

NATURE-BASED SOLUTIONS IMPLEMENTATION GUIDE

Applying nature-based measures to the sites of
public schools and health facilities in Pakistan

Screening • Site evidence • Design • Establishment • Maintenance



CATCHMENT



DRAINAGE



INFILTRATION



PLANTING



RESILIENCE



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Abbreviations

Term	Meaning
AHJ	Authority Having Jurisdiction
BCP-2021	Building Code of Pakistan 2021
CD-CRI	Capacity Development for Climate-Resilient Infrastructure
CRDG	CD-CRI Climate-Resilient Design Guidelines
EIA	Environmental Impact Assessment
GBCP-2023	Green Building Code of Pakistan 2023
GBIG	CD-CRI Green Building Implementation Guide
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
IEE	Initial Environmental Examination
ITM	CD-CRI Institutional Training Manual
IUCN	International Union for Conservation of Nature
KnK	Kokkyo naki Kodomotachi (Children without Borders) Japan
NAP	National Adaptation Plan of Pakistan, 2023
NDRMF	National Disaster Risk Management Fund
O&M	Operation and maintenance
PEC	Pakistan Engineering Council
PEPA	Pakistan Environmental Protection Act 1997
PMD	Pakistan Meteorological Department
RWH-BCP-2023	Rainwater Harvesting Provisions for Building Code of Pakistan 2023
SHA	Structural Health Assessment
WHO	World Health Organization

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1 Purpose, Scope and Legal Basis

A nature-based measure is a piece of engineering that happens to be alive. It is designed, sized, approved, built and maintained like any other part of a facility, and it fails like any other part when those things are not done.

IUCN defines Nature-based Solutions more broadly, as actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges while benefiting people and biodiversity. This Guide applies that concept to measures designed within a facility boundary, which is why it treats them as engineering.

1.1 What this Guide does

- 1.1.1** This Guide sets out how a nature-based measure is screened, designed, approved, built, established, maintained and verified on the site of a public school or health facility in Pakistan, and how the decision and its evidence are recorded. It applies to new construction, rehabilitation and retrofit.
- 1.1.2** A nature-based measure is a designed system with a stated function, design event, establishment period, maintenance regime, exceedance path and failure behavior. A measure that cannot be described in those terms has not been designed and shall not be adopted.
- 1.1.3** The unit of application is the facility and its campus: site drainage within the boundary and its outfall; surface erosion and shallow slope stabilization; shade, surface treatment, shelter and screening; rainwater harvesting and reuse integrated with landscape; and species selection, planting, establishment and habitat outcomes within the boundary.
- 1.1.4** A condition acting on the facility from outside the boundary shall be identified, its owner named and the interface recorded, but this Guide does not extend design authority beyond the boundary. Catchment, hill-torrent, riverine and coastal works are referred to as separate proposals, and the facility design shall not depend on them until they are committed in writing.
What this Guide does not establish
 - 1.2.1** This Guide does not establish structural design criteria. Where a measure interacts with a structure, foundation, retaining element or access route, the governing criteria remain those of the Building Code of Pakistan 2021 and of the CD-CRI Climate-Resilient Design Guidelines. Deep-seated slope stability remains a geotechnical design under CRDG Chapter 9, and the building envelope and mechanical systems remain under GBIG chapters 8 and 9.
 - 1.2.2** It does not establish an environmental approval, a rainfall or flood dataset, or a carbon accounting method. Approvals are obtained under cl. 1.5; the climate design basis is established under CRDG chapter 3 and carried in as an input; sequestration and offset claims, commercial forestry and protected-area management are outside its scope.
 - 1.2.3** It does not fix numeric design values belonging to the site, the authority or the adopted code, with the single exception of the minimum design and exceedance events at cl. 6.1.3, which apply only where the Authority Having Jurisdiction has specified neither and no value has been

established under CRDG chapter 3. Table 14.2 lists those values and states where each is established.

1.2 Framework and statement hierarchy

- 1.3.1** The eight criteria of the IUCN *Global Standard for Nature-based Solutions*, 1st edition, 2020, are the organizing framework. That edition is retained for consistency with the CD-CRI Climate-Resilient Design Guidelines, which cite it. IUCN published the Second Edition in October 2025, retaining eight criteria with revised indicators. This Guide uses the criteria to organize its provisions and claims no conformity with either edition. A project seeking assessment against the Standard shall carry out the criterion-and-indicator self-assessment against the edition current at that time, and check the mapping at Table 1.1 against it. The edition cited shall be reconsidered at the review under cl. 1.7.1.
- 1.3.2** The strength of every statement is fixed by the verb used, as set out in Table 1.1. Where a statement conflicts with a code requirement, the code governs and the conflict is recorded under cl. 14.2.5.

Table 1.1 Terms used for requirement strength, and where the IUCN criteria are addressed

Term or criterion	Meaning, or where this Guide addresses it
Shall	A requirement of this Guide. Departure is a deviation, recorded under cl. 14.2.5.
Should	A strong recommendation. Where not followed, the reason is recorded in the design basis record.
May	A permitted option carrying no presumption either way.
Competent	Holding the qualification, registration, experience and resources appropriate to the task, and accountable for it. The project shall record who carried out a competent assessment and on what basis.
IUCN 1 and 2, societal challenge and scale	Chapter 2, the function-first screen; chapter 3, catchment and site delineation.
IUCN 3 and 6, biodiversity and trade-offs	Chapters 3 and 10, habitat baseline and species selection; chapter 2, the trade-off record.
IUCN 4 and 5, feasibility and governance	Chapter 12, whole-life comparison; chapter 4, participation, inclusion and safeguarding.
IUCN 7 and 8, adaptive management and mainstreaming	Chapters 11 and 12, maintenance and monitoring; chapter 13, the authority toolkit and institutionalization.

1.3 Relationship to the other CD-CRI knowledge products

- 1.4.1** This Guide is subordinate to the CD-CRI Climate-Resilient Design Guidelines on every matter of hazard, structural performance and life safety. CRDG cl. 5.6.2 governs: a nature-based measure shall not be credited with structural or life-safety capacity that has not been demonstrated for the project. Nothing here varies that clause. This Guide expands CRDG cl. 5.6 and CRDG Table 5.5 into a design method.

1.4.2 Where the Green Building Code of Pakistan 2023 applies to the facility, the CD-CRI Green Building Implementation Guide governs the compliance claim for site, landscape, stormwater and water efficiency, and the Code value governs. GBCP-2023 was approved by the Federal Cabinet on 28 July 2025 and notified by S.R.O. 1531(I)/2025 and S.R.O. 1532(I)/2025 dated 11 August 2025. The notified text reads, at Section 101.3: *"The provisions of this code shall apply to the design, construction, addition, alteration, equipment, change of occupancy, relocation, replacement, demolition and removal of every building or structure or any appurtenances connected or attached to such buildings or structures and to the building site on which the building is located."* At Section 101.3.1 it reads: *"The provisions of this code do not apply to the following: 1. Single-family dwellings. 2. Multiple-family dwellings of three stories or fewer above grade. 3. Manufactured houses (mobile homes). 4. Manufactured houses (modular). 5. Building projects that use none of the following: 1. Electricity. 2. Fossil fuels. 3. Water."* On that text the three-storey threshold applies to dwellings only, and a one- or two-storey school or health facility is not among the exclusions. Public statements issued at approval in July 2025 described the Code as applying to buildings of four or more storeys; that limit does not appear in the notified text, but the difference means that the point is not settled. The reading given here is the consultant's interpretation of the notified text and not a determination. The project shall obtain the determination of the Authority Having Jurisdiction on whether GBCP-2023 applies to the facility, record it at Table 1.4, and apply the Code where it is determined to apply. Where the Rainwater Harvesting Provisions for Building Code of Pakistan 2023 apply to the facility, their requirements for collection, first flush, storage, overflow, treatment and use govern over chapter 9 of this Guide; whether they apply to a school or health facility shall be determined by the Authority Having Jurisdiction and recorded at Table 1.4. The CD-CRI Structural Health Assessment Manual supplies the assessed condition of an existing structure relied upon at cl. 13.1.4. The CD-CRI Engineer's Field Handbook carries the field checks, and the CD-CRI Construction Management and Quality Assurance Protocols the inspection and hold-point machinery.

1.4.3 This Guide is the technical source for Module M4 of the CD-CRI Institutional Training Manual. Where that Manual carries general material on nature-based measures, this Guide governs on any difference of substance and the Manual is read as pointing to it. Delivered as a module, the content runs over two days and may be compressed into one where the training schedule requires by shortening the screening exercise and omitting the submission and decision exercise: what a nature-based measure is and is not; turning climate and hazard information into design inputs; screening three measures, of which at least one must be rejected; delineating a catchment and tracing the exceedance route; preparing the establishment water arrangement and assigning every maintenance task to a named post; and a submission and decision exercise under Table 13.3, half the groups submitting and half acting as the authority.

1.4 Legal basis and approvals

1.5.1 The design shall identify every legal instrument that applies, the authority that administers it, and the permission it requires, and record them in the applicability record at cl. 1.7.2. The

instruments at Table 1.2 shall be examined as a minimum, and any further instrument applying at the facility identified, recorded and complied with in the same way. A measure shall not be assumed exempt from approval because it is described as natural, green or low impact; exemption is a determination by the competent authority, not a description adopted by the designer.

1.5.2 Environmental protection is a devolved subject. The governing instrument is the provincial or territorial environmental protection act of the jurisdiction in which the facility stands, read with the Pakistan Environmental Protection Act 1997 where that act has not been displaced. The design shall state, by name, the act it works under, the section under which the assessment duty arises, the review regulations in force and the administering agency, taken from Table 1.3. Tree felling, lopping and removal are governed by the Pakistan Forest Act 1927 as applied and amended in Punjab and in Sindh and as applicable in Islamabad Capital Territory; by the Khyber Pakhtunkhwa Forest Ordinance 2002; by the Balochistan Forest Act 2022; by the Gilgit-Baltistan Forest Act 2019 as amended; and in Azad Jammu and Kashmir by the Jammu and Kashmir Forest Regulation 1930 as amended by Act XXI of 2017; each administered by the forest department of the jurisdiction, together with any ban or restriction on tree cutting notified under them at the date of design. Discharge to or abstraction from a canal, tributary or notified drain is governed by the Canal and Drainage Act 1873 and the provincial irrigation statutes made under or in place of it. The amendment status of each instrument, and any regulation notified since the issue of this Guide, shall be confirmed with the administering agency at the date of the design and the confirmation recorded at cl. 1.7.2.

Table 1.2 Instruments that commonly govern a nature-based measure

Instrument	What it governs here	Authority
Provincial environmental protection act, read with the Pakistan Environmental Protection Act 1997, and the IEE and EIA review regulations	Whether an Initial Environmental Examination or Environmental Impact Assessment is required, the screening category, and compliance with the applicable national or provincial environmental quality standards for any discharge	Federal or provincial Environmental Protection Agency
Provincial and territorial forest law named at cl. 1.5.2, and the Pakistan Forest Act 1927 where it still applies	Felling, lopping or removal of trees, including any notified ban or restriction on tree cutting; planting on or near notified forest land; species restrictions	Forest department of the province or territory
Canal and drainage law, the provincial irrigation statutes, and provincial local government law with the municipal or cantonment by-laws	Discharge to or abstraction from a canal, tributary or notified drain; connection to a municipal drain; works in a public right of way; planting in public space	Irrigation Department or Irrigation and Drainage Authority; local council, municipal corporation, development authority or cantonment board
Building Code of Pakistan 2021; Green Building Code of Pakistan 2023 and Rainwater Harvesting	Structural, foundation and life-safety requirements with which a measure shall not conflict; site, landscape, stormwater	Pakistan Engineering Council and the Authority Having Jurisdiction

Instrument	What it governs here	Authority
Provisions for Building Code of Pakistan 2023, where they apply under cl. 1.4.2	and water-efficiency requirements; rainwater collection, first flush, storage, treatment, overflow and reuse	
Land law, the record of rights, and any easement or customary use	Whether the land is available for the measure and for its maintenance in perpetuity	Revenue authority and the owning department

Table 1.3 Environmental assessment: the governing instrument by province and territory

Province or territory	Governing act	Assessment section	Review regulations	Administering agency
Punjab	Punjab Environmental Protection Act 1997, as adapted and amended by the Punjab Environmental Protection (Amendment) Act 2012 and subsequently	Section 12	Punjab Environmental Protection (Review of IEE and EIA) Regulations 2022, with Schedule I as amended by Notification No. 348/PA/DG/EPA/2025 of 30 September 2025	Punjab Environmental Protection Agency
Sindh	Sindh Environmental Protection Act 2014	Section 17	Sindh Environmental Protection Agency (Review of IEE and EIA) Regulations 2014	Sindh Environmental Protection Agency
Khyber Pakhtunkhwa	Khyber Pakhtunkhwa Environmental Protection Act 2014 as amended	Section 13	Khyber Pakhtunkhwa Environmental Assessment Rules 2021, which place a General Environmental Approval alongside the IEE and the EIA and against which the project shall screen	Khyber Pakhtunkhwa Environmental Protection Agency
Balochistan	Balochistan Environmental Protection Act 2012	Section 15	Balochistan Environmental Protection Agency (Review of IEE and EIA) Regulations 2020	Balochistan Environmental Protection Agency
Azad Jammu and Kashmir	Azad Jammu and Kashmir Environmental Protection Act 2000	As provided in the Act	Regulations made under that Act	Azad Jammu and Kashmir Environmental Protection Agency
Gilgit-Baltistan	Gilgit-Baltistan Environmental Protection Act 2014	As provided in the Act	Gilgit-Baltistan IEE and EIA Regulations 2024	Gilgit-Baltistan Environmental Protection Agency
Islamabad Capital Territory	Pakistan Environmental Protection Act 1997	Section 12	Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations 2000	Pakistan Environmental Protection Agency

Province or territory	Governing act	Assessment section	Review regulations	Administering agency
Where the provincial or territorial act has not displaced it	Pakistan Environmental Protection Act 1997	Section 12	Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations 2000	Federal Environmental Protection Agency

The amendment status of every entry in Table 1.3 shall be confirmed under cl. 1.5.2 before the design relies on it. Forest, irrigation and local government instruments are at Table 1.2.

- 1.5.3** Where two requirements conflict, the order of precedence is: law and any condition attached to a statutory approval; the adopted code; the contract and the approved design and specification; this Guide; then referenced standards and guidance applied for method.
- 1.5.4** Before a measure is adopted, the project shall determine whether the works, taken with the rest of the project, require an Initial Environmental Examination or an Environmental Impact Assessment, and record the determination and the authority that made or confirmed it. A constructed wetland, a greywater reuse scheme or any other measure whose function is to treat water shall be screened under the applicable environmental protection act, and its approval category shall be confirmed by the competent Environmental Protection Agency or Authority Having Jurisdiction; this Guide does not assign that category. Covered and sealed rainwater storage under cl. 9.2.3, and a measure that detains, conveys or infiltrates stormwater without a treatment function, are not treated as treatment facilities by this Guide, but remain subject to any approval the authority requires. In Punjab, the exemptions from section 12 of the Punjab Environmental Protection Act 1997 notified in 2025 shall be checked, and any exemption relied upon shall be recorded with its notification.
- 1.5.5** Where a measure discharges to ground, to a channel, to a drain or to any receiving body, the design shall state the quality of the discharge, the standard it must meet and the evidence by which compliance will be shown; the applicable national or provincial environmental quality standards govern.
- 1.5.6** Each approval shall be held on file with its conditions and the party responsible for each: the environmental determination; the irrigation consent with its permitted rate, quality and any seasonal restriction; the municipal connection approval with its point of connection agreed on the drawing; the source protection assessment where infiltration is near a water source; the tree permission with its replacement ratio; and, for anything outside the boundary, the landowner consent with a maintenance agreement.
- 1.5.7** Policy creates no permission but it creates the mandate and the funding argument. Where a measure is claimed to contribute to a policy commitment, in particular under the National Adaptation Plan of Pakistan 2023 or the National Water Policy 2018, the claim shall state the instrument, the commitment relied upon and the indicator against which the contribution is reported.

1.5 Land, maintenance duty and jurisdiction

- 1.6.1** A measure shall not be adopted unless the land it occupies, and the access needed to maintain it, are under the control of the owning institution or secured by a written agreement lasting at least as long as the design life of the measure.
- 1.6.2** The land take shall be stated in square meters in the design basis record with the use displaced. Where the displaced use is a playground, assembly area, parking area or emergency vehicle route, the displacement shall be agreed in writing with the facility before the design is fixed.
- 1.6.3** The duty to maintain shall be assigned to a named post in a named institution before construction begins. A measure whose maintenance duty is unassigned shall not be built.
- 1.6.4** The project shall identify, by name and office, the authority that approves each aspect of the measure, and shall not assume that approval by one authority disposes of the interest of another. Where no authority exercises jurisdiction over a question, the owning department shall act as the approving authority and record the decision and its basis; chapter 13 sets out the toolkit for an authority in that position.

1.6 Custodianship, revision and the applicability record

- 1.7.1** This Guide is prepared by Dr. Qaisar Ali Associates for KnK Japan under the CD-CRI program and is issued as a program knowledge product. Its status is technical guidance. It is not a code; it carries no regulatory endorsement, and it binds a project only where the owning department, the Authority Having Jurisdiction or the contract adopts it, and then to the extent of that adoption, which chapter 13 sets out how to state. The Pakistan Engineering Council and the National Disaster Risk Management Fund are the institutional owners of this Guide as a CD-CRI program knowledge product, and custodianship of its future revision rests with them. Ownership of the Guide is distinct from regulatory endorsement or adoption: neither body has adopted it as a code or requirement, and no such endorsement or adoption is claimed or implied until it is recorded in writing by the body concerned. It shall be reviewed when the Building Code of Pakistan, the Green Building Code of Pakistan, the Rainwater Harvesting Provisions for Building Code of Pakistan or the applicable environmental protection act is amended in a way that affects it, when the National Adaptation Plan is revised, or at intervals not exceeding five years.
- 1.7.2** The record at Table 1.4 shall be completed for every project adopting a nature-based measure and held with the design basis report. No entry shall be left blank; where an entry does not apply, the record shall say so and state the basis.

Table 1.4 Minimum applicability record

Field	Entry required
Facility and owner	Name, coordinates, district, province, and the department that owns the asset.
Measures proposed	Each measure, its function, and the chapter under which it is designed.

