Groundwater

UNFC Supplemental Specifications

RESOURCE MANAGEMENT WEEK 2021

ENABLING SUSTAINABILITY PRINCIPLES IN RESOURCE

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What is Groundwater

Groundwater is found everywhere below the earth's surface

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- Groundwater is any accumulation of naturally occurring and freely moving water found beneath the surface of the Earth.
- This includes all such water found in the pore spaces, voids, caverns, and fractures in igneous, sedimentary, and metamorphic rock as well as in pores, fissures, and interstices in unconsolidated earth materials.
- It includes all groundwater regardless of chemical quality from fresh to highly saline, and with or without the presence of dissolved mineral salts, minor amounts of organic liquids like petroleum, dissolved gases, and natural or anthropogenic chemical contaminants.
- Groundwater includes any surface water induced to flow into the subsurface due to groundwater development.

Why Groundwater is Important

The World's Largest Extracted Raw Material by Volume

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- Groundwater is the world's most extracted raw material with withdrawal rates currently in the estimated range of 982 km^3 /year. [World oil production in comparison is ~6 km^3/year.]
- About 70% of groundwater withdrawn worldwide is used for agriculture.
- Groundwater provides almost half of all drinking water worldwide.
- Globally, about 38% of irrigated lands are equipped for irrigation with groundwater.
- The total volume of groundwater in the upper 2 km of the Earth's continental crust (not inclusive of high-latitude North America or Asia) is approximately 22.6 million km^3 , of which 0.1 million km^3 to 5.0 million km^3 is less than 50 years old (judged as "modern" or recently recharged).
- The volume of modern groundwater is equivalent to a body of water with a depth of about 3 m spread over the continents.
- Source: Groundwater | Facts about global groundwater usage (ngwa.org) accessed 29/03/2021

Complicating Groundwater Aspects

Groundwater Moves, Projects Can Mutually Interfere

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- Groundwater moves naturally and under influence of climate, land use, and resource development.
- Because it moves and transmits pressure change, groundwater projects interfere across both 3D space and time.
- In situ, groundwater performs valuable geotechnical and environmental services such as
  - Support to groundwater-dependent ecosystems
  - Baseflow to streams and rivers
  - Prevention of seawater encroachment
  - Prevention of land subsidence
  - Dilution, storage, and isolation of wastes.

- Groundwater quality is also an important aspect of developments. Quality is affected by natural mineral reactions, natural contaminants like iron or arsenic, and anthropogenic surface and subsurface contaminants from industrial and waste sources.

Challenges in Groundwater Governance

Highly Variable Governance and Legal Frameworks

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- Groundwater governance is very heterogeneous across and within nations.
- Project rights to groundwater may be accessed by a lease, license or commercial arrangement like other subsurface commodities, but more often is linked to social, traditional, historical, property, indigenous, or constitutional rights.
- Groundwater is described as a “common pool resource”: it is “subtractable”, meaning an extracted volume can only be used by one user at a time, and at the same time it is very difficult or expensive to deny access to its use or benefit by individuals.
- Because of interference between projects and across source, groundwater sources can be afflicted by “tragedy of the commons” where rational decisions made by individual actors acting in their own best interests can collectively harm everyone.
- Groundwater sources have a dual nature – groundwater is potentially renewable and non-renewable at the same time, depending on project parameters.

