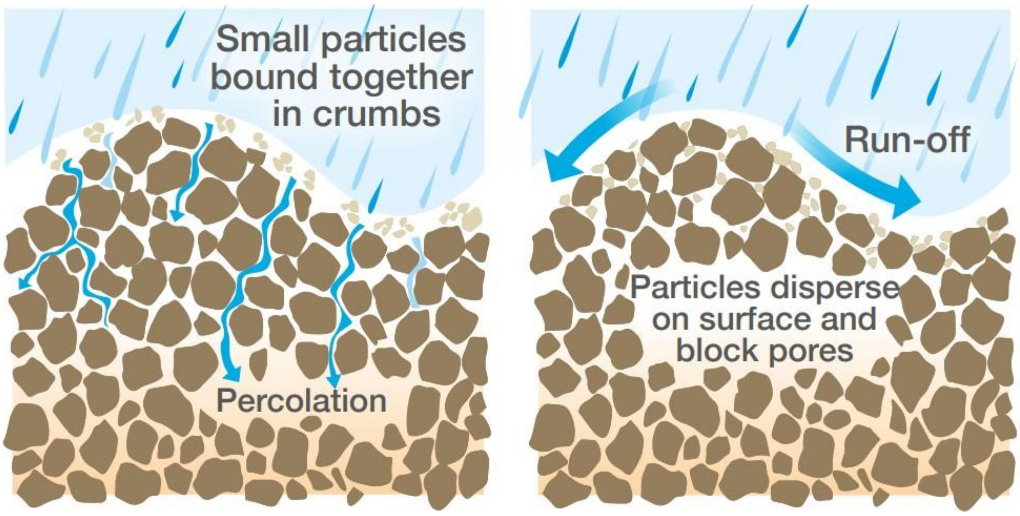
Picture2-3: Moderate and extreme example of many but small water retention paddies (Photo source: FAO)

4.2.3 Minimalized land compaction by soil disturbance and heavy machinery use

It is widely acknowledged that the use of heavy machinery has been demonstrated to result in the compaction of soil to a considerable extent. This soil is an essential water reservoir. Additionally, the extraction of organic topsoil can compromise the soil's capacity for water retention. It is therefore recommended that soil disturbance be kept to a minimum and only occur where necessary. This solution is endorsed for implementation across all locations.

Key considerations should include: Water management goals of the region should be considered, and this option should only be chosen if there is no water shortage downstream of the area. As in the same rear cases, it is recommended to provide run-off in all areas. However, after the results of the Valencia floods in 2024, please consider this solution with more care.

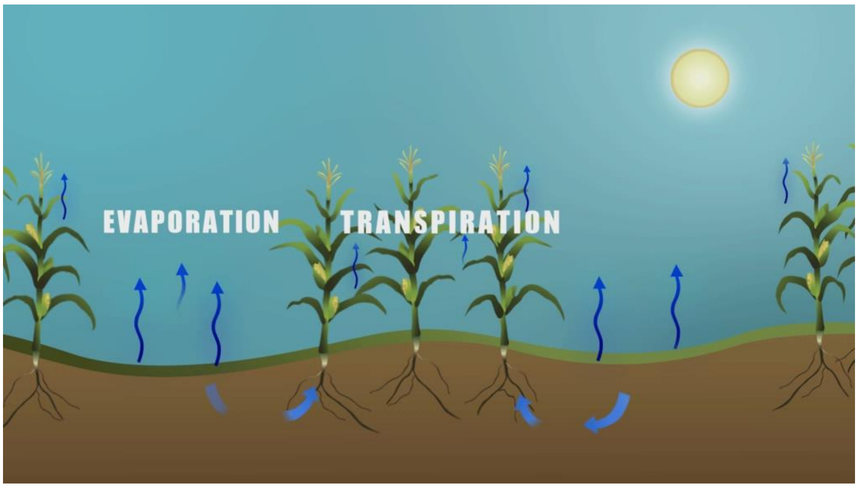
This measure is associated with minimal soil, social, or topographic limitations.