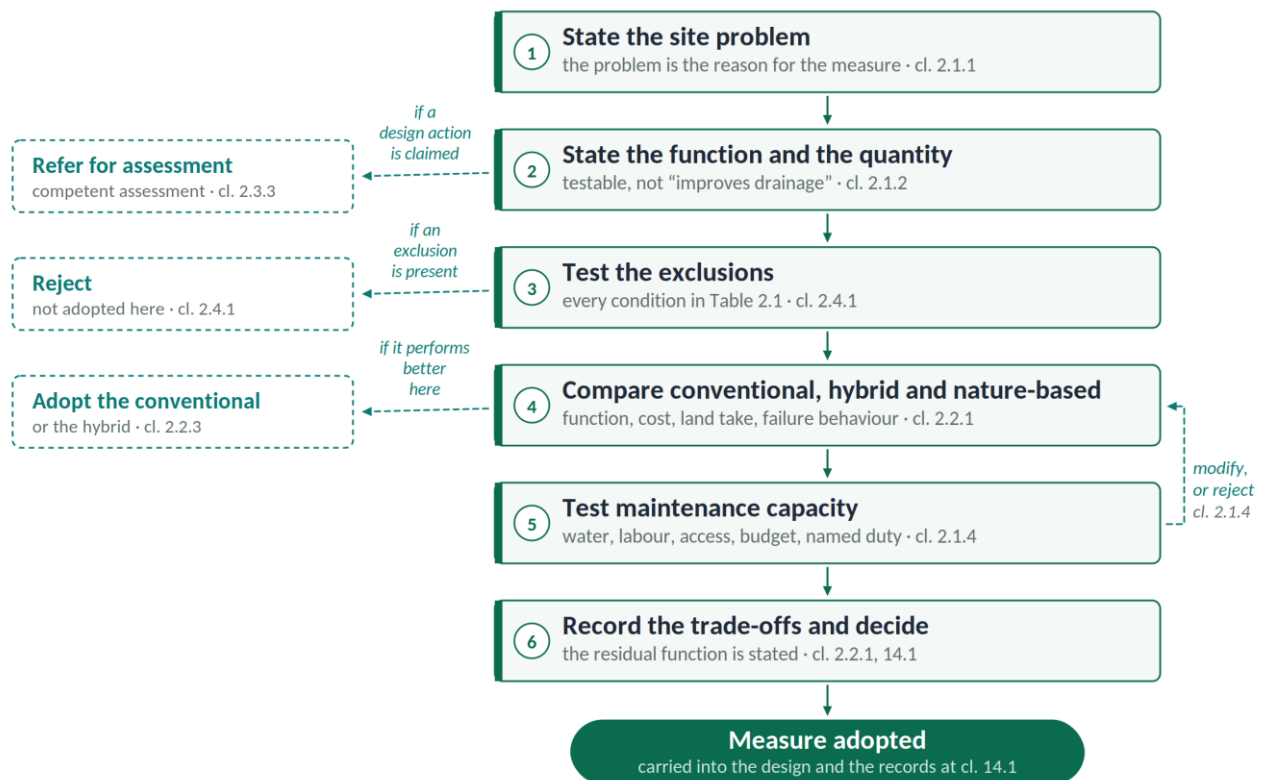
Field	Entry required
Environmental screening	The act relied upon, the outcome, the authority and the date.
GBCP-2023 and RWH-BCP-2023 applicability	The determination of the Authority Having Jurisdiction on whether each applies to the facility under cl. 1.4.2, its reference and date, and the number of storeys of the facility.
Statutory approvals and discharge consents	Each approval and consent, its authority, its status, the date obtained or expected, and the permitted rate and quality.
Tree removal and replacement	Number and species removed, permission reference, replacement obligation and location.
Land take and displaced use	Area in square meters, the use displaced, and the written agreement of the facility.
Maintenance duty	The named post, the named institution, and the budget line under cl. 12.3.
Departures	Each departure from this Guide, with the named acceptance under cl. 14.2.5.

2 Deciding Whether a Measure Is Appropriate

This chapter is a screen, not an argument for nature-based measures. A guide that cannot say no is of no use to an approving authority.

2.1 The function-first screen

- 2.1.1** A measure shall be adopted only in answer to a stated site problem. The design shall state the problem, the function performed against it, and the quantity by which the problem is reduced. A measure adopted because it is desirable in principle shall not be adopted. A measure adopted under this clause in answer to a stated site problem addresses IUCN criterion 1. Figure 2.1 illustrates the screening sequence and is illustrative, not normative.
- 2.1.2** The statement of function shall be specific enough to be tested. "Improves drainage" is not a function. "Detains the runoff from 1,850 square meters of roof and hardstanding and releases it at not more than 12 liters per second" is a function.
- 2.1.3** Each proposed measure shall be screened separately. A package shall not be justified by the aggregate benefit of measures that have not each been shown to be appropriate.
- 2.1.4** The screening shall include a maintenance capacity test: whether the owning institution has, and will continue to have, the water, labor, access, budget line and assigned responsibility to maintain the measure at the frequency chapter 11 requires. Where the answer is no, the measure shall be modified until it is yes, or rejected in favour of an option the institution can maintain.



Each measure is screened separately. A package is not justified by the aggregate benefit of measures that have not each passed this screen (cl. 2.1.3).

Figure 2.1 The screening sequence from stated problem to adopted measure

2.2 Comparing the options

- 2.2.1** A nature-based measure shall be compared against a conventional engineered option and against a hybrid, on function, whole-life cost, land take, failure behavior and maintenance burden. The comparison shall not assume either is preferable. Where the options are close, the option whose failure behavior is more tolerable at that location shall be preferred.
- 2.2.2** In broad terms, a nature-based option delivers a partial, rate-dependent function that is strongest against frequent events, takes one to five growing seasons to reach it, takes a large amount of land, fails gradually and visibly, and carries a continuous maintenance burden with real co-benefits.
- 2.2.3** A hybrid arrangement should be preferred where the facility is critical, where maintenance capacity is uncertain, or where the consequence of a lost function is disproportionate. In a hybrid, the conventional element shall carry any life-safety or code-governed case on its own, and any contribution from the nature-based element to that case is a margin, not a reduction; credit in a serviceability or frequent-event case is taken only under cl. 2.3.3 and cl. 2.3.4.

2.3 The life-safety boundary

- 2.3.1** Credit for a nature-based measure is governed by the case being designed. For a life-safety or code-governed case, including every item at cl. 2.3.2, the conventional or structural element shall carry the full case and no credit shall be taken for the nature-based measure. For a serviceability or frequent-event case, verified nature-based capacity may be credited under cl. 2.3.3 and cl. 2.3.4. A nature-based measure shall not be credited with structural or life-safety capacity that has not been demonstrated for the project. This restates CRDG cl. 5.6.2 without variation.
- 2.3.2** The following shall not be reduced, deferred or substituted on account of a nature-based measure: the design flood level and the freeboard derived from it; the seismic design actions; the wind design actions; the slope stability case; the fire and egress provisions; and the access and lifeline redundancy required by CRDG chapter 5.
- 2.3.3** Where a measure is proposed to carry a design action in a serviceability or frequent-event case, the proposal shall be referred for competent assessment under CRDG cl. 1.2.2 and the capacity established by analysis or test for the project. Vegetation shall not be assigned a design capacity from published values for another site, climate or species.
- 2.3.4** Where a measure is credited with a reduction in the frequent-event case, the design shall state the condition assumed in that credit, and what happens to the facility if the measure is absent, immature, blocked or dead. Where that consequence is not tolerable, no credit shall be taken.

2.4 When a measure shall not be adopted

- 2.4.1** Where any condition in Table 2.1 is present, the default is that the measure is not adopted at that location. The default may be varied only on the evidence stated against the condition, recorded under cl. 14.2.5.

Table 2.1 Exclusions and the evidence required to vary them

Condition	Default	Evidence required to vary it
The measure would be credited with a life-safety or structural duty, or with a case listed at cl. 2.3.2	Not credited	None. This default is not varied under this Guide. Structural capacity demonstrated for the project is dealt with under CRDG cl. 5.6.2 and the governing code, not by this Guide.
Infiltration within the zone of influence of a foundation, basement, retaining wall or unlined pit latrine	Not adopted there	Geotechnical assessment of the founding soil, separation distance, and a drainage path away from the structure.
Infiltration on collapsible, dispersive or expansive soil, over shallow groundwater, or where soil or groundwater is contaminated	Not adopted	Ground investigation, groundwater record, contamination and source protection assessment accepted by the authority.
Permanent open water at a school or pediatric facility, including the permanent pool of a retention feature and a constructed wetland with open water	Not adopted	An exception only, with a documented safeguarding and vector-control solution agreed in writing with the provincial health department (in Islamabad Capital Territory, the federal health authority), including its dengue and malaria control program, and with the owning department, recorded under cl. 4.3 and cl. 14.2.5.
Standing water that cannot be drained within 72 hours at any other facility where vector-borne disease occurs	Not adopted	A design draining within 72 hours, or a vector-control solution agreed in writing with the provincial health department (in Islamabad Capital Territory, the federal health authority), recorded under cl. 4.3.
The institution cannot demonstrate maintenance capacity under cl. 2.1.4, or establishment water is not available without reducing the supply for drinking, sanitation or clinical use	Not adopted	A funded and assigned maintenance arrangement under chapter 11 and cl. 12.3, or a simpler measure; and an establishment water source under cl. 9.4 that does not draw on that supply. Exceptionally, a departure under cl. 12.3.2 made in writing by the head of the owning department, stating the consequence when the maintenance is not carried out, recorded under cl. 14.2.5 and reported at the first monitoring round.
The measure would obstruct an emergency egress route, assembly area or emergency vehicle route, or would transfer runoff, sediment or nuisance off site	Not adopted until resolved	Redesign that clears the route, confirmed on the emergency plan; or analysis of the downstream, neighboring and environmental effect with acceptance by the affected party and the authority.
The species required is invasive, prohibited, or carries a health, structural or safeguarding hazard	Not adopted	This default cannot be varied by evidence. The measure proceeds only with a species permitted under chapter 10, screened under cl. 10.1.4 and, where the species falls in Part B of Table 10.2, with the stated condition satisfied and recorded.

2.5 Trade-offs and the screening record

2.5.1 Every adopted measure shall carry a trade-off record stating what is given up to obtain the benefit, who bears it, over what period, and who accepted it. It shall cover land, water, maintenance burden, time to function, safeguarding and health consequences, capital cost,

and any risk transferred to a neighbour, a downstream party or the receiving environment. The trade-off record addresses IUCN criterion 6.

- 2.5.2** The screening record at Table 2.2 shall be completed for every proposed measure, whether adopted or not, and held with the design basis report. A measure rejected at screening shall be recorded with its reason, so that the decision is not revisited without new evidence.

Table 2.2 Screening record

Field	Entry required
Measure and location	The measure, and its location on the site plan.
Problem addressed	The stated problem and the evidence for it under chapter 3.
Function and quantity	The quantified performance statement under cl. 5.3.1.
Exclusions tested	Each exclusion at Table 2.1, with the result and the basis.
Options compared, and maintenance capacity	Nature-based, conventional and hybrid, with the reason for the choice; and the result of the test at cl. 2.1.4 with its evidence.
Trade-offs	The record at cl. 2.5.1.
Decision and decided by	Adopt, adopt with modification, refer, or reject, with the reason; and the name, post, institution, signature and date.

3 Site Evidence and Baseline

Most failed nature-based measures were designed on an assumption that a survey would have corrected in a morning: the infiltration rate assumed, the groundwater assumed, and the catchment drawn from the site plan rather than from the levels.

3.1 Evidence required before design

- 3.1.1** No measure shall be designed before the evidence in Table 3.1 has been obtained for the functions it is intended to perform. Where an item cannot be obtained, the design shall record the gap, the assumption adopted in its place, and the consequence if the assumption is wrong.
- 3.1.2** Evidence shall be recorded with its source, date and method. An observation reported by a facility user is admissible evidence and shall be recorded with the name of the person, the date of the account and the period it refers to.

Table 3.1 Minimum site evidence by function

Function	Evidence required	Method or source
All measures	Topographic survey with levels tied to a datum; boundary, buildings, hard surfaces, trees, services and outfalls.	Instrument survey. A plan without levels is not sufficient.
Stormwater and flood	Catchment delineation, flow paths, ponding areas, outfalls and receiving condition, observed flood marks with dates.	Levels survey, walkover after rain, facility and community accounts, agency records.
Infiltration	Infiltration rate at the proposed depth and location; soil profile; groundwater level and seasonal range.	In-situ testing at the proposed invert; trial pit or borehole; groundwater observation over a wet and a dry period where obtainable.
Slope and erosion	Slope geometry, materials, seepage, existing erosion features, and the geotechnical position on deep-seated stability.	Desk study and investigation under CRDG chapter 9; geomorphological walkover with photographs.
Heat, shade and water	Sun path at the site latitude, existing shade at the hours of use, surface materials and hot spots; roof and hardstanding areas; supply source, reliability, storage and demand.	Site observation at the hours of use in the hottest month available; measured areas from survey; facility records and meter readings.
Planting and habitat	Soil texture, depth, pH, salinity and compaction; existing vegetation and trees by species and girth; nesting and roosting use; grazing and browsing pressure.	Soil sampling and testing; walkover survey by a competent person, recorded on plan with photographs.

An account given by a facility user or by the community is admissible evidence against any row of Table 3.1 under cl. 3.1.2, and is recorded with the name of the person, the date of the account and the period it refers to.

3.2 Catchment and drainage

- 3.2.1** The catchment draining to each measure shall be delineated from surveyed levels, not from the site boundary, and shall include any area outside the boundary that drains onto the site. The area shall be stated in square meters and shown on plan. Delineation under this clause establishes the scale at which the measure is designed and addresses IUCN criterion 2. Figure 3.1 illustrates catchment delineation and flow paths on an example campus and is illustrative, not normative.
- 3.2.2** The flow path from each catchment to its outfall shall be traced and shown on plan, including where it leaves the site, the receiving body, and the condition of that body in the wet season, in particular whether it surcharges and what then happens on the site.
- 3.2.3** Runoff from areas that may carry contamination, including workshop aprons, fuel and waste storage, vehicle washing, laboratory drainage and health-care waste areas, shall be identified and excluded from infiltration measures unless treated to a standard accepted under cl. 1.5.5.

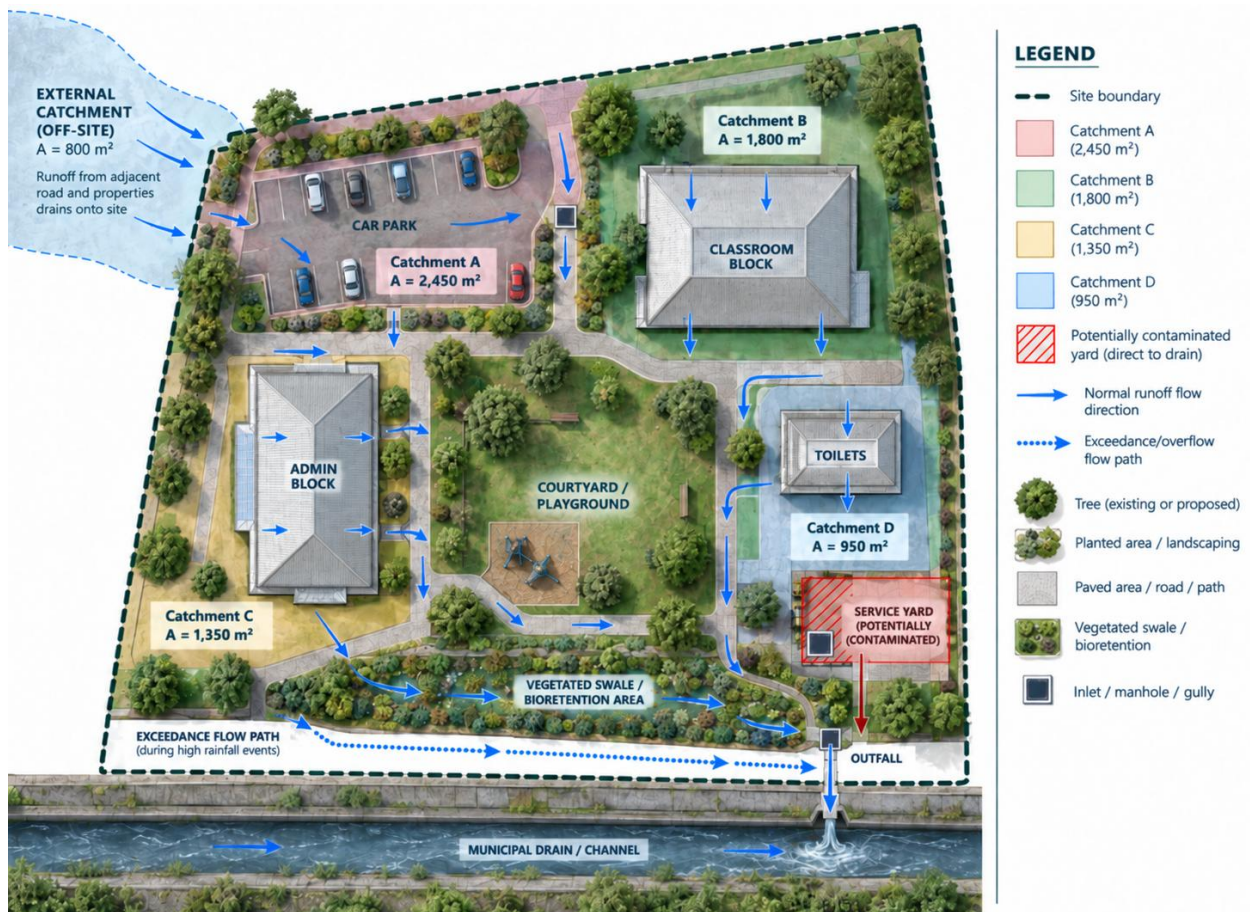


Figure 3.1 Catchment delineation and flow paths on an example campus plan

3.3 Ground, infiltration and groundwater

- 3.3.1** Where infiltration is proposed, the rate shall be measured in situ at the proposed invert level and location. It shall not be taken from a soil classification, a published table, or a test carried out elsewhere on the site.