UNFC Groundwater Specifications

Supporting the SDGs, Stepping towards the UNRMS

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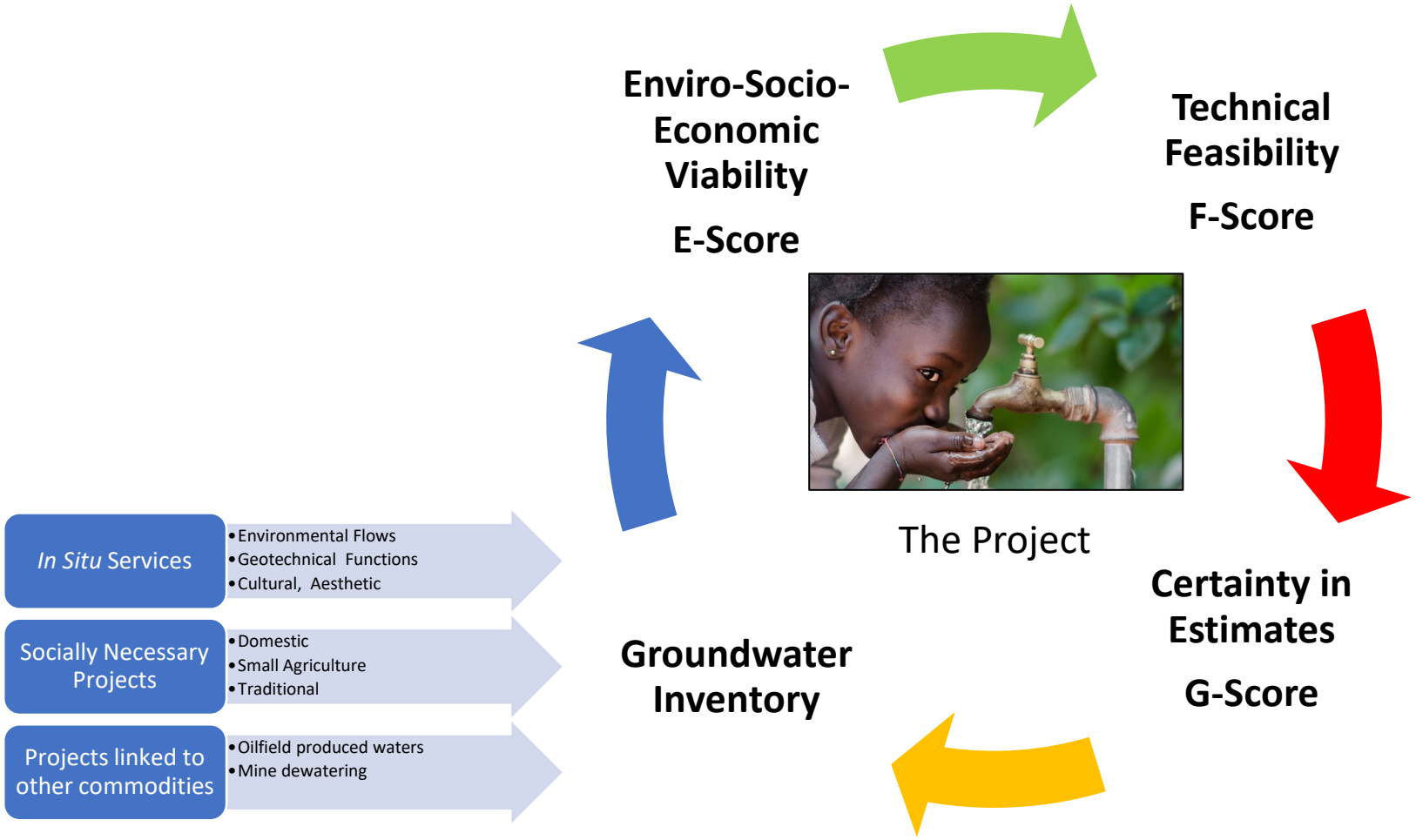

E-Axis

Recognizing *In Situ* Services and Socially Necessary Projects

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- E-score needs to consider context of entire source because of groundwater's role in environmental flows of water, its in-situ service values, other types of development.
- E-score context has to be spatially beyond a project boundary because groundwater moves, and historical because changes in groundwater conditions propagate into the future past a project's lifespan, and then decay over long intervals of time.
- E-score needs to consider the existence and persistence of socially necessary projects that can fall outside formal licensing systems.
- Socially necessary projects are a new category that reflect the reality that small projects exist because of human need, sustainment of small farms, traditional practice, or purposely permissive or absent governance.




F-Axis

Promoting the adoption of feasibility ladders.

- Opportunities exist for better design practice in groundwater projects by using UNFC:
  - Most groundwater projects have a fast path from inception to maturity in practice. This is because capital requirements of many groundwater projects tend to be small, the technology is well known, needs are immediate, and tolerance for failure is high.
  - Using UNFC in Groundwater may catalyze better design, leading to better resource development, less waste of capital, and fewer project failures by promoting UNFC's use of laddered or phased approaches to groundwater development, as captured by the F-Axis score.