Picture 4: The effect of compaction of the soil – in general terms, it flattens the S curve of the soil water retention capacities

4.2.4 Evaporation reduction in bare lands

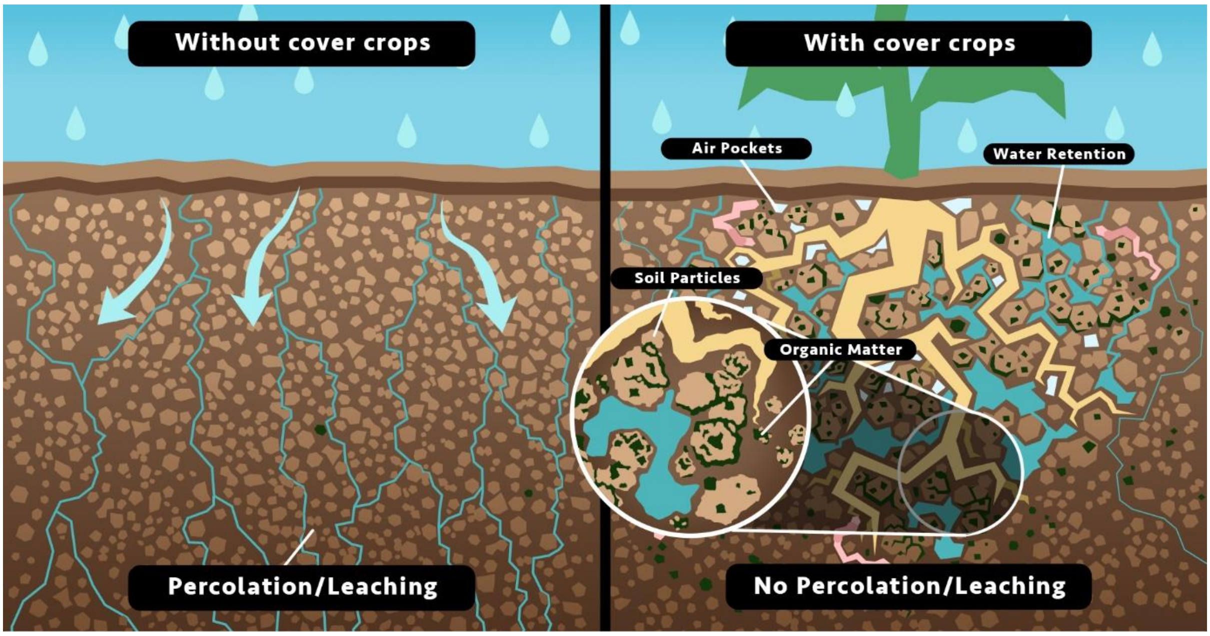
In areas where precipitation is limited and/or precipitation and cover cropping are highly seasonal, it is often difficult to maintain optimal conditions during drier periods. The application of mulch has been shown to reduce soil moisture loss and kaolin has been shown to reduce albedo, which reduces the temperature of the top soil, which reduces soil moisture loss as well. It is therefore recommended that areas intended for bare land or rock be mulched or sprayed with kaolin where appropriate. These solutions have a beneficial effect on soil moisture. This solution is recommended for all locations.



Picture 5: In this method the aim is to lower the loss of water from evaporation, the downside is that is increases daytime soil temperature in bare lands, therefore mulching or kaolin usage is advisable.

4.2.5 Use of site-specific selected cover-crops with minimalized mowing

One method of enhancing the area's water retention capacity is to leverage natural resources. Carefully selected flora improve soil water retention capacity and require minimal maintenance. This solution is recommended for implementation across all locations. This solution also boosts the local biodiversity and provides habitat for many.



Picture 6: Cover crops are changing the soil structure for a higher water retention capacity soil texture. Photo source: ARID

4.2.6 Agrivoltaics

Carefully selected crops could be used as cover while generating income as well, also they serve as a cover crop.