- 3.3.2** Not fewer than three tests shall be carried out for each infiltration measure, and the lowest rate adopted unless the variation is explained by the ground model. The method, date, antecedent rainfall and operator shall be recorded.
- 3.3.3** The seasonal high groundwater level shall be established, and a minimum unsaturated thickness maintained between the invert of an infiltration measure and that level. The value and its basis shall be stated, and shall not be less than any value required by the authority. Where the level cannot be established from observation it shall be inferred conservatively from the ground model, local well records and the facility account, and recorded as an assumption.
- 3.3.4** The ground conditions shall be read against the measure proposed. High clay content or a low measured rate means detention and conveyance with an underdrain to a positive outfall, not infiltration; collapsible, dispersive or contaminated ground means no infiltration at all, lined and positively drained; expansive clay means keeping infiltration away from structures; shallow rock means shallow-rooting species and imported medium of stated depth; saline or sodic soil means salinity testing and tolerant species. A compacted construction platform will neither infiltrate nor grow roots whatever its classification, so testing shall be at the actual level and repeated after any treatment.

3.4 Vegetation, water and climate inputs

- 3.4.1** Existing trees shall be surveyed by species, girth, height, canopy spread, condition and location, and shown on the design plan. A tree shall not be removed to make room for a measure unless the measure cannot be relocated and the removal is permitted under cl. 1.5.6, read with cl. 1.5.2.
- 3.4.2** The existing habitat shall be recorded, including any hedgerow, scrub, grassland, watercourse or wet area and its condition, and any observed nesting, roosting or breeding use. This establishes the baseline against which the biodiversity outcome is judged and addresses IUCN criterion 3.
- 3.4.3** The water required to establish and to operate each measure shall be estimated in cubic meters per year, stated separately for the establishment and operational periods, and compared against the water available. Where demand cannot be met without reducing water for drinking, sanitation, clinical use or food preparation, the measure shall be redesigned or rejected under Table 2.1.
- 3.4.4** Rainfall, temperature and flood inputs shall be those established under CRDG chapter 3, carried across with their source, record period, station, horizon and status unchanged. A measure shall not be designed against an intensity or depth generated by the designer without a stated source.

3.5 The baseline records

- 3.5.1** The evidence obtained under this chapter shall be compiled as a single baseline record held with the design basis report, and shall be the reference against which the monitoring at

chapter 12 is compared. A monitoring program with no baseline cannot demonstrate an outcome.

- 3.5.2** The baseline record shall contain the survey; the drainage evidence; the ground evidence including infiltration results and groundwater; the vegetation and habitat record with photographs keyed to plan; the water evidence; the climate inputs with their status; the facility account; and a statement of every gap and the assumption adopted in its place.

4 Responsibilities, Participation and Safeguards

A nature-based measure sits in the part of a facility that children use unsupervised and that staff are expected to look after without being asked. That is why it succeeds, and why it fails.

4.1 Who does what

- 4.1.1** Every requirement of this Guide shall be assigned to a named role before the design is approved. The roles at Table 4.1 shall each be assigned to a named post or organization, and the assignment recorded in the design basis record; where a role is not required on a project, the record shall say so and state why.
- 4.1.2** The maintenance holder shall be identified by post, not by person, so that the assignment survives the transfer of the individual holding it, and shall be recorded in the operation and maintenance plan at cl. 11.4.1.

Table 4.1 Roles and responsibilities

Role	Responsibility
Owning department	Owns the asset, funds it, holds the maintenance duty in perpetuity, and approves the land take, displaced use and maintenance budget line.
Facility head	Represents the users; agrees the land take and displaced use; nominates the maintenance post at facility level; reports failure.
Design lead	Carries the screening, design basis record, performance statement and trade-off record, and is accountable as a competent professional.
Specialists	The geotechnical or hydrological specialist establishes the ground model, infiltration parameters and any stability or flood position relied on. The landscape or ecological specialist establishes the habitat baseline, species selection and establishment regime. The environmental focal point carries the screening determination and the approvals.
Contractor and supervision consultant	The contractor supplies and plants to specification, protects the ground, retained trees and planting during construction, and replaces failures due to defective stock, planting or protection within the defects liability period under cl. 12.2.2. The supervision consultant holds the hold points, verifies acceptance criteria and signs the handover record.
Maintenance holder	The named post that waters, cuts, clears, inspects and replaces, including the establishment regime from handover under cl. 11.1.3. Named before construction begins under cl. 1.6.3.

4.2 Participation and inclusion

- 4.2.1** The facility head, teaching or clinical staff and representatives of the users shall be consulted before the location and type of each measure are fixed.
- 4.2.2** Consultation shall be conducted at times and in a manner that allow women, girls, persons with disabilities and staff without decision-making authority to take part, and not solely through a single officer or committee. The participation record addresses IUCN criterion 5.
- 4.2.3** The design shall test each measure against its effect on the safety, dignity, access and use of the site by women and girls, by persons with disabilities, and by any group whose use of the

facility is already constrained. Planting, swales, kerbs and level changes shall not reduce the width, gradient, surface or continuity of an accessible route, and crossings shall be at grade or ramped, firm and slip-resistant. Planting shall not create concealed areas on routes to toilets, water points, boundaries or gates, nor obstruct lighting on a route used after dark, and mature canopy and clear-stem heights shall be specified accordingly. The maintenance regime shall not place an unpaid or informal burden on female staff, students or patients. Where a measure displaces a play, assembly or rest area, the replacement provision shall be stated and agreed under cl. 1.6.2. The measure shall remain usable and non-hazardous in the wet season and the hottest months, not only at handover.

4.3 Safeguarding, health and biosecurity

- 4.3.1** Where works are carried out on an occupied school or health facility, the contractor and every person on site shall be bound by the program's safeguarding and conduct requirements, including protection from sexual exploitation, abuse and harassment. Site access, separation of works from users, and supervision shall be arranged accordingly.
- 4.3.2** A measure shall not create an unsupervised hazard for children. Open water, deep sections, steep batters, retained water and dense concealing planting shall be assessed against the age of the users and the control recorded; where a hazard cannot be designed out, Table 2.1 applies. In particular: a basin shall have a stated maximum depth and side slope, no vertical faces and an edge treatment agreed with the facility; a bioretention area shall have a stated drawdown and route levels above the ponding level; a swale shall have crossings at stated locations with firm surfacing and grass kept at a stated height; canopy planting shall have a specified clear-stem height and a limb-failure inspection; and a treated slope shall be closed to access until the stated cover is achieved.
- 4.3.3** No measure shall retain open or accessible standing water for longer than 72 hours unless it is designed as a permanent water body under a vector-control regime agreed in writing with the provincial health department (in Islamabad Capital Territory, the federal health authority) and, at a school or pediatric facility, only as an exception under Table 2.1. Water held in storage that is covered and sealed under cl. 9.2.3, and water held within a sealed pipe, chamber or subsurface medium, is not open or accessible standing water for the purposes of this clause. The permanent pool of a retention feature is open water and is governed by Table 2.1.
- 4.3.4** The design shall record, for each species, any hazard relevant to the users: thorns, toxic parts, significant allergenic pollen, heavy fruit fall, brittle limbs, aggressive roots, and attraction of stinging insects or snakes. A species carrying a hazard incompatible with the user group shall not be used. Planting shall not be placed where root growth will damage a foundation, a below-ground service, a septic or soakage system, a boundary wall or a paved route; the separation adopted shall be stated on the planting drawing.
- 4.3.5** Where a measure receives runoff from an area that may carry pathogens, including health-care drainage, sanitation overflow or animal holding, the runoff shall be excluded or treated to an agreed standard before it enters.

- 4.3.6** No species in Part A of Table 10.2 shall be planted. A species in Part B of that table shall be planted only where the condition stated against it is satisfied under cl. 10.3.1. Plant material, growing medium and mulch shall be sourced so as not to import weed seed, soil-borne pathogens or pests, and the source of each recorded. Where an invasive species is already present, its extent and treatment shall be recorded in the baseline, and the works shall not spread it through soil movement, machinery or arisings.
- 4.3.7** Photographs of identifiable individuals, and personal data collected during consultation or monitoring, shall be obtained with informed consent, held only as long as needed, and not published without consent.

5 Design Control and Progressive Assurance

A nature-based measure is decided early, drawn late and cut last. This chapter attaches the performance, fixes the gates at which it is checked, and makes its deletion a decision that somebody has to sign.

5.1 Sequence and gates

5.1.1 A measure shall be introduced at concept stage, with the site layout and the drainage strategy. A measure retro-fitted to a fixed layout will occupy whatever land is left over, which is rarely where the function is required.

5.1.2 The gates in Table 5.1 shall be held. A gate shall not be passed until the deliverables listed against it exist and have been accepted by the party named. Gate G7 falls at the end of the establishment period, not at practical completion: a measure accepted at practical completion has been accepted before it is capable of performing.

Table 5.1 Progressive assurance gates

Gate	Held at	Deliverable required	Accepted by
G1 Screening	Concept, before the layout is fixed	Screening record, baseline evidence sufficient for the decision, trade-off record.	Design lead and owning department.
G2 Design basis	Before detailed design	Design basis record, performance statement, exceedance statement, approvals route.	Design lead and the authority where it has an interest.
G3 Detailed design	Before tender	Drawings, specification, planting schedule, maintenance plan, whole-life comparison, budget lines.	Owning department and the approving authority.
G4 Pre-construction	Before ground is broken	Statutory approvals in hand, tree protection in place, maintenance holder named, establishment water source confirmed.	Supervision consultant.
G5 Construction	At each hold point in Table 5.2	Inspection record for each hold point.	Supervision consultant.
G6 Practical completion	At handover	As-built record, acceptance criteria demonstrated so far as possible, O&M plan issued, training delivered.	Supervision consultant and owning department.
G7 End of establishment	At the end of the establishment period	Establishment acceptance, replacement of failures completed, monitoring baseline confirmed.	Owning department and maintenance holder; and the authority where it has set a condition requiring the establishment acceptance, consistent with cl. 12.5.1 and cl. 13.4.2.

Table 5.2 Construction hold points

Hold point	What is verified
Setting out and tree protection	Levels and extents checked; protective fencing to retained trees erected before any plant enters the site.
Formation level of an infiltration or bioretention measure	Level and extent; absence of smearing or compaction of the infiltration surface; retest of infiltration rate where specified.
Subgrade, drainage layers and growing medium	Layer thickness and grading, geotextile placement, underdrain level, fall and connection to the outfall; growing medium source, depth, composition and test certificate, placed without over-compaction.
Overflow and exceedance route	Overflow level, capacity and route to the receiving body, checked against cl. 5.4.
Erosion control before planting	Surface protection in place on all bare surfaces before the first rain after formation.
Plant material on delivery, and planting	Species, size, stock quality, health and provenance against the schedule, substandard stock rejected before planting; pit dimensions, backfill, staking, mulching, watering-in and spacing against the drawing.

5.2 The design basis record

5.2.1 Every adopted measure shall have a design basis record containing the fields at Table 5.3. It is the single document against which the measure is reviewed, approved, built, accepted, maintained and monitored, and shall be issued with the design.

Table 5.3 Design basis record

Field	Entry required
Measure and reference	The measure, its unique reference, and its location on the site plan.
Problem, function and performance	The stated problem, the function performed against it, and the quantified statement at cl. 5.3.1 with its design event and units.
Design inputs	Rainfall, temperature and flood inputs from CRDG chapter 3 with source and status; catchment area; infiltration rate and factor of safety; groundwater level.
Sizing basis	The method, calculation, assumptions, and the standard relied upon with its edition.
Land take	Area in square meters, displaced use, and the agreement under cl. 1.6.2.
Establishment and maintenance	The establishment period, the regime and its completion criterion; the maintenance tasks, frequencies and named holder.
Exceedance and failure	The statement required by cl. 5.4.
Acceptance and monitoring	The acceptance criteria, when each is tested and by whom; the indicators and reporting route under chapter 12.
Trade-offs and departures	The trade-off record, and each departure with its acceptance under cl. 14.2.5.

5.3 Performance and acceptance

- 5.3.1** Each measure shall carry a performance statement expressed as a quantity, a unit and a design event, capable of being tested by observation, measurement or calculation after construction. It shall not rely on a co-benefit that has not been quantified; shade, amenity, habitat and air quality benefits may be stated as expected outcomes and monitored, but shall not size the measure.
- 5.3.2** Acceptance criteria shall be stated separately for practical completion and for the end of the establishment period, with the method of verification and the party verifying.

5.4 Exceedance and failure behavior

- 5.4.1** Every measure shall have a stated exceedance route: where the water, soil or load goes when the design event is exceeded, when the measure is blocked, and when it is absent because it has died or has not yet established. The route shall be shown on the drawings and shall not pass through a building, an accessible route in use, an emergency egress route or a neighbouring property without the acceptance required by Table 2.1.
- 5.4.2** The design shall state the failure behavior: whether failure is gradual or sudden, visible or hidden, recoverable or not, and what the facility experiences while it is failed.

5.5 Controlling value engineering

- 5.5.1** A measure carrying a performance statement is a functional element of the works and shall not be reduced, deferred or omitted as landscaping. Any proposal to reduce it, or to reduce its establishment period, maintenance provision or plant stock size, shall be assessed against the performance statement, shall state what now performs the function and what the residual risk is, and shall be accepted by the party that accepted the design basis record at gate G2.
- 5.5.2** The following shall not be removed by value engineering without a recorded acceptance under cl. 14.2.5: the overflow and exceedance provision; the underdrain and its outfall; the growing medium depth; the establishment irrigation arrangement; the establishment period; the tree protection; and the monitoring provision.
- 5.5.3** Where a measure is omitted, the drainage, flood, heat or erosion case that relied on it shall be revisited and the design reissued. Omitting the measure without revisiting the case leaves the facility with a design that no longer describes it.

5.6 Change control after approval

- 5.6.1** A change to an approved measure shall be recorded under chapter 14 and shall state its effect on the performance statement, the exceedance route, the maintenance regime and the approvals held.

6 Stormwater and Flood

On most public campuses in Pakistan the drainage problem is not the design storm. It is that rain falls on a large paved area, runs to a low corner, stands there for a week, and leaves a classroom or a ward unusable.

6.1 The runoff hierarchy and the design events

6.1.1 Runoff shall be managed in the order at Table 6.1. A measure lower in the hierarchy shall not be adopted in place of one higher in it unless the higher measure has been shown to be impracticable and the reason recorded. The design shall state the proportion of the site that is impervious before and after the works, and justify any increase against step 1.

Table 6.1 The campus runoff hierarchy

Order	Step	What it means on a campus
1	Do not create the runoff	Limit impervious area. Use the smallest hardstanding the function needs, and shape it to drain to a pervious area rather than to a gully.
2	Intercept at source	Take roof and small paved areas into a measure adjacent to them, before the flow concentrates. Many small measures outperform one large one and fail less severely.
3	Convey slowly and visibly	Move water across the site in vegetated conveyance at low velocity, on the surface where it can be seen and cleared, rather than in a buried pipe nobody inspects.
4	Store and release at a controlled rate	Detain the volume the receiving system cannot take, and release it at a rate it can accept.
5	Infiltrate where the ground and setting allow	Return water to ground where the tests at cl. 3.3 and the exclusions at Table 2.1 permit.
6	Discharge	Discharge the remainder at the consented rate and quality to the consented receiving body.

6.1.2 Each measure shall be designed against a stated design event and checked against a separate, larger exceedance event. The two shall not be confused: the design event sizes the measure, the exceedance event sizes the route the water takes when the measure is full.

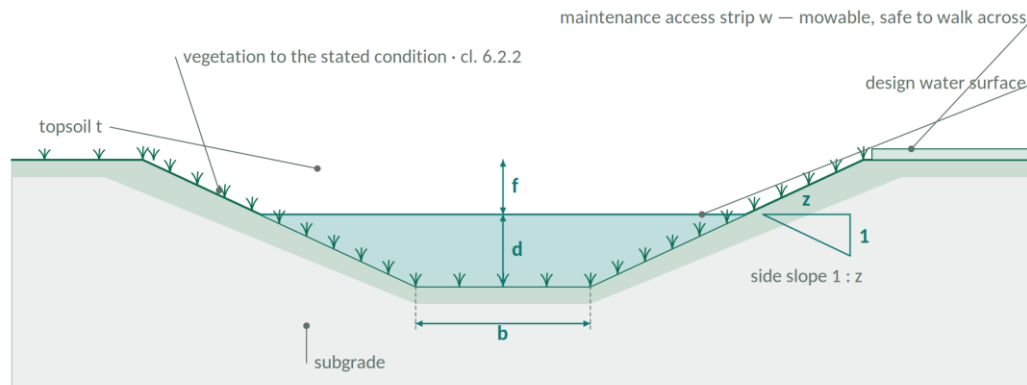
6.1.3 The events and the rainfall depths or intensities shall be those established under CRDG chapter 3, or as required by the Authority Having Jurisdiction where it specifies them. Where it specifies neither, the events adopted and the reason shall be recorded, and the default of this Guide applies: the design event shall be not less severe than the one in ten-year event, and the exceedance case shall be checked against an event not less severe than the one in one-hundred-year event. That default is a minimum floor and is the single exception to cl. 1.2.3 and cl. 14.2.6; it is not a design value, and a more severe event required by the authority or established under CRDG chapter 3 governs over it. The design and exceedance events at this clause size a measure and its exceedance route; they are not a code compliance check. Where GBCP-2023 applies to the facility, its stormwater criteria shall also be met, including the on-site

retention of the percentile rainfall volume at Section 501.3.4.1 and Section 501.3.4.2 and the discharge criterion at Section 501.3.4.3, which are volume-based and are checked separately from the events at this clause. Where RWH-BCP-2023 applies, its requirements for collection, storage and overflow shall also be met. Applicability is determined under cl. 1.4.2. The default follows the minor and major drainage concept used in urban drainage practice. The design event of one in ten years sizes the measure that routinely carries runoff; it is set above the one-in-two to one-in-five-year events commonly used for minor municipal drains because the facility is occupied and critical and a surcharged measure disrupts its use. The exceedance event of one in one hundred years checks that water beyond the capacity of the measure follows a route that keeps it out of buildings and off egress routes; it is the event commonly used to judge flooding of buildings and is the reference flood at GBCP-2023 Section 501.3.1.2. Apart from that floor, this Guide states no design event, exceedance event or permitted discharge rate and none shall be assumed from it, because rainfall, catchment, receiving system and consent differ at every facility; the values are established for the project from the evidence at chapter 3 and recorded in the design basis record. The climate allowance established under CRDG chapter 3 shall be applied to the design rainfall before sizing; a nature-based measure shall not be used as a substitute for that allowance.