Groundwater G-Axis

G1+G2 is Recommended Reporting Level of Certainty in Estimate

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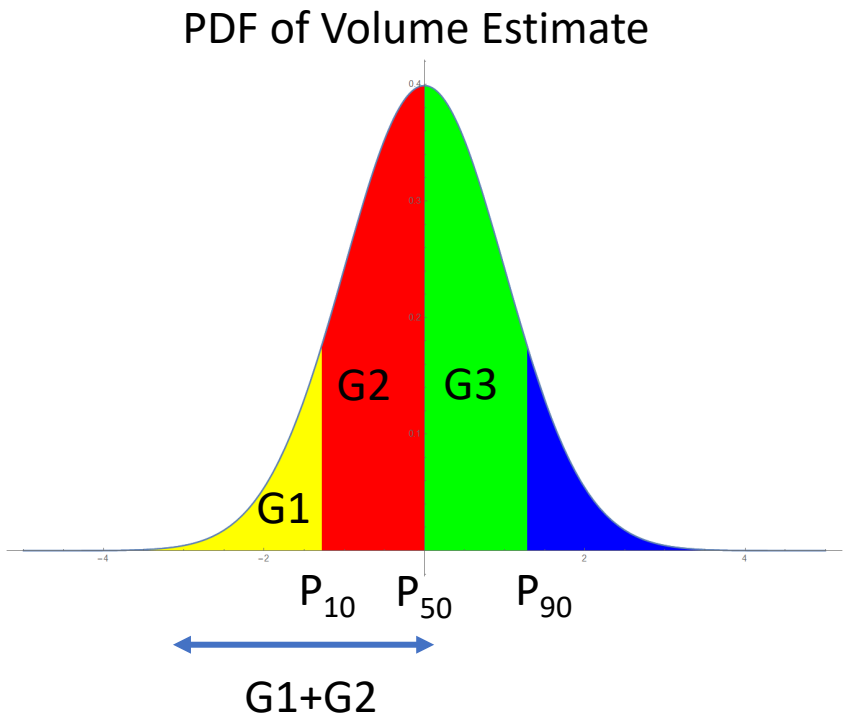
- UNFC G-Axis standard definitions use G1-G2-G3 hierarchy of certainty as derived from mineral and petroleum deposits, roughly coincident with the proven-probable-possible spectrum of reserves assignment.
- Groundwater specifications recommend use of G1+G2 (best estimate) as the standard for reporting project quantities as allowed by UNFC 2019.
- This recommendation is based on need to aggregate all claimed volumes in a groundwater source prior to setting a level for the E-axis score of a project.



Aggregation and Inventory

Embedded in Supplemental Standards for Groundwater

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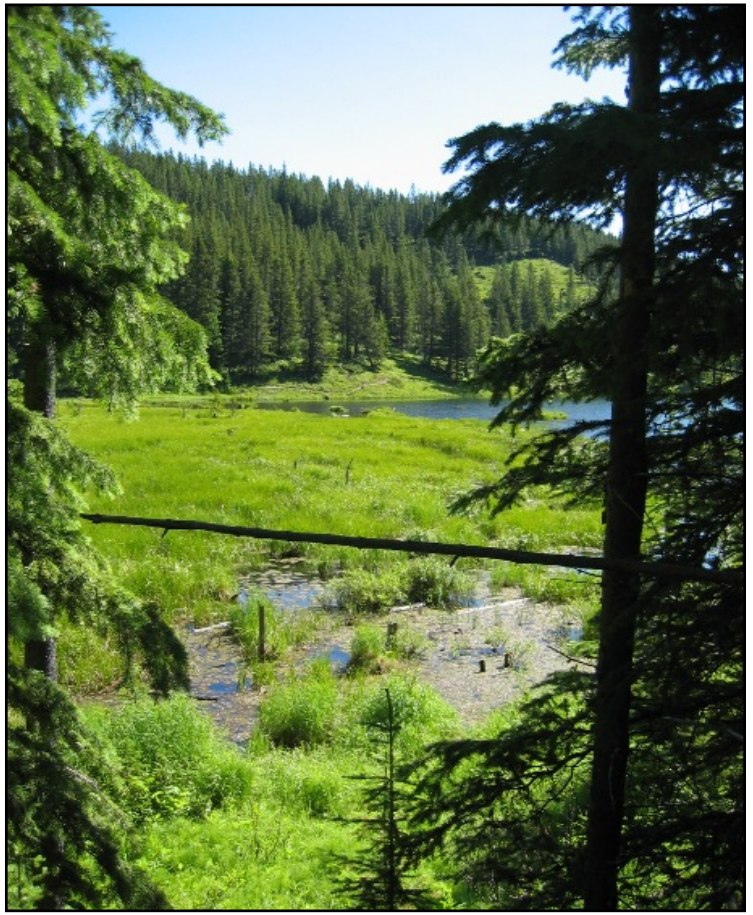
- Aggregation of all claimed volumes for projects in a groundwater source, socially necessary projects, and volumes need to sustain environmental flows and in situ geotechnical services need to be tracked to avoid double-counting and overdraft.
- Use of “best estimates” of G1+G2 makes high quality aggregation practical in an inventory.
- The UN’s SEEA-Water schema already provides the necessary framework to support UNFC Supplemental Groundwater Specifications.



Groundwater Resources Working Group

Workplan 2021-2023

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- Groundwater Supplemental Specifications draft delivered.
- Next steps in GRWG Workplan (2021-2023):
  - Proof of Concept/Case Studies in 4 areas:
    - Policy Formulation
    - Resource Management
    - Corporate Business Processes
    - Financial Capital Allocation.
  - Application Guidance including incorporation of SEEA-Water
  - Socialization with international communities of groundwater practice including
    - International Association of Hydrogeologists (IAH)
    - European Federation of Geologists (EFG)
    - Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP).

Thank you!

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Chair, Groundwater Resources Working Group
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