Picture7: Vegies under the shade of PVs, the morning moist condensates at the PVs improve the water availability, while the evapotranspiration of the cover crop reduces heat. Photo: UMASS NREL

5 Questions to be answered

By following the flowchart, we are confident that the local expert will be able to fulfil the aims of this document. These are to analyse, answer, and document the water stewardship recommendations and options for the given PV Construction.

We kindly ask the experts to go through the flowchart as follows before starting to put together the Power Plant layout. We ask that they do not modify the template, as the results of the template are aggregated at company and holding levels.

Before jumping into the flowchart, there are certain aspects we should think of:

Landscape analysis upper watersheds (heads)

Actors and stakeholders have already posed an independent view of the water-related issues of the given area, a preconception. These preconceptions are:

- Evidence-based
- Legal based
- Anecdotal

We should develop our document so that it provides information to cope with all these concepts/misconceptions if they appear during permitting, construction, or public involvement.

For better understanding, there are a couple of examples: The area has been flooded every two years; that area is arid, the grass is always burned out by August; That area is in Spain, so it is dry; According to the National WFD Report, there is a significant risk of flooding; etc.

Demand analysis

Prior to analysing the supply side, it is imperative to comprehend the demand side. It is futile to allocate water resources if there will be no one to utilise them, including the local flora and fauna, or if there is no necessity for flood protection in the area. When assessing the demand side, it is essential to consider the **legally binding requirements** that must be fulfilled and the **voluntary objectives** that could be achieved in the pursuit of effective water stewardship.

The legally binding demands are set in national, regional, and local legislation, which must be adhered to. The voluntary demands can be translated into anticipated results, which will be categorised by the affected Sustainable Development Goals (SDGs)[6].

[6] https://sdgs.un.org/goals

5.1 Flowchart of considerations

Flowchart of considerations

DEFINE THE WATER CHALLANGE TO BE ADDRESED

Please clearly identify and outline the water challenges of the region based on:

1. Local Water Basin Plan
2. Legal documents
3. Evidences of past events
4. Anecdotal local wisdom

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SET WATER STEWARD SHIP OBJECTIVES

The measures to be taken should be based on the location's defined water challenges and on measures that are feasible for the given location based on following factors:

1. Location within the watershed
2. Inclanation and other topographic features
3. Soil type
4. Present and intended land-use
5. Natural vegetation of the region

OUTLINE THE LEGAL REQUIREMENTS

It is important to clearly identify and separate regulatory and voluntary measures to address site-specific water challenges.

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CHOOSE THE MEASSURE TO BE IMPLEMENTED

Please provide measures for the challenges. This applies to both legally required and proposed voluntary measures.

Please refer to Paragraph 4 of this document for a summary of suggested measures. We warmly welcome additional site-specific measures.

OUTLINE THE IMPACTS

Please outline the measures in a quantified manner, by size and anticipated effect on the water balance. Please provide a brief description of how the metrics have been carried out to ensure reproducibility.

Please document the process for reproducibility and acountibility purposes!

5.2 Collection of sources of ideas on suggested measures

The following selection of sources could provide developers with ideas of good practices. Any additional suggestions are also welcome, provided they align with the specific requirements of your local site-specific context.

https://ec.europa.eu/eip/agriculture/sites/default/files/eip-agri_fg_water_and_agriculture_final-report_en.pdf

https://betterenergy.org/wp-content/uploads/2023/01/PV-SMaRT-Best-Practice.pdf

https://www.centralbedfordshire.gov.uk/info/44/planning/1096/solar_farm_development_flood_guidance

https://mde.maryland.gov/programs/water/StormwaterManagementProgram/Documents/ESDMEP%20Design%20Guidance%20Solar%20Panels.pdf

https://www.nrcs.usda.gov/sites/default/files/2024-03/Conservation_Considerations_Solar_Farms.pdf

https://ec.europa.eu/enrd/sites/default/files/tg3_egd_presentation_herrero_agripv.pdf

https://api.solarpowereurope.org/uploads/Agrisolar_Handbook_80645d1593.pdf