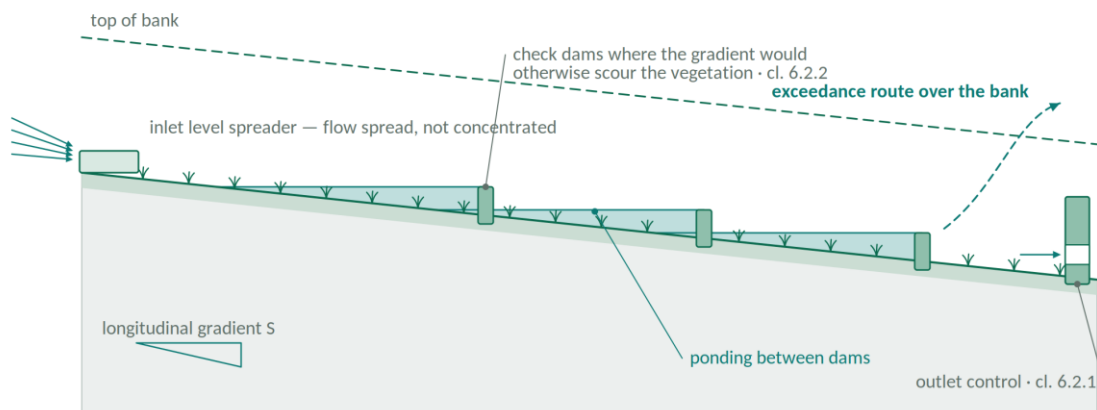
6.2 Conveyance, retention and infiltration

- 6.2.1 A swale shall be designed as a hydraulic element. Its catchment area, design flow, cross-section, longitudinal gradient, design velocity, freeboard and vegetation condition shall be stated and calculated, and its inlet, outlet and exceedance route shown on the drawings.
- 6.2.2 The design velocity shall be low enough that the vegetation is not scoured at the design event, and the velocity adopted and its basis stated. Where the gradient produces a higher velocity, check dams, a stepped profile or a lined section shall be used and shown on the drawings. Side slopes shall be no steeper than the stated maximum, movable and safe to walk across, and crossings provided at stated locations with a firm, slip-resistant surface. Figure 6.1 illustrates a vegetated swale in section and long section and is illustrative, not normative.

a Cross-section



b Long section with three check dams



Dimension call-outs are symbols. The project states b , d , f , z , w and S , with the design velocity and the vegetation condition, from the evidence at chapter 3 (cl. 6.2.1–6.2.2).

Figure 6.1 Vegetated swale, section and long section with check dams

- 6.2.3** A bioretention area shall be designed as a filter, not a planting bed. Its filter media composition and depth, ponding depth, surface area, underdrain arrangement, overflow level and drawdown time shall be stated and calculated. Ponding depth is limited by the safeguarding assessment at cl. 4.3.2, and drawdown from a filled condition shall not exceed 72 hours in any case, and shall be shorter where cl. 4.3.3 requires it.
- 6.2.4** An underdrain shall be provided unless infiltration alone has been shown to achieve the stated drawdown at the measured rate with its factor of safety. Where provided, its outfall shall be identified and shown to be available at all times, including when the receiving system is surcharged. Filter media shall be specified by composition, grading and permeability and tested on delivery; site topsoil shall not be used unless tested and shown to meet the specification.
- 6.2.5** Runoff carrying silt from unstabilized ground shall be excluded from a bioretention area or a permeable surface until the contributing surfaces are stabilized. A measure commissioned during construction, receiving construction runoff, will be clogged before it is handed over.

- 6.2.6** A detention basin holds water temporarily and releases it at a controlled rate; a retention feature holds a permanent volume and is not adopted at a school or pediatric facility except as provided in Table 2.1. The detention volume shall be calculated for the design event against the permitted discharge rate, and the outlet control specified, made accessible for clearing and protected against blockage.
- 6.2.7** A permeable surface shall have a stated subbase storage volume, subgrade condition, outlet or infiltration arrangement and maintenance regime. It shall not be laid over a subgrade that cannot accept the water unless tanked and drained to a stated outfall; a permeable surface over an impermeable, undrained subgrade is a reservoir under a pavement.
- 6.2.8** Infiltration shall be adopted only where the exclusions at Table 2.1 are cleared, the rate has been measured under cl. 3.3.1, and the unsaturated thickness at cl. 3.3.3 is maintained. The design shall state the separation between any infiltration measure and every foundation, basement, retaining structure, below-ground service, septic tank, soakage pit and drinking-water source, with the basis for the separation adopted.
- 6.2.9** Sediment is the most common contaminant and the most common cause of failure. A pretreatment provision shall be included in every infiltration measure and shall be accessible for cleaning: a leaf guard and first-flush diversion on a roof; a vegetated filter strip or forebay with a litter trap for footpaths, courtyards and play areas; a filter strip and forebay with hydrocarbon control for a car park or access road.

6.3 Interface with buildings and access

- 6.3.1** No measure shall raise the groundwater, soil moisture or surface water level adjacent to a building, foundation or retaining structure in a way that has not been assessed. Where the assessment has not been made, the measure shall be relocated.
- 6.3.2** Finished levels shall be designed so that the exceedance flow passes away from buildings and from routes required in an emergency, and the threshold levels of buildings relative to the ponding and exceedance levels shall be shown on section. The design flood level, the freeboard and the elevation of the facility established under CRDG chapter 7 shall not be varied on account of a measure in this chapter.
- 6.3.3** Access for maintenance plant and for manual clearing shall be provided to every measure, shown on the drawings, and usable in the wet season. A measure that cannot be reached will not be maintained.
- 6.3.4** The evidence held for a stormwater measure shall comprise the catchment delineation; rainfall inputs with source and climate allowance; infiltration results with method, date and factor of safety; groundwater level and range; the sizing calculation with its reference; drawdown and velocity checks; the overflow and exceedance route on drawing and section; the discharge consent and permitted rate; the construction hold point records; and the drawdown or infiltration test on completion and at end of establishment.

7 Slope, Erosion and Ground

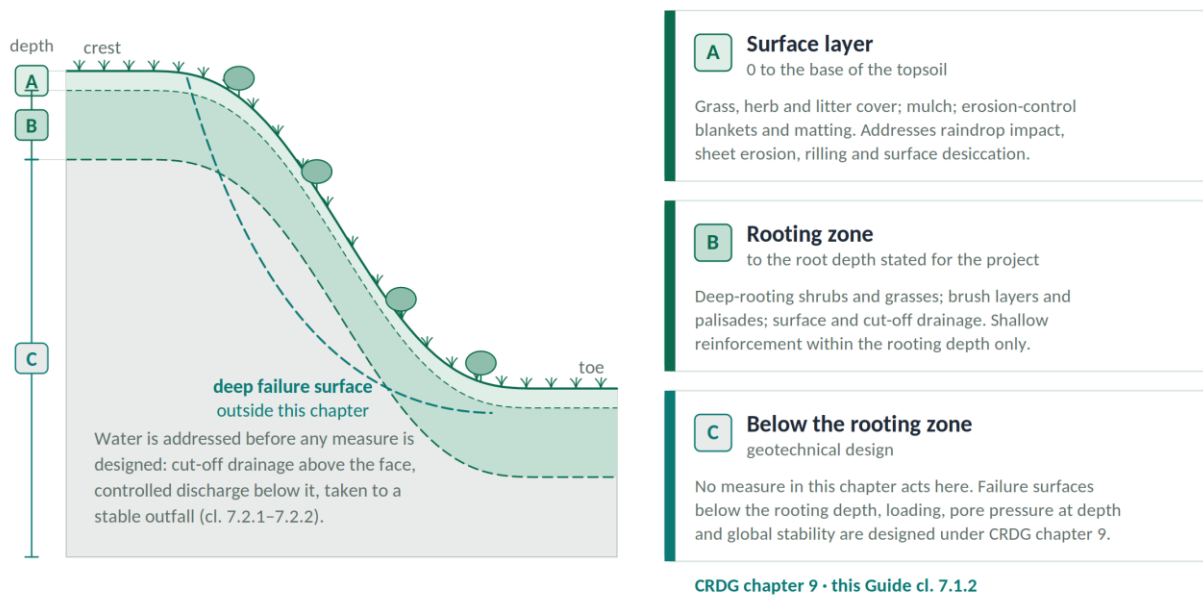
Vegetation holds the surface. It does not hold the slope. Most of the damage seen on hillside school sites in Pakistan is surface erosion, riling and shallow slip in the top meter, and bioengineering treats that well and cheaply.

7.1 What bioengineering can and cannot do

- 7.1.1** Bioengineering measures address surface erosion, riling, gullying, shallow soil movement and the surface consequences of water. They shall not be credited with resisting deep-seated instability, and shall not reduce any stabilization, drainage or retaining provision established under CRDG chapter 9. Table 7.1 shall be applied to every bioengineering measure: a measure shall be credited only with what its mechanism addresses in that table, and shall not be credited with anything in the column of matters the mechanism does not address. Figure 7.1 illustrates the selection of a slope treatment by mechanism and depth and is illustrative, not normative.
- 7.1.2** Where the slope on or above a site is potentially unstable, the position shall be established by competent geotechnical assessment before any bioengineering measure is designed, and the bioengineering design prepared within the boundary that assessment sets.
- 7.1.3** The root depth, the root reinforcement contribution and the time at which each is achieved shall be stated for any measure claimed to reinforce soil. A contribution not established for the project, the species and the soil shall not be claimed.

Table 7.1 What each mechanism addresses

Mechanism	Addresses	Does not address
Surface cover by grass, herbs or litter	Raindrop impact, sheet erosion, riling, surface desiccation	Any depth of instability below the rooting zone.
Deep-rooting shrubs and grasses	Shallow soil reinforcement within the rooting depth; surface drainage by transpiration	Failure surfaces below the rooting depth; loading and pore pressure at depth.
Live structures such as brush layers and palisades	Interruption of slope length, trapping of moving material, shallow reinforcement	Retaining function; global stability.
Vegetated gabion or crib with planting	The retaining function is carried by the structure; vegetation controls surface erosion on and around it	Nothing additional. The structural design governs.
Surface and cut-off drainage	Concentration of water on the face; saturation of the surface layer	Groundwater at depth, or seepage pressure requiring a designed drainage system.
Tree planting on a slope	Surface cover and interception	Slope stability. Trees add weight and wind loading and their roots can open fissures; planting on an unstable slope requires geotechnical acceptance.



The rooting depth is stated for the species and the soil of the project; a contribution not established for the project is not claimed (cl. 7.1.3).

Figure 7.1 Slope treatment selection by mechanism and depth

7.2 Water first, then cover, then structures

- 7.2.1** Before any bioengineering measure is designed, the water acting on the slope shall be addressed: where it arrives, concentrates, infiltrates and discharges. A treatment applied to a slope still receiving concentrated flow will be removed by the first event.
- 7.2.2** Cut-off drainage above a treated face, and a controlled discharge below it, shall be designed and shown on the drawings. The discharge shall be taken to a stable outfall and not released onto the slope below. Infiltration measures shall not be placed above or on a slope whose stability depends on the soil remaining unsaturated.
- 7.2.3** Every bare surface created by the works shall be protected before the first rainfall after formation. The protection, its extent and the time by which it shall be in place shall be stated in the specification and held as a hold point. The design shall state the cover to be achieved, the method by which cover is measured, and the date by which it is to be achieved; cover is the acceptance criterion, not the number of plants installed.
- 7.2.4** Where a live structure is used, the specification shall state the species, the cutting or plant size, the spacing, the depth and orientation of placement, the season of installation and the expected rooting behavior. Live material shall be installed within the stated period after harvesting, and in the planting season appropriate to the species and the site. Where a hybrid structure is used, the structural element shall carry the full design case on its own under CRDG chapter 9, and the vegetation is surface protection only.

7.3 Boundaries, establishment and inspection

- 7.3.1** Where a gully, hill torrent or natural channel passes along or through the site, this chapter applies to the margins and the ground surface within the boundary. Works within the channel, and the assessment of its behaviour, are referred under cl. 1.1.4. Planting shall not be placed where it will be carried away and become debris, or where it will obstruct a conveyance the facility depends on.
- 7.3.2** Where the site lies within a valley draining a glaciated catchment, downstream of a moraine- or ice-dammed lake, on or adjacent to an alluvial fan, or on a channel with a recorded history of debris transport, CRDG cl. 5.3.1 and 5.3.2 govern, and no measure in this chapter shall be presented as addressing that exposure.
- 7.3.3** Species for slope work shall be selected under chapter 10 and shall additionally tolerate the exposure, shallow soil and moisture regime of the face, and be capable of establishing without irrigation after the establishment period. The establishment period shall run until the stated cover has been achieved and has survived one full wet season; a slope measure shall not be accepted at practical completion.
- 7.3.4** Grazing and browsing shall be excluded from a treated slope for the whole establishment period. The means of exclusion, its cost and the responsible party shall be stated. Where exclusion cannot be achieved, the measure fails the capacity test at cl. 2.1.4.
- 7.3.5** A treated slope shall be inspected after every significant rainfall event during the establishment period, thereafter at the frequency stated in the maintenance plan, and after every event exceeding a stated threshold. The inspection shall record new riling, gullying, tension cracks, seepage, bulging, leaning trees or poles, bare patches and blocked drainage.
- 7.3.6** Riling means surface flow is concentrating and cover has not been achieved: reinstate the cover and correct the drainage causing it. Bare patches after one season mean the species, establishment water or grazing exclusion was wrong, and cl. 2.1.4 shall be revisited. Sediment at the toe is a symptom of erosion upslope, and the source shall be treated rather than the accumulation. A blocked cut-off drain is the most common precursor to slope damage on a campus.
- 7.3.7** The appearance of tension cracks, seepage, bulging, or leaning trees, poles or fence lines shall be reported immediately under cl. 12.5.3, access restricted, and the matter referred for geotechnical assessment. It shall not be treated as a maintenance item, and nothing shall be planted over it.

8 Heat, Shade, Wind and Air

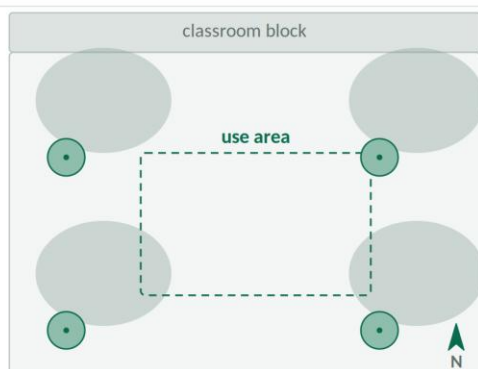
A shade tree over a school courtyard in Punjab or Sindh does more for the usable hours of that facility than most things bought for the same money. It also takes eight years, needs water in the years when it gives nothing back, and will be cut down by a caretaker who was never told why it was planted.

8.1 Heat exposure and shade

- 8.1.1** The design shall identify where and when people are exposed to heat: routes, waiting and assembly areas, play areas, queues and outdoor teaching or triage areas, and the hours and months at which they are used. Entrances and waiting areas need continuous shade at the hours of use with air movement retained; an assembly area needs shade over its footprint at the assembly hour, or a change to the assembly time recorded with the facility; a play area needs enough shade that shaded play is possible; routes need shade continuous enough to be used.
- 8.1.2** The heat design basis shall be the temperature data established under CRDG chapter 3, and measures designed for the condition expected over the design life. Where a facility is identified under CRDG as relying on passive survivability during a power outage, outdoor and envelope shading shall be recorded as contributing to that strategy and shall not be omitted under cl. 5.5.
- 8.1.3** A shade measure shall state the area to be shaded, the use it serves, the hour and date at which the shade is required, and the year after planting at which it is achieved. A planting drawing without those four statements is not a shade design. Tree positions shall be set from the sun path at the site latitude for the hour and date stated, not from the plan appearance of the layout, and the design shall show the shadow cast for the stated year. Figure 8.1 illustrates shade positioning from the sun path and is illustrative, not normative.
- 8.1.4** The mature canopy spread, mature height and clear stem height shall be stated for each species, and positions set so that mature canopies do not conflict with buildings, lighting, overhead services, sight lines required under cl. 4.2.3 or maintenance access. Species shall be screened under cl. 4.3.4; a species that drops heavy fruit shall not be planted over a play area, a route or a parking area.
- 8.1.5** The design shall state the water required for establishment and operation, what happens if that water is not available in a dry year, and what provides shade during the years before the canopy performs: built shade, fast-growing nurse planting, or a recorded acceptance that there is none. Where a location requires shade in the hot season and solar access in the cool season, a deciduous species shall be preferred and the leaf-on and leaf-off periods stated.

a Positioned from the plan

trees set symmetrically as a layout gesture



✗ The shadow falls outside the use area.
A planting drawing is not a shade design (cl. 8.1.3).

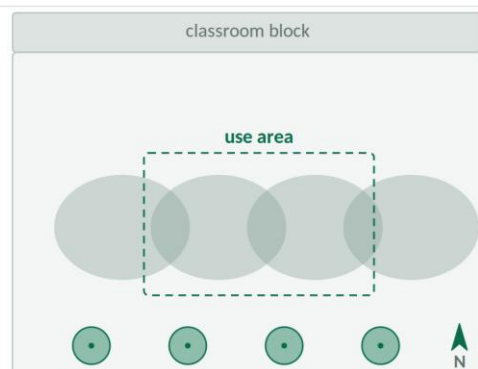
Sun path at the site latitude



sun at the stated
hour and date
shadow direction

b Positioned from the sun path

trees set from the sun path for the stated hour and date



✓ The shadow covers the use area.
Set from the sun path at the site latitude (cl. 8.1.3).

The design states

Area to be shaded and the use it serves
Hour and date at which the shade is required
Year after planting at which it is achieved
Site latitude, mature spread and clear stem
cl. 8.1.3–8.1.4

Shadows are shown for one stated hour and date, and for the stated year after planting.
What provides shade in the years before the canopy performs is stated under cl. 8.1.5.

Figure 8.1 Shade positioning from the sun path, not from the plan

8.2 Roofs, surfaces and air movement

- 8.2.1** A green roof or vegetated wall shall not be adopted unless the structural capacity, waterproofing, irrigation supply and maintenance access have each been established, and the maintenance capacity test at cl. 2.1.4 has been passed for a measure at height. The saturated weight, including growing medium at field capacity, plants at maturity, retained water and maintenance loading, shall be carried by the structure as designed under BCP-2021. On an existing structure the assessed condition under the CD-CRI Structural Health Assessment Manual governs.
- 8.2.2** Shading a roof, increasing its reflectance, or planting at ground level to shade a wall will usually deliver more of the thermal benefit for less cost, risk and maintenance than a green roof. The design shall state why those options were not adopted before a green roof is proposed.
- 8.2.3** The extent of hard paving adjacent to occupied space shall be reduced under step 1 of the runoff hierarchy before a change of surface is considered. Where a surface treatment is adopted to reduce heat, the design shall state the property relied upon, the value assumed, its source, and the maintenance required to retain it; a reflective surface that is never cleaned does not retain its stated performance.
- 8.2.4** A shading or planting measure shall not obstruct the air movement on which the facility relies for natural or mixed-mode ventilation. Where GBIG chapter 9 establishes a ventilation strategy, the planting design shall be checked against it and the check recorded. Dense

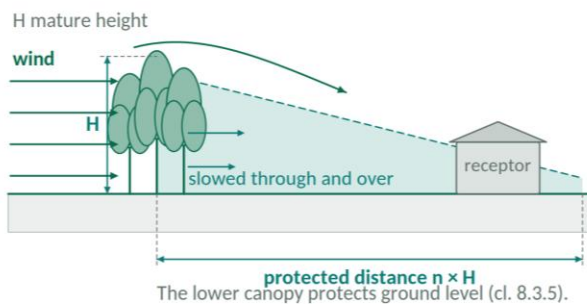
planting on the windward side of a naturally ventilated block will reduce the ventilation it depends on; clear stem height and species density shall be specified so that air movement at opening level is retained.

8.3 Wind, dust and air

- 8.3.1** Planting may reduce wind speed at ground level in the lee of a shelterbelt, intercept airborne dust, screen a dust source from a receptor, and reduce dust generation by covering bare ground. It shall not be credited with reducing the wind design actions established under CRDG chapter 8 or the adopted code.
- 8.3.2** A claim that planting improves air quality shall state the pollutant, the mechanism, the expected magnitude and the means of verification. Where those cannot be stated, the benefit may be recorded as an expected co-benefit but shall not size the measure.
- 8.3.3** Covering bare ground is the most reliable dust measure available on a campus and shall be considered before any shelterbelt is designed. Most campus dust is generated on the campus.
- 8.3.4** A shelterbelt shall state the receptor it protects, the wind direction and season it is designed against, its length, mature height, porosity, number of rows and species composition. The protected distance downwind shall be expressed as a multiple of mature height, with the multiple and its source stated.
- 8.3.5** A shelterbelt shall be moderately porous rather than solid. A solid barrier produces turbulence in its lee and protects a shorter distance than a permeable belt of the same height. The design shall state the years at which the belt reaches the assumed height and what protects the receptor in the meantime. Its most common failure is loss of the lower canopy to grazing or pruning, which is the part that protects ground level. Figure 8.2 illustrates shelterbelt geometry, porosity and the protected distance and is illustrative, not normative.

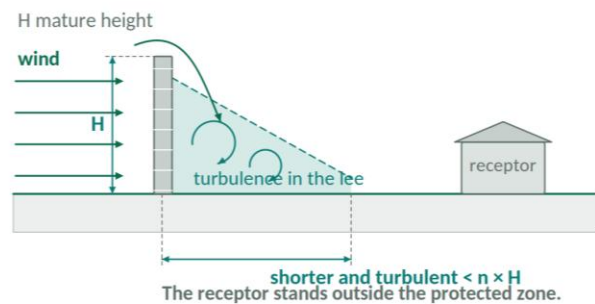
a Porous belt, section

the belt is moderately porous, not solid



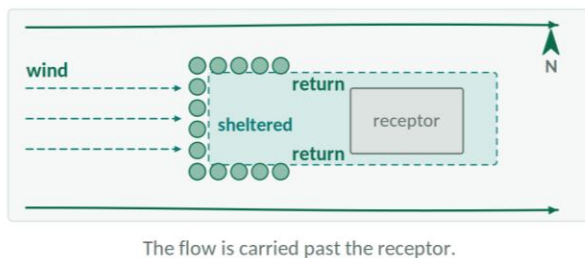
b Solid barrier, section

a solid barrier protects a shorter distance



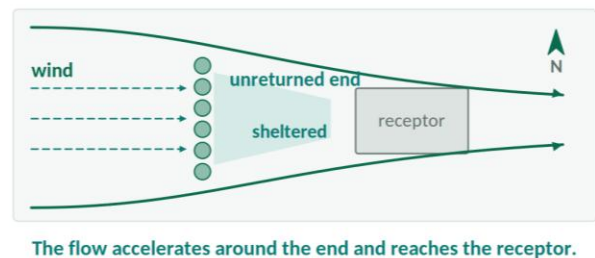
c Belt with returned ends, plan

the ends are turned into the wind



d Belt without returns, plan

the end becomes the failure



Not to scale. The multiple n and its source, the mature height, the porosity, the number of rows and the species composition are stated by the project (cl. 8.3.4–8.3.5).

Figure 8.2 Shelterbelt geometry, porosity and the protected distance

- 8.3.6** A shelterbelt shall not obstruct the ventilation at cl. 8.2.4 or the sight lines at cl. 4.2.3, or stand where wind-thrown material would strike a building or route. Trees near a building shall be positioned and specified so that failure of the plant does not become a hazard, and the separation from buildings, overhead services, boundary walls and routes shall be stated with its basis.
- 8.3.7** Species with significant allergenic pollen shall not be planted at or upwind of a health facility or a school. Where the facility is a health facility, or a school with children with respiratory conditions, dust measures shall be coordinated with the indoor air quality provisions of GBIG chapter 9 and the coordination recorded.
- 8.3.8** A heat, shade, wind or dust measure shall be verified against the acceptance criteria at cl. 5.3.2 and monitored under chapter 12. Survival, height and continuity are verified at the end of the establishment period; the shaded area at the year stated in the performance statement. Where surface temperature or dust deposition is monitored, the method, location, height and times of measurement shall be stated and repeated identically at each visit, with the baseline at cl. 3.5 as the comparison.

9 Water: Harvesting, Reuse and Drought

The question that decides whether planting on a Pakistani public campus lives or dies is not which species. It is who carries the water in June, from where, and paid for by whom.

9.1 The water balance

9.1.1 A water balance shall be prepared for every project adopting a measure that requires water. It shall contain, as a minimum, each entry at Table 9.1, stated on the basis shown there, and shall be held with the design basis record.

9.1.2 Where total demand exceeds available supply in any month, the design shall reduce demand, add supply, or reduce the measure.

Table 9.1 Water balance, minimum contents

Entry	What is stated
Facility demand	Drinking, sanitation, clinical, cleaning and food preparation demand, by month, with its basis.
Establishment demand	Liters per plant per application, applications per week, number of plants, by month, for each year of the establishment period.
Operational demand	Irrigation demand after establishment, by month, by measure, and the year at which it falls to its long-term value.
Supply: mains, scheme or groundwater	Reliability, hours of supply and any seasonal restriction; borehole yield, depth, quality including salinity, pumping arrangement and energy supply, and any abstraction restriction.
Supply: rainwater and reuse	Catchment area, monthly rainfall from the CRDG chapter 3 basis, runoff coefficient, storage volume and monthly yield; and for reuse the source, volume, quality, treatment and approval position.
Dry-year case, shortfall and response	The same balance on dry-year rainfall and reduced supply reliability; any month in deficit, and the design response to it.

9.2 Rainwater harvesting

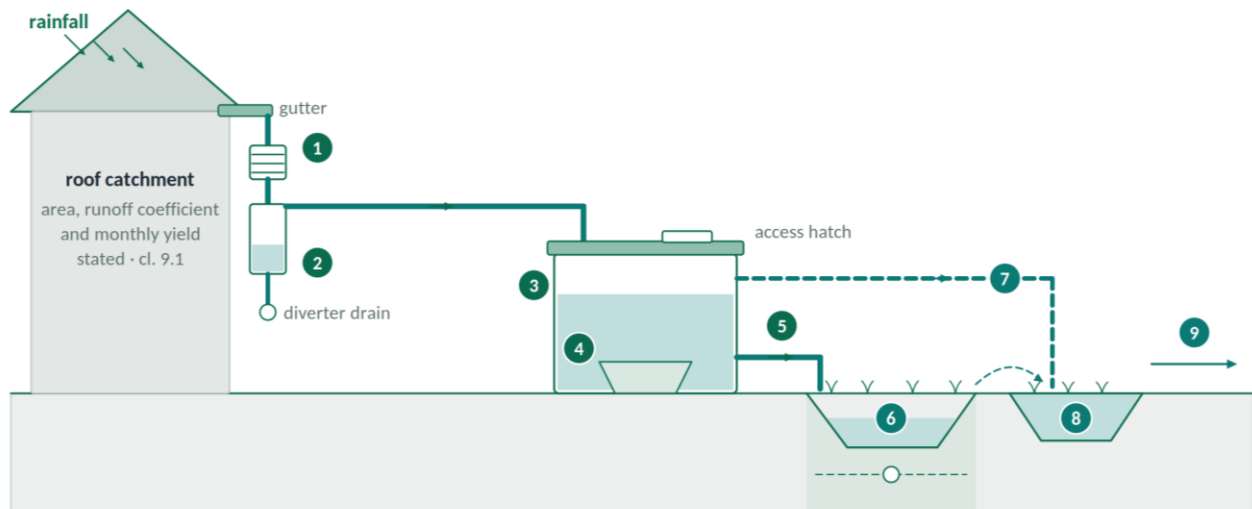
9.2.1 Where RWH-BCP-2023 applies to the facility under cl. 1.4.2, the rainwater harvesting system shall comply with it, and the provisions of this section apply in addition to it only where they are more stringent. Rainwater harvesting shall be designed as a system: catchment, conveyance, first-flush diversion, filtration, storage, distribution, overflow and maintenance access. Figure 9.1 illustrates rainwater harvesting integrated with a landscape measure and is illustrative, not normative.

9.2.2 The first-flush diversion volume shall be stated, with an automatic or clearly operable means of resetting it; a device that requires a person to remember will not operate.

9.2.3 Storage shall be covered, sealed against insects and light, and accessible for cleaning, with a cleanable sump and a drain. An open or unsealed tank does not satisfy this clause: it retains accessible standing water and is excluded under cl. 4.3.3, which exempts covered and sealed

storage designed under this clause only. Harvested rainwater shall not be used for drinking, clinical use or food preparation unless treated and approved for that purpose.

9.2.4 The overflow shall be sized for the design event and taken to a stormwater measure under chapter 6 or to a consented outfall, and shall not discharge against a building, onto an access route or onto a slope.



- | | | | |
|--|---|--|---|
| 1 Leaf filter - cl. 9.2.1 | ⌚ | 6 Bioretention area — filter media, underdrain and drawdown stated - cl. 6.2.3 | ⌚ |
| 2 First-flush diverter — stated volume, with an operable means of resetting it - cl. 9.2.2 | ⌚ | 7 Overflow sized for the design event - cl. 9.2.4 | |
| 3 Covered, sealed storage, accessible for cleaning - cl. 9.2.3 | ⌚ | 8 Swale - chapter 6 | |
| 4 Cleanable sump and drain | ⌚ | 9 Consented outfall — not against a building, a route or a slope - cl. 9.2.4 | |
| 5 Gravity distribution to the measure | | ⊗ Contaminated or unsuitable surface — excluded from harvesting - cl. 4.3.3, 9.2.3 | |

⌚ maintenance point — access, frequency and the responsible post are stated under chapter 11
Harvested rainwater is not used for drinking, clinical use or food preparation unless treated and approved (cl. 9.2.3).

Schematic only, not to scale. Storage volume, first-flush volume, overflow capacity and the monthly water balance are calculated for the project (cl. 9.1, 9.2.1–9.2.4).

Figure 9.1 Rainwater harvesting integrated with a landscape measure

9.3 Reuse and treatment

9.3.1 A greywater reuse scheme shall be screened under cl. 1.5.4, with its approval category confirmed by the competent Environmental Protection Agency or Authority Having Jurisdiction, and shall meet the discharge or reuse standard applicable to it. Greywater shall not be reused for any purpose involving contact with people or food without treatment to an approved standard; subsurface irrigation of non-edible planting is the lowest-risk application. The restriction on the source from which greywater may be taken is at cl. 9.3.2.

9.3.2 Greywater shall not be taken from a source that may contain blackwater, clinical waste, laboratory waste or health-care facility drainage, unless treated under a design prepared for that duty and approved.

9.3.3 A constructed wetland shall state its design flow, hydraulic retention time, media, planting, inlet and outlet arrangement, bypass for flows above the design flow, and its sludge and media replacement regime, and shall be designed by a competent person for that duty. It shall not be adopted at a school or paediatric facility except as provided in Table 2.1 for permanent open water, and a subsurface-flow arrangement with no open water should be preferred.

9.3.4 The maintenance capacity test at cl. 2.1.4 shall be applied to a treatment measure with particular care. A treatment measure that is not operated is worse than no treatment measure, because the facility will believe the water has been treated.

9.4 Dry-climate planting and establishment water

9.4.1 The planting design shall be capable of surviving without irrigation after the establishment period, except where a permanent irrigation supply is confirmed in the water balance and funded under cl. 12.3. Where the Green Building Code of Pakistan 2023 has been adopted, its chapter 6 governs: not more than one third of the improved landscape area may be irrigated with potable water, potable irrigation of rainfall-compatible planting shall cease at the end of the establishment period, and the irrigation design shall be prepared by an accredited professional. Where the Code is adopted, the Code value governs.

9.4.2 Turf and other high-demand ground cover shall be limited to areas where the use requires it, stated in square meters, and shall carry its own entry in the water balance; the alternative of a hard or stabilized surface shall be considered and the decision recorded. Where the Green Building Code of Pakistan 2023 has been adopted, such areas count against the limit on potable irrigation at GBCP-2023 chapter 6 and the Code value governs.

9.4.3 The establishment water source shall be identified, quantified and confirmed before construction begins, and confirmation shall be a requirement of gate G4.

9.4.4 Establishment water shall not be drawn from the supply required for drinking, sanitation, clinical use or food preparation. Where no alternative source exists, the planting shall be reduced to what the available water supports, or phased so that each phase can be established.

9.4.5 Where establishment water is to be delivered by tanker, the number of deliveries, the cost, the access route and the budget line shall be stated.

9.4.6 The establishment regime shall state liters per plant per application, applications per week by month, and the duration in years, and shall be stated in the operation and maintenance plan as a regime assigned to the maintenance holder under cl. 11.1.3, rather than as a general requirement to maintain.

9.4.7 Where a water-related performance statement is made, the means of verifying it shall be installed as part of the works.

10 Species Selection and Planting

Species selection is where a nature-based measure is usually lost. A list is copied from another project, the nursery supplies what it has, nobody checks the soil, and three years later the caretaker is watering a species that was never going to survive without him.

10.1 Selection rules

- 10.1.1** A species shall be selected against the site, not against a regional list. The selection shall state, for each species, why it is suited to this site's rainfall, temperature range, soil texture, depth, pH, salinity, drainage and exposure, and against the function it is asked to perform.
- 10.1.2** Species shall be capable of surviving without irrigation after the establishment period, except as permitted under cl. 9.4.1. Native and locally naturalized species shall be preferred; a non-native species shall be adopted only where a native species will not perform the function, and the reason recorded. Where the Green Building Code of Pakistan 2023 has been adopted, its chapter 5 governs the minimum proportion of the planted area to be biodiverse native or adapted species and requires the removal of invasive plants, and the Code value governs.
- 10.1.3** The planting shall not be a monoculture. The design shall state the number of species and the proportion represented by the most abundant, and shall limit that proportion so that a single pest, disease or drought event does not remove the whole measure.
- 10.1.4** Every species shall be screened for the hazards at cl. 4.3.4 against the user group, and for root behaviour against structures, pavements, drains and soakage systems. A species acceptable at a district office may be unacceptable at a primary school.
- 10.1.5** The selection shall be confirmed with the provincial forest department or an equivalent competent local source, and with the nursery that will supply the stock, before the schedule is issued for tender. Availability is part of suitability. Species that are locally sensitive, protected or subject to a provincial restriction shall be confirmed with the provincial forest department before the planting schedule is fixed.

10.2 Ecological zones and indicative palettes

- 10.2.1** Table 10.1 is an orientation to the broad zones in which public facilities in Pakistan stand, with species commonly suitable in each. It is a starting point for discussion with the provincial forest department, not a specification. Every entry shall be confirmed under cl. 10.1.5 before use, and nothing in it displaces the screening at cl. 10.1.4 or the prohibitions and restrictions at Table 10.2. Where an entry in Table 10.1 falls within Part B of Table 10.2, because it is thorny or because a part of it is toxic or on any other ground stated there, the restriction at Table 10.2 governs its use and its position, and the qualifications carried in Table 10.1 are read as recording that restriction.

Table 10.1 Indicative species by ecological zone, for confirmation under cl. 10.1.5

Zone	Shade and canopy	Shrub, screen and shelterbelt	Grass, ground cover and bioengineering
Irrigated Indus plains, Punjab and Sindh	<i>Azadirachta indica</i> , <i>Dalbergia sissoo</i> on well-drained ground only, see cl. 10.2.2, <i>Albizia lebbeck</i> , <i>Terminalia arjuna</i> , <i>Syzygium cumini</i> , <i>Mangifera indica</i>	<i>Vachellia nilotica</i> away from children's areas, <i>Bombax ceiba</i> , <i>Moringa oleifera</i>	<i>Cynodon dactylon</i> , <i>Desmostachya bipinnata</i> , <i>Chrysopogon zizanioides</i> sterile cultivar
Arid and semi-arid rangeland: Thal, Cholistan, Thar, Balochistan uplands	<i>Prosopis cineraria</i> , <i>Salvadora oleoides</i> , <i>Tamarix aphylla</i> , <i>Ziziphus mauritiana</i> away from children's areas	<i>Capparis decidua</i> on a boundary away from children's areas, <i>Calligonum polygonoides</i> , <i>Haloxylon</i> species	<i>Lasiurus sindicus</i> , <i>Cenchrus ciliaris</i> , <i>Panicum turgidum</i>
Coastal Sindh and Balochistan, saline and wind-exposed	<i>Tamarix aphylla</i> , <i>Thespesia populnea</i>	<i>Salvadora persica</i> , salt-tolerant shrubs on local advice	Salt-tolerant grasses on local advice; coastal mangrove work lies outside the site boundary and is referred under cl. 1.1.4
Pothohar and sub-mountainous scrub	<i>Olea ferruginea</i> , <i>Acacia modesta</i> , <i>Melia azedarach</i> away from children's areas due to fruit toxicity, <i>Ficus</i> species away from structures	<i>Dodonaea viscosa</i> , <i>Ziziphus</i> species away from children's areas, <i>Justicia adhatoda</i>	<i>Cynodon dactylon</i> , <i>Chrysopogon zizanioides</i> sterile cultivar, local tussock grasses
Moist and dry temperate mountains, KP and AJK	<i>Platanus orientalis</i> , <i>Juglans regia</i> , <i>Pinus roxburghii</i> , <i>Cedrus deodara</i> at elevation, <i>Populus</i> species with caution on water demand	<i>Berberis</i> species, <i>Indigofera</i> species, local willows for bioengineering	<i>Saccharum bengalense</i> , local grasses; willow and poplar cuttings for live structures
High-altitude Gilgit-Baltistan and Chitral	<i>Salix</i> species, <i>Populus</i> species, <i>Juglans regia</i> , <i>Hippophae rhamnoides</i>	<i>Hippophae rhamnoides</i> , <i>Myricaria</i> species	Local alpine grasses and sedges on forest department advice

10.2.2 Where a species in Table 10.1 is subject to a current disease, pest or policy advisory in the province concerned, the advisory governs and the species shall not be specified against it. The advisories standing at the date of issue are these. *Dalbergia sissoo* is affected by dieback and wilt across the Punjab plains and elsewhere in the Indus basin, associated with *Fusarium solani*, *Ceratocystis fimbriata* and *Ganoderma* root rot, for which no reliable field control is established; it shall not be specified on waterlogged, poorly drained or heavy ground, nor within the wetted zone of an infiltration measure, shall be taken only from a nursery with no record of dieback in its stock, and shall not form more than a minor proportion of any planting. *Conocarpus erectus* and *Conocarpus lancifolius* shall not be specified at any facility under this Guide: the genus is associated with respiratory complaint from its pollen, with root behaviour damaging to drains, pavements and foundations, with high water use, and with suppression of neighbouring vegetation. Its sale and purchase were banned by the Commissioner Karachi

in 2016, and its planting is discouraged by a national advisory issued by the Government of India in 2025 and prohibited by the Gujarat forest department in 2023. Its exclusion here is a technical rule of this Guide and does not depend on those orders. Eucalyptus species, and Eucalyptus camaldulensis in particular, shall not be specified for shade, screening or shelter at a school or health facility, on account of water demand and the drawdown it causes; use is permitted only where the provincial forest department advises it for a stated drainage or waterlogging purpose at that site, the advice is recorded, and the water balance, any shallow aquifer relied on for supply and adjacent agricultural land have been checked; the same rule is stated at Table 10.2. These entries state the position at the date of issue and do not displace the confirmation required at cl. 10.1.5, which governs where it differs. Where a species is used for live cuttings, its rooting behaviour shall be confirmed locally rather than assumed.

10.3 Species that shall not be planted

- 10.3.1** Table 10.2 has two parts and they operate differently. A species or group in Part A shall not be planted under this Guide at any facility, and no condition, local advice or recorded acceptance varies that prohibition. A species or group in Part B is restricted, not prohibited: it shall not be planted unless the condition stated against it in that table is satisfied, the screen at cl. 10.1.4 has been applied to the species at its proposed position, and the condition, the position and the reason are recorded in the design basis record. Neither part is displaced by an entry in Table 10.1.
- 10.3.2** Where a species at Table 10.2 is already present on the site, its presence shall be recorded in the baseline and its removal or management considered as part of the works. Table 10.2 is not exhaustive: a species shall be excluded wherever the screen at cl. 10.1.4 identifies a hazard incompatible with the user group, or where local advice identifies it as invasive or unsuitable. An existing mature tree of a Part A species is dealt with under cl. 10.3.3.
- 10.3.3** Where a mature tree of a Part A species is present at a facility and provides shade or shelter, it shall not be removed immediately unless it presents an immediate hazard. It shall be replaced in phases: native shade trees from Table 10.1 are planted first, and the existing tree is removed once the replacement provides useful shade, with the phasing and dates recorded in the operation and maintenance plan. Removal is subject to the tree permission required at cl. 1.5.6 and any tree-cutting ban in force.

Table 10.2 Species prohibited absolutely (Part A) and species restricted on a stated condition (Part B)

Species or group	Part and ground	Note
<i>Prosopis juliflora</i> and related introduced mesquite	Part A, absolute: invasive. Technical exclusion under this Guide; and, where GBCP-2023 applies, Section 501.3.3.1.	Spreads aggressively, displaces native vegetation, lowers groundwater, thorny. Not to be confused with the native <i>Prosopis cineraria</i> , which is acceptable.
<i>Broussonetia papyrifera</i> , paper mulberry	Part A, absolute: allergenic and invasive. Technical exclusion under this Guide;	A major cause of seasonal pollen allergy in Islamabad and Rawalpindi. Shall not be planted at any facility, and is a removal candidate where

Species or group	Part and ground	Note
	and, where GBCP-2023 applies, Section 501.3.3.1.	present near a school or health facility, removed under cl. 10.3.3.
<i>Conocarpus</i> species	Part A, absolute: health and infrastructure. Technical exclusion under this Guide; also a local order: sale and purchase banned by the Commissioner Karachi, 2016.	Widely planted and now widely discouraged. Aggressive roots damaging pavements, drains and foundations; associated pollen and respiratory complaints; high water demand for the benefit delivered.
<i>Lantana camara</i> , <i>Parthenium hysterophorus</i> , <i>Ailanthus altissima</i> , <i>Eichhornia crassipes</i>	Part A, absolute: invasive, and toxic or allergenic. Technical exclusion under this Guide; and, where GBCP-2023 applies, Section 501.3.3.1.	Aggressive colonizers of scrub, disturbed ground and water bodies. Lantana foliage and berries are toxic; Parthenium causes dermatitis and respiratory allergy, and its appearance on a site is a control failure under cl. 4.3.6. Water hyacinth shall never be introduced to any water body or treatment measure.
<i>Nerium oleander</i> , <i>Thevetia peruviana</i> , <i>Ricinus communis</i> , <i>Calotropis procera</i> , <i>Datura</i> species	Part A, absolute: acutely toxic. Technical exclusion under this Guide.	All parts toxic; seeds of <i>Thevetia</i> are lethal in small quantity. Not to be planted at any facility under this Guide. Where present they are removal candidates: where accessible to children, patients or visitors they are removed without phasing, notwithstanding cl. 10.3.3, and elsewhere on the site they are removed under cl. 10.3.3. The last three are common volunteers on disturbed ground, and their appearance is a maintenance item rather than a planting choice.
<i>Eucalyptus</i> species	Part B, conditional: water demand. Technical restriction under this Guide.	High transpiration rates. Not to be specified for shade, screening or shelter at a school or health facility. Permitted only where the provincial forest department advises it for a stated drainage or waterlogging purpose at that site, the advice is recorded, and the water balance, any shallow aquifer relied on for supply and adjacent agricultural land have been checked, as at cl. 10.2.2.
Any thorny species	Part B, conditional: injury. Technical restriction under this Guide.	Not to be planted adjacent to a play area, accessible route, assembly area or route used by children. Acceptable on a boundary where a barrier function is required and the position is recorded.

10.4 Stock, soil and workmanship

10.4.1 The planting schedule shall specify, for each species, the stock or container size, minimum height or girth, form, age and condition required, the number required and the planting season. Stock shall be inspected on delivery as a hold point and shall be true to name, well-

rooted and not root-bound, undamaged, free of visible pest and disease, and hardened off; substandard stock shall be rejected before planting, because rejection afterwards is not an effective control.

- 10.4.2** The provenance of the stock shall be recorded, and stock raised at a markedly different elevation or climate from the site shall not be accepted without a recorded justification. The nursery shall be identified before tender and its capacity to supply the schedule in the planting season confirmed in writing; where it cannot, the schedule shall be revised or the planting phased.
- 10.4.3** Larger stock is not better stock. Smaller, well-grown stock commonly establishes faster and survives better than large stock planted into a small pit with limited water. The stock size specified shall be justified against the establishment regime and the water available.
- 10.4.4** The soil into which planting is placed shall be tested and shall be ameliorated, replaced or decompacted where the test shows it will not support the planting. Planting into an untreated construction platform is the most common single cause of failure. The rootable soil volume and depth available to each tree shall be stated, and where it is insufficient for the mature canopy assumed in the shade design the volume shall be increased or the canopy reduced.
- 10.4.5** Growing medium imported to site shall be specified by composition, grading, organic content, pH and salinity, shall be from a source complying with cl. 4.3.6, shall be tested before placement and shall not be over-compacted during placement.
- 10.4.6** The specification shall state the planting season, pit dimensions, backfill, mulch type and depth, watering-in, staking and tying, protection and spacing. Planting shall be carried out in the stated season; planting outside it shall not proceed without a recorded acceptance and an extended establishment regime.
- 10.4.7** Every tree and planted area shall be protected from vehicles, footfall, tethered and grazing animals and construction activity, from planting until the end of the establishment period at least. The protection shall be specified and priced for the construction period, not left to the contractor's discretion, and maintained by the maintenance holder from handover.
- 10.4.8** The as-planted record shall state the species, number and location of everything planted and shall be issued at practical completion. The monitoring at chapter 12 is measured against it.

11 Establishment, Operation and Maintenance

This is the chapter that decides whether anything in the preceding ten survives. A measure is not finished when it is built; it is finished when it has established, and it performs only for as long as someone maintains it.

11.1 The establishment period

- 11.1.1** Every measure involving living material shall have a stated establishment period, beginning at planting and ending when the establishment acceptance criterion is met. It shall be stated in the design basis record and the operation and maintenance plan, with its regime assigned to the maintenance holder under cl. 11.1.3 and its cost confirmed under cl. 12.3.
- 11.1.2** The establishment period shall not be shorter than the period required for the measure to survive without intervention at this site. As a minimum it shall extend through one full dry season and one full wet season, and for a slope measure until the stated cover has survived one full wet season. The periods in Table 11.1 are starting points; the period adopted shall be stated for the project against the species, the site and the establishment water available.
- 11.1.3** During the establishment period the maintenance holder of the owning institution shall water, weed, replace failures, maintain protection and repair erosion, to a regime stating volumes, frequencies and responsibilities, not a general obligation to maintain. Failures due to defective stock, planting or protection during construction are replaced by the contractor within the defects liability period under cl. 12.2.2; other failures shall be replaced within the period, with the same species unless the failure indicates the species is unsuited, in which case the selection is reviewed before replacement.
- 11.1.4** Gate G7 shall not be passed, and the establishment period shall not be closed, until the acceptance criterion is met and the replacements have themselves established.

Table 11.1 Indicative establishment periods and their acceptance

Measure	Indicative period	Acceptance at end of establishment
Grass and ground cover	One full wet and dry season cycle	Stated cover achieved and surviving; no bare patch larger than the stated area.
Slope surface treatment	Until stated cover has survived one full wet season	Stated cover; no rilling or gullying on the treated face; drainage functioning.
Live bioengineering structures	Two to three growing seasons	Stated proportion of cuttings sprouted and rooted; structures intact; no movement of trapped material.
Shrub, screen and shelterbelt planting	Two to five years by type	Stated survival and height; continuity of the screen or belt without gaps, including the returns.
Shade and canopy trees	Three to five years	Stated survival, height and stem calliper; protection intact; formative pruning carried out.
Bioretention and swale planting	Two years, including one full wet season	Stated cover; drawdown criterion still met; no erosion at inlet or outlet.

11.2 The maintenance regime and who holds it

11.2.1 A maintenance regime shall be stated for every measure, listing each task, its frequency, its season, the skill and equipment required, and the estimated hours per year. It shall distinguish tasks that preserve function from tasks that preserve appearance, and shall state explicitly that function tasks are carried out first where budget is constrained. The regime shall include every task at Table 11.2 that applies to the measure, at a frequency not less than the frequency stated there, and shall identify those tasks as function-critical.

11.2.2 Inspection shall be a scheduled task with a record, not an expectation that a problem will be noticed. The record shall be held by the maintenance holder and shall feed the reporting at cl. 12.5.1.

Table 11.2 Function-critical maintenance tasks by measure

Measure	Function-critical tasks	Frequency
Swale	Cut to the stated height; remove sediment at the head and inlets; repair scour; reinstate bare patches	Cutting through the growing season; sediment and scour before and after each wet season.
Bioretention area	Remove surface silt and litter; clear the underdrain outfall; verify drawdown; top up mulch; replace failed planting	Litter monthly; silt and drawdown check before each wet season; mulch annually.
Detention basin	Clear the outlet control and its screen; remove forebay sediment; cut floor and sides; check the emergency overflow	Outlet before and during each wet season; forebay at the stated sediment depth.
Permeable surface	Sweep or vacuum; clear joints or pores; remove surface vegetation; verify infiltration	At the stated frequency and always before each wet season; infiltration check annually.
Rainwater system	Clean gutters and leaf filters; reset and clean the first-flush device; clean the tank; check the overflow	Gutters and filters before and during the wet season; tank at the stated frequency.
Slope treatment	Clear cut-off and toe drainage; repair rills; reinstate bare patches; maintain grazing exclusion	Drainage before, during and after each wet season; inspection per cl. 7.3.5.

11.2.3 Each task shall be assigned to a named post: facility staff, a departmental maintenance unit, a term contractor, or a community arrangement. Where a task requires a skill or equipment the assigned holder does not have, the design shall state how it will be obtained and the cost shall appear in the budget line at cl. 12.3.

11.2.4 Where a task is proposed to be carried out by students, patients, volunteers or the community, the arrangement shall be voluntary, shall not displace paid work, shall not fall disproportionately on women or girls, shall be safe and supervised, and shall be recorded. A function-critical task shall not depend on it.

11.2.5 The design team shall train the maintenance holder before handover, covering what each measure does, what each task achieves, what failure looks like and what to report. Delivery of the training is a requirement of gate G6.

11.2.6 The most common cause of loss of a mature measure on a public campus is a maintenance decision taken without knowledge of its purpose: a swale filled to make a level surface, a tree felled for tidiness, a bioretention area paved over. A durable on-site marker stating the measure's function and its inspection points shall be provided, and the operation and maintenance plan shall be held at the facility, not only by the department.

11.3 Failure

11.3.1 The operation and maintenance plan shall state, for each measure, what constitutes failure, the immediate response, and who is to be informed. Where a measure has failed, the cause shall be determined before replacement; a measure replaced without determining why it failed will fail again, and the second failure will be taken as proof that the approach does not work.

11.4 The operation and maintenance plan

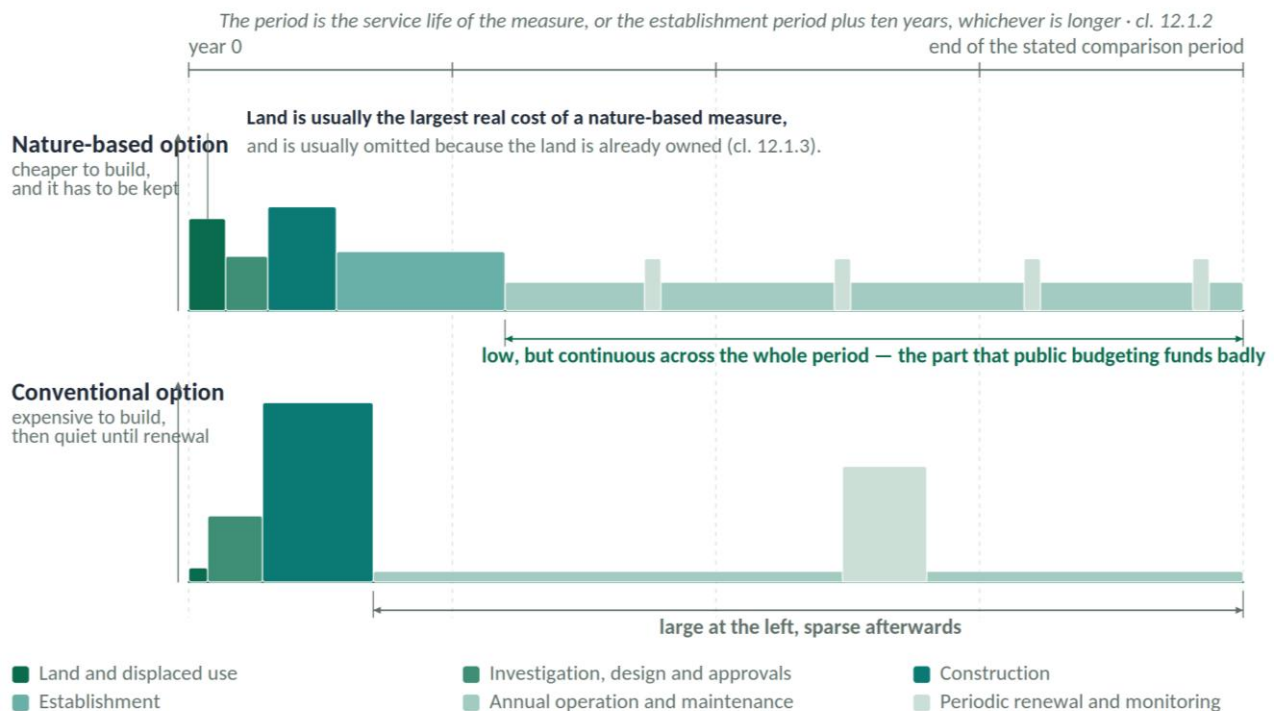
11.4.1 An operation and maintenance plan shall be issued at gate G6, which is practical completion, and held at the facility and by the owning department. It shall contain: each measure and what it does in plain language, and what happens if it stops; a site plan locating every measure, inlet, outlet, overflow, underdrain outfall, access route and inspection point; the task schedule with frequencies, skills, hours and named posts; identification of the function-critical tasks; the inspection regime with photographs of acceptable and unacceptable condition; the failure and escalation route; an explicit list of the actions that would destroy each measure; the records to be kept and where they are sent; the annual maintenance cost and its budget line; and the contacts.

12 Cost, Procurement and Monitoring

Nature-based measures are usually cheaper to build and more expensive to keep. Long-term operation and maintenance financing is a key factor in whether a measure survives, so it shall be confirmed before implementation, not after handover.

12.1 Cost and the whole-life comparison

- 12.1.1** The cost of a measure shall be stated under all of the following headings: land, as the value or opportunity cost of the area taken and any provision replacing the displaced use; investigation, design and approvals, including ground investigation, infiltration testing and habitat survey; construction; establishment for the full establishment period, including watering and tanker delivery, weeding, replacement of failures and maintenance of protection; annual operation and maintenance by task; and periodic renewal and monitoring with their intervals.
- 12.1.2** The nature-based, conventional and hybrid options shall be compared over a stated period on a whole-life basis, using those headings and a stated discount approach, or undiscounted where the owning department requires it. The period shall be the service life of the measure or a period not shorter than the establishment period plus ten years, whichever is longer. The comparison made under this clause addresses IUCN criterion 4. Figure 12.1 illustrates where the money goes over the life of a measure and is illustrative, not normative.
- 12.1.3** The comparison shall state the land cost explicitly. Land is usually the largest real cost of a nature-based measure and is usually omitted because the land is already owned.
- 12.1.4** Where the options differ in the function delivered, the comparison shall say so and not present them as equivalent; where the nature-based option delivers less, the residual is stated and carried into the decision.



Height is spend in the period. No values are shown: the project states the period, the discount approach and the amount under each heading, and says so where the options differ in function (cl. 12.1.1–12.1.4).

Figure 12.1 Where the money goes over the life of a measure

12.2 Procuring living work

12.2.1 Plant material and planting shall be measured items in the bill of quantities, each with its own rate and quantity. Planting shall not be priced as a lump sum for landscaping. Establishment and maintenance are not contractor items unless the owning institution procures them under cl. 12.2.2.

12.2.2 The contractor's obligation for living work is the supply, planting and protection of the stock during construction. Within the defects liability period, which for living work shall include at least one full wet season and one full dry season after planting, the contractor shall replace any plant that fails through defective stock, planting or protection during construction. The planting item shall be paid in instalments: a stated part on acceptance of the as-planted record, and the balance against survival checks at the end of the wet season and at the end of the defects liability period. The obligation is secured by those instalments and the normal retention, and no separate multi-year bond is required. The establishment regime of watering, weeding, protection and replacement of other failures is the responsibility of the owning institution from handover. Where the institution procures it from others, through a landscape maintenance contract, a term contractor or a survival and replacement warranty, the arrangement shall be subject to the applicable PPRA or provincial procurement rules and PEC contract conditions. The institution's arrangement shall cover the full establishment period at Table 11.1 without a gap and shall be confirmed at gate G4.

12.2.3 The specification shall state the division of responsibility at handover: the contractor is responsible for failures due to defective stock, planting or protection during construction

within the defects liability period; the owning institution is responsible for watering, weeding and protection from handover, and for failures due to drought, lack of watering, vandalism, grazing or a water supply failure after handover.

- 12.2.4** The tender documents shall include the species schedule with stock specification, the planting season, the protection requirement during construction, the survival checks for the instalment payments at cl. 12.2.2 and the acceptance criteria. The establishment regime is issued to the owning institution with the operation and maintenance plan.

12.3 Budget lines that must exist

- 12.3.1** Before construction begins, the owning department shall confirm in writing that the following exist, each with an amount and a source: the establishment cost for the full establishment period; the annual operation and maintenance cost; the periodic renewal cost at the stated intervals; and the monitoring cost. The annual cost shall be expressed in a form that can enter a recurrent budget: an annual figure per facility, attributable to a named cost centre and a named post.
- 12.3.2** Where the annual operation and maintenance cost cannot be secured as a recurrent budget line, the measure fails the capacity test at cl. 2.1.4. It shall then be redesigned to a measure the institution can sustain, replaced by a conventional option, or supported by a written and funded maintenance agreement with a third party running for at least the design life of the measure and naming the post responsible on each side. A measure shall not be adopted on an expectation of future funding, on a one-off allocation, or on unpaid labour by staff or pupils. Where a measure is nevertheless to proceed without one of those three, the decision is a departure from this Guide and is available only as the exceptional route recorded in the evidence column of the maintenance-capacity row of Table 2.1: it shall be made in writing by the head of the owning department, shall state the consequence that follows when the maintenance is not carried out, shall be recorded under cl. 14.2.5, and shall be reported at the first monitoring round under chapter 12.

12.4 What is monitored

- 12.4.1** Every measure shall be monitored against its performance statement and against the baseline at cl. 3.5. The monitoring plan shall state, for each indicator, what is measured, the method, the location, the frequency, who measures it, where the record goes, and the value or condition that triggers action; the trigger shall be set at the point where intervention is still effective, and an indicator with no trigger is a record, not a control. The indicators at Table 12.1 shall be monitored as a minimum for each measure group present, by the method and at the frequency stated there, together with any further indicator required to test the performance statement.
- 12.4.2** Monitoring shall be proportionate. The extent, frequency and cost of monitoring shall be set against the scale of the measure, the consequence of its failure, and the capacity of the maintenance holder to carry it out, and the basis on which they were set shall be stated in the

monitoring plan. Where the maintenance holder cannot carry out the programme at the stated frequency, either the resource to carry it shall be provided and funded under cl. 12.3.1 or the programme shall be reduced to what can be carried out, but it shall not be reduced below the minimum indicators at Table 12.1.

12.4.3 Photographs used for monitoring shall be taken from fixed positions marked on the site plan, in the same direction, at a comparable time of year, and dated.

Table 12.1 Minimum performance indicators

Measure group	Indicator	Method	Frequency
All planting	Survival against the as-planted record; cover as a percentage of the treated area	Count against the as-planted record; stated cover method repeated identically	Annually to end of establishment, then at the stated interval
All measures	Condition against the inspection criteria in the O&M plan	Inspection record with photographs from fixed, marked positions	At the O&M plan inspection frequency
Stormwater and infiltration	Drawdown time from full; surface or media infiltration rate	Observation after rainfall or a controlled fill test; the test method used at design	Annually before the wet season
Conveyance and detention	Scour, sediment accumulation, blockage, time to empty	Inspection with measurement of sediment depth; observation after an event	Before and after each wet season
Slope measures	New rilling, gully, cracking, seepage or movement	Inspection per cl. 7.3.5 with photographs from fixed positions	After every significant event during establishment, then as stated
Shade, shelter and water measures	Height, canopy spread, shaded area at the stated hour, belt continuity; volume harvested, reused or applied	Measurement; shadow observation or model at the stated year; meter, tanker and irrigation records	Annually to end of establishment, then at the year stated; water volumes monthly, reported annually

12.5 Reporting, action and residual risk

12.5.1 A monitoring report shall be produced at the end of the establishment period and thereafter at the stated interval, and sent to the owning department and to the authority where it has set a condition requiring it.

12.5.2 An indicator that reaches its trigger shall result in a stated action within a stated period, and the action, its owner and its period shall be in the monitoring plan before the trigger is ever reached.

12.5.3 The following shall be reported immediately, outside the normal cycle: tension cracks, seepage, bulging or movement on a slope; failure of an overflow or exceedance route; water standing longer than the period at cl. 4.3.3; a safeguarding hazard; and a failure that has caused or could cause water to enter a building. An immediate report shall go to the owning

department and, where it concerns slope movement, flood risk or structural interaction, shall be referred for competent assessment under CRDG cl. 1.2.2.

- 12.5.4** Where monitoring shows that a measure does not meet its performance statement and cannot be brought to meet it by maintenance, the measure shall be re-screened under chapter 2 rather than maintained indefinitely in a failed condition. Where it performs better than stated, the design basis record may be updated and the result reported under cl. 13.5. These provisions address IUCN criterion 7.
- 12.5.5** The residual risk remaining after the measures are in place shall be stated in the design basis record and accepted by a named person in the owning institution, covering the exceedance case, the establishment period before the function is delivered, and the case in which the measure is not maintained.

13 Retrofit, a Worked Application, and the Authority

Most public schools and health facilities in Pakistan already exist, are occupied, have limited spare land, and have a drainage problem that has already been addressed in some form. Retrofit is the normal case, and this chapter gives the approving authority a clear basis on which to assess and decide a retrofit proposal.

13.1 Retrofit of an existing facility

13.1.1 On an existing campus, measures shall be considered in the order at Table 13.1. Removing a cause is better than treating a symptom, and both are better than adding a measure that needs maintenance the institution cannot supply.

Table 13.1 Retrofit hierarchy

Order	Step	What it means
1	Repair what exists	Clear the blocked drain, reinstate the fallen gutter, repair the broken downpipe, unblock the outfall. A large part of the observed flooding on public campuses is a maintenance backlog, not a design deficiency.
2	Remove the cause	Reduce the impervious area generating the runoff; regrade the local low spot; redirect the roof discharge away from the wall it is undermining.
3	Intercept at source	Take roof and small paved areas into a small measure adjacent to them, needing little land and buildable in a school holiday.
4	Cover bare ground	The cheapest dust, erosion and heat measure available, and the one with the lowest maintenance burden.
5	Add shade	High value per rupee in the plains, but it needs land, water and time, and is planned as infrastructure under chapter 8.
6	Add conveyance, storage or treatment	These need land and regrading and are most likely to conflict with existing use. A treatment measure shall pass cl. 9.3.4 before it is considered.

13.1.2 Before any measure is added, the existing drainage shall be surveyed and its condition recorded, including any measure previously installed and its current state. A previous failed attempt is evidence about this site and shall be investigated under cl. 11.3.1 rather than ignored.

13.1.3 The works shall be programmed so that the facility continues to function, with the areas unavailable and their dates agreed with the facility head, and are subject to the safeguarding requirements at cl. 4.3.1. The planting season and the facility calendar shall be reconciled before the programme is fixed. Where the works leave ground bare across a wet season, temporary erosion and sediment control shall be provided.

13.1.4 A retrofit measure shall not change the moisture regime, the loading or the drainage adjacent to an existing structure without an assessment of the effect on that structure, based on the assessed condition under the CD-CRI Structural Health Assessment Manual. Where the foundation type, depth or condition is unknown, infiltration shall not be proposed within its zone of influence.

13.1.5 Where a facility is used, or designated for use, as an emergency shelter under CRDG chapter 12, no retrofit measure shall obstruct the access, assembly, egress or service provisions on which that designation depends. A retrofit shall produce the same records as a new-build measure, proportionate to its scale but with none omitted, and shall additionally state the condition of the existing drainage before the works, the maintenance backlog cleared, and the cause determined for any previous failed measure.

13.2 A worked application

A government girls' high school occupies about 1.2 hectares in a plains district, with about 1,450 square meters of roof and 3,200 square meters of paved courtyard and access. The site falls to the north-west corner, where water stands for four to six days after monsoon rain, making the toilet block unreachable and one classroom unusable. A municipal drain on the north boundary surcharges during the monsoon; groundwater is at about six meters and brackish; the soil is a silty clay loam. The facility asked for a detention pond in that corner. The case is a composite, assembled from conditions common to government schools in the plains districts; the figures are illustrative and are not design values for any real site. It is worked here to show the order in which the questions are asked and the point at which each record is made. Where a pilot facility is adopted under the program, the same sequence shall be re-run against that facility's own survey, levels, infiltration results, rainfall record and maintenance budget position, and the notional figures discarded.

13.2.1 Chapter 2 required the problem to be stated before the solution. The problem was standing water disabling a toilet block and a classroom, so the function required was to remove standing water within a stated period, not to store water in that corner. Two exclusions at Table 2.1 were engaged: slow-draining open water at a school beside a toilet block used by children, and a maintenance capacity test the school could not pass, having no desilting budget and no equipment. The pond was recorded as rejected, with the reason, and the problem recorded as still live, so that the request is not made again next year without new evidence.

13.2.2 The catchment was then delineated from a levels survey rather than the site plan. It showed that the corner receives runoff from both roofs, the whole courtyard, part of the playground, and a strip of the adjacent street draining in through a gap in the boundary wall that nobody had noticed. Closing the gap and reinstating the kerb line, agreed with the local council under cl. 1.1.4, cost very little and removed a large part of the problem before any nature-based measure was designed.

13.2.3 Because the municipal drain surcharges, the design assumed the outfall unavailable at the monsoon peak and traced where the water then goes. Finished levels were set so the surplus passes along the northern boundary and out at a low point away from the buildings, with the toilet block threshold above the resulting level. That is the provision which keeps the classroom usable, and the one cl. 5.5.2 forbids value engineering from removing. The water balance, prepared before the planting schedule was fixed, showed that establishment demand could not be met from the piped supply without reducing water for drinking and sanitation, which

cl. 9.4.4 forbids; tanker delivery was priced and found affordable for a reduced number of trees, so the planting was reduced and phased to the number it supports. At tender, deleting the underdrain and shortening the establishment period were both refused, the first because the measured rate cannot achieve the drawdown and the second because it transferred the risk of total planting loss to the school with no party accepting it; reducing the stock size was accepted as a recorded deviation, and the remaining saving was found by reducing the paved area further.

13.2.4 The screening record for the case, at the fields of Table 2.2, read as follows. Measure and location: detention pond proposed by the facility at the north-west corner, adjacent to the toilet block. Problem addressed: water standing four to six days after monsoon rain, evidenced by the levels survey, the flood marks recorded with dates and the facility account under cl. 3.1.2. Function and quantity: removal of standing water from the corner within the drawdown period stated for the project, not storage of water in it. Exclusions tested: all eight conditions at Table 2.1 were tested; two were engaged, being slow-draining open water at a school beside a toilet block used by children, and failure of the maintenance capacity test at cl. 2.1.4 for want of a desilting budget and equipment. Options compared, and maintenance capacity: pond, conventional piped connection to the municipal drain, and the hybrid finally adopted of boundary repair, regrading, roof discharge redirection and a small bioretention area with an underdrain; the school could maintain the last of these and could not maintain the first. Trade-offs: land taken from the playground edge, a continuing cutting and silt-clearing burden on the caretaker post, and two growing seasons before the planting performs. Decision and decided by: pond rejected with the reason recorded, hybrid adopted with modification, signed by the design lead and the head of the owning department, with the problem recorded as still live.

13.2.5 The design basis record for the adopted measure, at the fields of Table 5.3, carried: the measure and its unique reference with its location on the site plan; the stated problem, the function and the quantified performance statement with its design event and units under cl. 5.3.1; the design inputs, being the rainfall and climate allowance from CRDG chapter 3 with source, station, record period and horizon, the catchment area from the levels survey, the measured infiltration rate with its factor of safety, and the seasonal high groundwater level at about six metres; the sizing basis with the method, the calculation, the assumptions and the standard relied upon with its edition; the land take in square metres with the displaced use and the written agreement of the facility under cl. 1.6.2; the establishment period with its regime and completion criterion, and the maintenance tasks, frequencies and named holder; the exceedance statement required by cl. 5.4, being the route along the northern boundary to the low point with the toilet block threshold above the resulting level, shown on plan and section; the acceptance criteria at practical completion and at end of establishment with the party verifying each; and the trade-off record with the one departure accepted at tender.

13.2.6 The water balance, at the entries of Table 9.1, showed: facility demand for drinking, sanitation and cleaning by month with its basis, taken from the facility records and meter readings;

establishment demand in litres per plant per application, applications per week by month and number of plants, for each year of the establishment period; operational demand after establishment by measure and the year at which it falls to its long-term value; supply from the piped scheme with its hours and seasonal restriction, the brackish groundwater being unsuitable for establishment; supply from rainwater with the roof catchment area, monthly rainfall on the CRDG chapter 3 basis, runoff coefficient, storage volume and monthly yield; and the dry-year case, which put the months before the monsoon in deficit. The response to that deficit was the one recorded at cl. 13.2.3: tanker delivery priced for a reduced number of trees, and the planting reduced and phased to the number the confirmed source supports.

13.3 Setting up the jurisdiction and what to require

13.3.1 An authority adopting this Guide shall state which provisions it adopts as requirements, which it treats as guidance, and the date from which the adoption takes effect. It shall state the design and exceedance events it requires; the permitted discharge rate to each receiving system; any local separation distance, unsaturated thickness, factor of safety or drawdown period; any conditions additional to Table 2.1 for open water at a facility used by children, an authority being able to add to that rule but not to relax it; any locally prohibited or required species; the minimum establishment period by measure type; whether a confirmed recurrent budget line is a condition of approval; and the monitoring reports required.

13.3.2 An authority should require the submission at Table 13.2 and should not accept a landscape drawing in place of it. Almost every failure this Guide addresses can be detected at submission by asking for these items.

Table 13.2 Submission requirements

Item	What it demonstrates	Source
Screening record	That the measure answers a stated problem and the exclusions were tested	cl. 2.5.2 and Table 2.2
Levels survey, catchment delineation, and the baseline record	That the design is based on the site rather than on assumption	cl. 3.5.1 and cl. 3.5.2
Infiltration results with method, location, date and factor of safety; groundwater level and range	That any infiltration claim is measured, not classified, and the unsaturated thickness is real	cl. 3.3.1, cl. 3.3.2 and cl. 3.3.3
Design basis record with performance statement, and the exceedance statement with finished levels on section	That the measure is a designed system, the claim is testable, and the authority knows where the water goes when the measure is full	Table 5.3, cl. 5.3.1, cl. 5.4
Species schedule with hazard screening	That nothing prohibited, toxic, allergenic or invasive is proposed	cl. 10.1.4 and cl. 10.3.1
Water balance including the dry-year case, and the establishment water source confirmed	That the planting can be established and kept alive	cl. 9.1.1, cl. 9.4.3

Item	What it demonstrates	Source
O&M plan, named maintenance holder, confirmed budget lines, whole-life comparison and monitoring plan	That the measure will still exist in five years, was chosen on evidence, and its performance will be known	cl. 11.4.1, cl. 12.3.1, cl. 12.1.2, cl. 12.4.1

13.3.3 The authority should apply the tests at Table 13.3 before deciding. They are ordered so that the tests that most often fail come first.

Table 13.3 Decision tests, in the order they should be applied

No.	Test	Refuse or return if
1	Is a life-safety or structural duty being assigned to the measure?	Any code-derived requirement has been reduced, deferred or substituted on account of it. Refuse under cl. 2.3.2.
2	Is the exceedance route stated, and does it avoid buildings and egress?	No route is shown, or it passes through a building, an emergency route or a neighbour without acceptance.
3	Is any infiltration claim measured, and the drawdown within the permitted period?	The rate is taken from a classification or a test elsewhere; or no drawdown is stated, or it exceeds the permitted period.
4	Is there open water or a safeguarding hazard at a facility used by children?	Permanent open water is proposed at a school or paediatric facility without the written safeguarding and vector-control agreement of the provincial health department and the owning department required by Table 2.1.
5	Is the establishment water source named and quantified?	No source is named, or it is the supply serving drinking and sanitation.
6	Is a maintenance holder named and a recurrent budget line confirmed?	Neither is provided. Return; this is the single strongest predictor of failure.
7	Is any species prohibited, toxic, allergenic or invasive for this user group?	Any species in Part A of Table 10.2 appears in the schedule; a species in Part B appears without the stated condition satisfied and recorded; or any species fails the screen at cl. 4.3.4.
8	Are the approvals held or in train, and is the performance statement testable?	An environmental determination, discharge consent or tree permission is missing; or the claim could not be confirmed or refuted after construction.

13.4 Decision language and what follows approval

13.4.1 A decision should be written so that the applicant knows exactly what is required. An approval should name the design basis record it is granted on, state which performance statements are conditions of it, and state that the exceedance route on the named drawing shall not be altered without a further approval. An approval with conditions should list each condition with its responsible party and the evidence that discharges it, and state that no condition is discharged by correspondence alone.

13.4.2 The authority should receive the establishment acceptance at gate G7 and the monitoring reports at the stated interval, and should hold a register of which facilities carry which measures. It should be notified of any proposal to remove, fill, pave over or substantially alter

an approved measure and should treat that as requiring a fresh decision. This is the point at which most approved measures are lost. It should also record, across its jurisdiction, which measures performed and which failed and why, which local species performed, and whether confirmed budget lines were actually spent; an authority that sees twenty campuses knows more about what works locally than any single designer.

13.5 Replication and institutionalization

- 13.5.1** Where a measure is to be replicated, the originating project shall issue a replication package: the problem it solves and the conditions under which it does not apply; the screening criteria as they applied; the site evidence required with the test methods used; the design method with its inputs and reference; typical details marked as requiring project-specific verification; the locally verified species palette, stock specification and nursery; the establishment regime that worked; actual outturn costs; the O&M plan; the monitoring results; and what went wrong, with causes.
- 13.5.2** A replicated measure shall be re-screened for each new site. The levels survey and catchment delineation, the infiltration rate, the groundwater level, the foundation and service positions, the establishment water source, and the maintenance holder and budget line shall always be established afresh and never carried over. A locally verified species palette should be built by recording which species survived, at what rate and under what regime; within a few projects that will be better evidence than any published list, including Table 10.1.
- 13.5.3** An institution's capability should be assessed before the measures are chosen. Where there is no established practice and no recurrent maintenance budget, the measures appropriate are ground cover, roof discharge redirection, repair of existing drainage, and tree planting only where a funded establishment arrangement exists. Swales, small bioretention, shade planting and rainwater storage suit an institution with a maintenance budget and some experience.
- 13.5.4** An institution adopting this Guide should, in this order: create a recurrent maintenance budget line; assign the maintenance duty to a named post in each facility and in the department; adopt a submission requirement based on Table 13.2; train design and supervision staff using cl. 1.4.3; train facility-level maintenance holders; establish a register of measures by facility; collect outturn cost data; build a locally verified species palette; adopt local design values; and review failures across the jurisdiction annually. The first two determine whether anything else survives. An institution that carries those steps into the instruments at cl. 13.5.5 addresses IUCN criterion 8.
- 13.5.5** Replication is most durable where the requirement enters an instrument the institution already uses: the standard design and specification for school or health facility construction; the standard bill of quantities, through measured items for plant material and planting; the scheme approval documentation, through separate establishment and recurrent maintenance lines; the development approval procedure, through Table 13.2; the facility maintenance manual and the post descriptions within it; the departmental training curriculum; and the monitoring and evaluation framework.

14 Records, Standards, Glossary and References

This chapter holds the evidence checklist, the edition control and deviation record, the terms as this Guide uses them, and the sources it relies on.

14.1 Clause-to-evidence matrix

14.1.1 Each row of Table 14.1 shall be capable of being answered on a project that has adopted a nature-based measure. Where a row does not apply, the file shall say so and state why.

Table 14.1 Clause-to-evidence matrix

Clause	Evidence that discharges it	Produced by	Gate	Held in
1.5, 1.6	Environmental determination; discharge consent; tree permission and replacement; land and maintenance access secured; land take agreed with the facility; named maintenance post confirmed in writing	Environmental focal point, owning department	G1 to G4	Applicability record, O&M plan
2.1, 2.3.1, 2.4, 2.5	Stated problem with evidence; maintenance capacity test; each exclusion tested with result and basis; trade-off record; confirmation that no code-derived requirement was reduced	Design lead	G1, G2	Screening record, design basis record
3.1 to 3.4	Site evidence with gaps and assumptions; catchment delineation with areas; infiltration results with method, invert, date and factor of safety; seasonal high groundwater; tree survey and habitat baseline	Design geotechnical lead, and ecological specialists	G2	Baseline record
4.2, 4.3	Participation record including matters not adopted; inclusion checks; safeguarding assessment; species hazard screening	Design lead, facility head	G2, G3	Design basis record
5.1 to 5.5	Gate records G1 to G7 signed and dated; design basis record with no blank field; performance statement with quantity, unit and design event; acceptance criteria; exceedance route on plan and section; assessment of every value engineering proposal	Design lead, named acceptor at each gate	All	Design basis record, drawings, deviation record
6.1.3, 6.2.8, 7.1.2, 8.1.3	Design and exceedance events with rainfall source and climate allowance; separation distances; geotechnical position before the bioengineering design; shaded area with the shadow study	Design geotechnical lead, specialist	G2, G3	Design basis record, drawings
9.1.1, 9.4.3, 10.1.5, 10.4	Water balance for an average and a dry year; establishment water source confirmed; species selection confirmed with forest department and nursery; stock inspection and rejection record; as-planted record	Design landscape specialist, supervision, contractor	G2 to G6	Design basis record, species schedule, O&M plan

Clause	Evidence that discharges it	Produced by	Gate	Held in
11.1.1, 11.2.3, 11.2.5, 11.4.1	Establishment period stated, assigned to the maintenance holder and funded; every task assigned to a named post; training delivered with attendance record; O&M plan issued and held at the facility	Design lead, owning department, design team	G3, G4, G6	Design basis record, O&M plan
12.1.2, 12.3.1, 12.4.1, 12.5.5	Whole-life comparison; written confirmation of establishment, maintenance, renewal and monitoring budget lines; monitoring plan with indicators and triggers; residual risk statement with a named acceptance	Design lead, owning department	G3, G4, G6	Project file, design basis record
14.2.5	Deviation record for every departure from this Guide	Design lead	All	Project file

14.1.2 A record shall be tested before it is accepted: who produced it and are they competent; when, and is it still current; by what method; where exactly it applies; whether an assumption is stated where evidence was unobtainable; whether it states a quantity and a unit; whether it can be tested after construction; and whether the next person can find it in the file.

14.2 Standards, edition control and deviations

14.2.1 Every standard, code, regulation or guidance document relied upon shall be cited with its edition or year and with its status: law; adopted code; reference code not adopted; standard; guidance; or program document. A citation without an edition shall not be accepted at gate G2. Where a document is superseded between design and construction, the project shall record which edition governs and why.

14.2.2 Where a numeric value is taken from a referenced document, the clause or table of that document shall be cited and the value checked against the document rather than a secondary source. A value carried forward from another project without that check shall not be used.

14.2.3 Each project shall hold an edition-control record listing every document relied upon, its edition, its status and the clauses of the design that depend on it, completed for the project and not carried over from another.

14.2.4 Where the application of this Guide, a code or a standard is unclear, a technical clarification shall be raised before the design proceeds on an assumption, stating the question, the clause, the interpretation proposed and the reasoning. It shall be answered by the party with authority over the question, and held in a register issued with the design.

14.2.5 A departure from a "shall" requirement is a deviation. It shall be recorded before it is acted upon, stating the clause departed from, the reason, the alternative adopted, the effect on the performance statement and on the residual risk, and the name and post of the person accepting it.

14.2.6 This Guide states what shall be established, recorded and verified. It does not fix numeric design values belonging to the site, the authority or the adopted code. Those at Table 14.2

shall be established for each project and recorded in the design basis record. Where an authority has stated a value under cl. 13.3.1, that value governs.

Table 14.2 Values established by the project, not by this Guide

Value	Established from
Design event and exceedance event	The authority under cl. 13.3.1; otherwise the project under cl. 6.1.3, subject to the minimum default stated in that clause; and, where GBCP-2023 or RWH-BCP-2023 applies, its retention and discharge criteria in addition (cl. 6.1.3).
Rainfall depths and intensities, and the climate allowance	CRDG chapter 3, with source, station, record period and horizon.
Design infiltration rate, factor of safety, unsaturated thickness, and separation distances	In-situ testing under cl. 3.3; ground conditions and structure type under cl. 6.2.8; and any authority requirement.
Maximum drawdown period, ponding depth and side slopes	cl. 4.3.3 sets an upper limit of 72 hours; the safeguarding assessment and the authority may require less.
Swale velocity limit, gradient range and freeboard	The hydraulic design under cl. 6.2, with roughness and maintained grass height stated.
Cover and survival percentages, the establishment period, the shelterbelt protected distance, and the whole-life comparison period	The measure, species and site under cl. 7.2.3 and cl. 11.1; cl. 8.3.4 with its source; and cl. 12.1.2 with the owning department requirement.

14.3 Glossary

Table 14.3 Terms as used in this Guide

Term	Meaning
Acceptance criterion	The observable or measurable condition to be demonstrated before a stage is accepted, stated separately for practical completion and for the end of establishment.
Baseline record	The compiled site evidence obtained under chapter 3, against which monitoring is compared.
Bioengineering	The use of living plant material, alone or with structures, to control surface erosion and shallow soil movement. It does not address deep-seated instability.
Bioretention	A measure in which runoff is filtered through a specified growing medium, usually with an underdrain.
Design basis record	The single record of the basis on which a measure is designed, required by cl. 5.2.1.
Deviation	A departure from a "shall" requirement of this Guide, recorded and accepted under cl. 14.2.5.
Drawdown	The time taken for a measure to empty from a filled condition. Limited under cl. 4.3.3.
Establishment period	The period from planting until the establishment acceptance criterion is met, during which the measure is watered, weeded, replaced and protected.
Exceedance route	The path taken by water when the design event is exceeded, or the measure is blocked or absent. Required by cl. 5.4.1.

Term	Meaning
Failure behaviour	How a measure ceases to perform: gradual or sudden, visible or hidden, recoverable or not, and what the facility experiences while it is failed.
Function-first screen	The requirement at cl. 2.1.1 that a measure be adopted only in answer to a stated site problem, with a quantified function.
Hybrid measure	An arrangement in which a conventional element carries any life-safety or code-governed case in full and a nature-based element provides a margin and co-benefits, with verified capacity creditable only in a serviceability or frequent-event case under cl. 2.3.3 and cl. 2.3.4.
Infiltration	The passage of water into the ground. Adopted only where measured under cl. 3.3.1 and the exclusions at Table 2.1 are cleared.
Invasive species	A species that spreads beyond where it is planted and displaces other vegetation or damages infrastructure. Not to be planted under cl. 10.3.1.
Maintenance holder	The named post, in a named institution, responsible for maintaining a measure. Assigned under cl. 1.6.3.
Nature-based measure	A designed measure using natural processes or living material to perform a stated function on a facility site, with a stated design event, establishment period, maintenance regime, exceedance route and failure behaviour.
Performance statement	The quantified statement of what a measure achieves, required by cl. 5.3.1.
Residual risk	The risk remaining after the measures are in place, stated and accepted by name under cl. 12.5.5.
Shelterbelt	A porous planted barrier designed to reduce ground-level wind speed and intercept dust over a stated area, under cl. 8.3.4.
Swale	A shallow vegetated channel conveying runoff at low velocity, designed as a hydraulic element under cl. 6.2.1.
Unsaturated thickness	The vertical separation maintained between the invert of an infiltration measure and the seasonal high groundwater level, under cl. 3.3.3.

14.4 References

14.4.1 Each entry carries its status under cl. 14.2.1. The status shown is the status for the purposes of this Guide; whether a code or standard applies to a particular facility is determined by the adopting authority. Editions and notification references shall be verified against the source document before a project relies on them.

Pakistan Environmental Protection Act 1997, with the Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations 2000, applying in Islamabad Capital Territory and where not displaced; Punjab Environmental Protection Act 1997 as adapted and amended, with the Punjab Environmental Protection (Review of IEE and EIA) Regulations 2022, Schedule I amended by Notification No. 348/PA/DG/EPA/2025 of 30 September 2025; Sindh Environmental Protection Act 2014, with the Sindh Environmental Protection Agency (Review of IEE and EIA) Regulations 2014; Khyber Pakhtunkhwa Environmental Protection Act 2014 as amended, with the Khyber Pakhtunkhwa Environmental Assessment Rules 2021; Balochistan Environmental Protection Act 2012, with the Balochistan Environmental Protection Agency (Review of IEE and EIA) Regulations 2020; Azad Jammu and Kashmir Environmental Protection Act 2000; Gilgit-Baltistan Environmental Protection Act 2014, with the Gilgit-Baltistan IEE and EIA Regulations 2024; and the applicable national or provincial environmental quality

standards. Status: law. The governing instruments under cl. 1.5.2 and Table 1.3, the screening route at cl. 1.5.4 and the discharge quality requirement at cl. 1.5.5.

Pakistan Forest Act 1927 as applied and amended in Punjab and in Sindh and as applicable in Islamabad Capital Territory; Khyber Pakhtunkhwa Forest Ordinance 2002; Balochistan Forest Act 2022; Gilgit-Baltistan Forest Act 2019 as amended; Jammu and Kashmir Forest Regulation 1930 as amended in Azad Jammu and Kashmir by Act XXI of 2017; Canal and Drainage Act 1873 and the provincial irrigation statutes; provincial local government law and the municipal, development authority and cantonment by-laws; National Disaster Management Act 2010; Pakistan Climate Change Act 2017. Status: law. Tree permissions and notified tree-cutting restrictions, discharge to a canal or notified drain, works and planting in public space, and the national disaster risk reduction and climate governance mandates.

Pakistan Engineering Council, *Building Code of Pakistan 2021*; *Green Building Code of Pakistan 2023*, released by the Pakistan Engineering Council on 24 May 2023 and developed from the 2021 International Green Construction Code; and *Rainwater Harvesting Provisions for Building Code of Pakistan 2023*. GBCP-2023 was approved by the Federal Cabinet on 28 July 2025 and given effect through amendments to the Conduct and Practice of Consulting Engineers Bye-Laws 1986 and the Construction and Operation of Engineering Works Bye-Laws 1987 under section 25(1) of the Pakistan Engineering Council Act 1976, notified by S.R.O. 1531(I)/2025 and S.R.O. 1532(I)/2025 dated 11 August 2025; RWH-BCP-2023 was approved with it through the same bye-law amendments. Status: adopted codes where they apply to the facility; applicability is determined by the Authority Having Jurisdiction under cl. 1.4.2. BCP-2021 governs structural, foundation and life-safety requirements with which no measure here may conflict, under cl. 1.2.1 and cl. 2.3.2, and is cited at whole-document level only. GBCP-2023 governs site, landscape, stormwater and water-efficiency compliance claims under cl. 1.4.2, cl. 6.1.3, cl. 9.4.1, cl. 9.4.2 and cl. 10.1.2, and its invasive plant provision at Section 501.3.3.1 is referred to at Table 10.2. The notified wording of Section 101.3 and Section 101.3.1 is quoted at cl. 1.4.2, where the reading given is the consultant's interpretation, subject to the determination of the Authority Having Jurisdiction. RWH-BCP-2023 governs over chapter 9 where it applies, under cl. 1.4.2 and cl. 9.2.1.

International Union for Conservation of Nature, *Global Standard for Nature-based Solutions*, 1st edition, Gland: IUCN, 2020, with its companion *Guidance for using the IUCN Global Standard for Nature-based Solutions*. Status: guidance. The organizing framework at cl. 1.3.1 and the indicator-level companion used when assessing a measure against the eight criteria at Table 1.1. The same edition is cited in the CD-CRI Climate-Resilient Design Guidelines. International Union for Conservation of Nature, *IUCN Global Standard for Nature-based Solutions*, Second Edition, Gland: IUCN, 2025. Status: guidance, noted and not adopted in this version; see cl. 1.3.1.

World Bank and GFDRR, *Implementing Nature-Based Flood Protection: Principles and Implementation Guidance*, 2017; World Health Organization, *Guidance for Climate-Resilient and Environmentally Sustainable Health Care Facilities*, 2020, and *Guidelines for the Safe Use of Wastewater, Excreta and Greywater*, 2006; GADRRRES, *Comprehensive School Safety Framework 2022-2030*, 2022. Status: guidance. Nature-based measures as engineered systems at chapters 5 and 6; health facilities at chapter 8; greywater reuse at cl. 9.3.1; school sites and safeguarding at chapter 4.

CIRIA, *The SuDS Manual*, C753, London: CIRIA, 2015, version 6 incorporating the amendments issued to 2019; Building Research Establishment, *Digest 365: Soakaway Design*, revised 2016; ASTM International, *ASTM D3385-18, Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer*. Status: guidance and standard. Method references for chapter 6 and for the in-situ infiltration testing at cl. 3.3.1. Applied for method only; design events, rainfall and permitted discharge rates are established under cl. 6.1.3, not taken from these sources, and the test method used shall be stated with the results.

Howell, J., *Roadside Bio-engineering: Site Handbook and Reference Manual*, Kathmandu: Department of Roads, Government of Nepal, 1999; Gray, D. H. and Sotir, R. B., *Biotechnical and Soil Bioengineering Slope Stabilization*, New York: Wiley, 1996; Food and Agriculture Organization, *Watershed Management Field Manual: Slope Treatment Measures and Practices*, FAO Conservation Guide 13/3, Rome: FAO, 1988; The Vetiver Network International, *Vetiver System Applications: Technical Reference Manual*, current edition. Status: guidance. Method references for chapter 7, the first developed in comparable Himalayan and sub-Himalayan conditions, all applied within the boundary set by cl. 7.1.1; only sterile *Chrysopogon zizanioides* cultivars shall be used.

Dr. Qaisar Ali Associates for KnK Japan, CD-CRI programme, 2026: *Climate-Resilient Design Guidelines; Green Building Implementation Guide; Structural Health Assessment Manual; Engineer's Field Handbook; Construction Management and Quality Assurance Protocols; Institutional Training Manual*. Status: *programme documents*. Their interfaces with this Guide are set out at cl. 1.4. The Climate-Resilient Design Guidelines govern on any conflict concerning hazard, structural performance or life safety.

Pakistan Meteorological Department, climate normals, rainfall records and station data; and the provincial forest departments and government nurseries, for species suitability advice, current advisories and stock availability. Status: *data sources*. Carried into the design under cl. 3.4.4 through the CRDG chapter 3 basis, and the confirmation required by cl. 10.1.5.