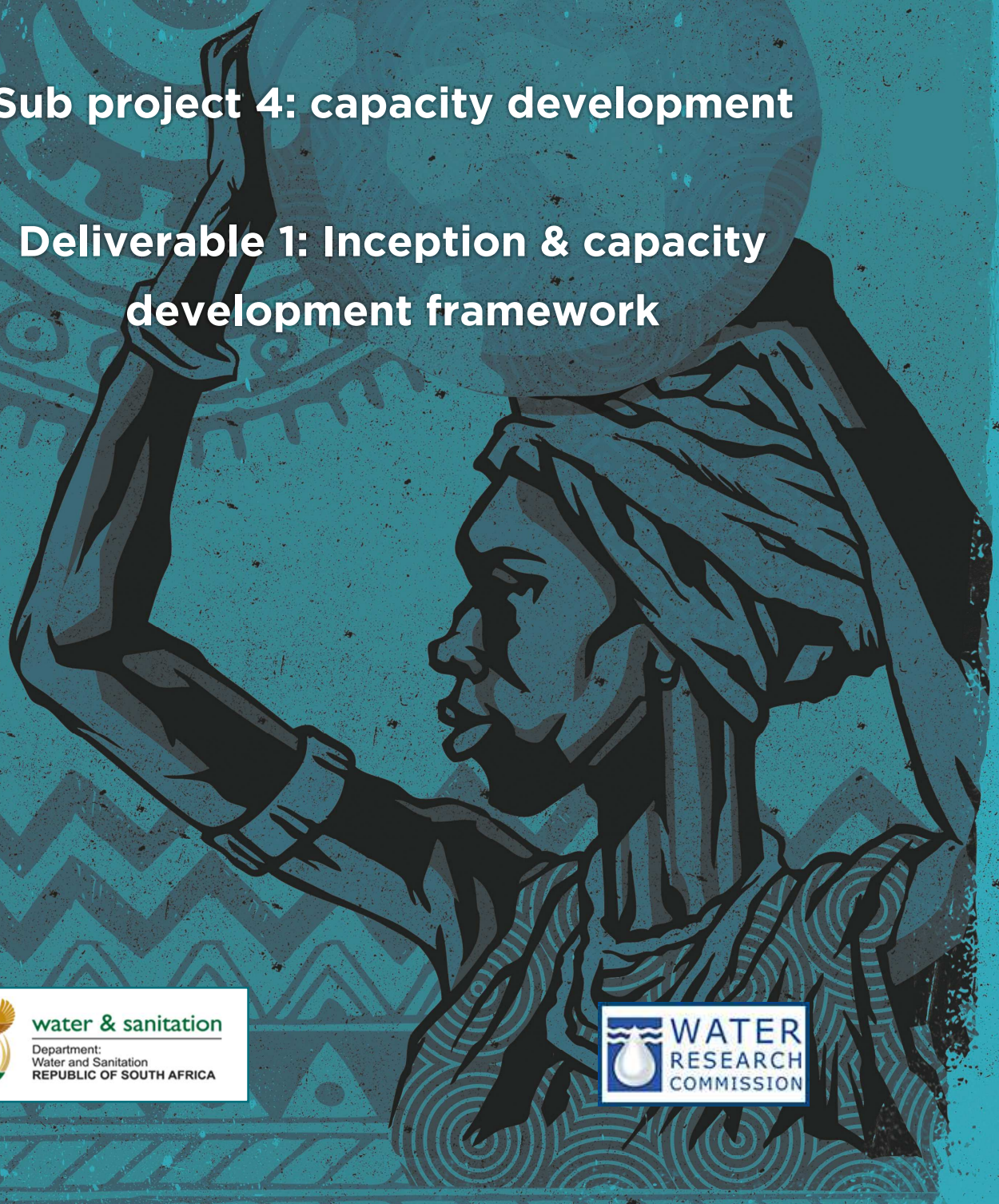
Dam siltation management in South Africa

Sub project 4: capacity development

Deliverable 1: Inception & capacity development framework



water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

WATER RESEARCH COMMISSION

Acknowledgements

The National Siltation Management Strategy for Dams in South Africa programme NatSilt is funded by the Department of Water and Sanitation (DWS) and managed by the Water Research Commission (WRC). The programme's overarching aim is to develop and pilot a strategy that will guide, advise and ensure effective siltation management and related improved storage capacity of dams, especially the 320 state-owned dams managed by DWS and any future dams built by DWS.

This is the first deliverable (Inception & capacity development framework) of the project "The development and piloting of two qualifications supported by an e-learning platform for the empowering of a new cohort of skilled professionals to enhance and improve the efficiency of dam siltation management." (WRC Proposal Number: 2022/2023-00663).

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About WRC: NatSilt

South Africa is a water scarce country with an expected deficit of 17% by 2030. It has a history of dam building to address water security needs with 320 large dams currently under the management of the state. Sedimentation rates in South Africa are significant when considered alongside increased water demands in the region. Storage capacity losses range between 10% and 30% (Msadala & Basson, 2017) with some dams experiencing 90% sedimentation in the last year, requiring urgent attention on continuous surveying, siltation and sedimentation solution development.

The Water Research Commission (WRC) received a directive from the Department of Water and Sanitation (DWS) on the 10th April 2019 to develop a Siltation Management Strategy for Large Dams in South Africa. The project has been initiated and will be managed by the Infrastructure Build Operate and Maintenance (IBOM) branch within the DWS. Its purpose is to operate and maintain bulk water resource infrastructure in a sustainable manner to ensure an effective and efficient supply of Bulk Raw Water for economic growth, social development and poverty eradication.
The National Siltation Management Strategy for Dams in South Africa programme NatSilt is funded by the Department of Water and Sanitation (DWS) and managed by the Water Research Commission (WRC). The programme's overarching aim is to develop and pilot a strategy that will guide, advise and ensure effective siltation management and related improved storage capacity of dams, especially the 320 state-owned dams managed by DWS and any future dams built by DWS.

This will aid in assisting the DWS in achieving its mandate to operate and maintain bulk water resource infrastructure in a sustainable manner to ensure an effective and efficient supply of bulk raw water for economic growth, social development and poverty eradication.

The programme's objectives are as follows:

1. Development of a siltation management strategy and related tools for dams;
2. Piloting of the draft strategy, models and tools for finalisation; and
3. Review and revision towards a final strategy, with relevant models and tools.

This programme develops over 4 main components: 1) 4 research calls; 2) the cementing of a Community of Practise (CoP) relating to siltation management; 3) a series of training and capacity development opportunities.

About AWARD

The Association for Water and Rural Development (AWARD) is a non-profit organisation specialising in multi-disciplinary, participatory, research based project implementation aimed at addressing issues of sustainability, inequity and poverty. We have been in existence for over 20 years. Informing our work are the values of trust, dignity for all, justice, fairness, non-discrimination, unity and learning through practice. Our approach involves thinking across disciplines, boundaries and systems.

While working collaboratively with other organisations and developing strong and rich professional networks, we strive to build natural resource management competence in civil society, government agencies and private enterprise. We believe this will help provide a foundation for robust and sustainable development policy and practice in South Africa that can stand up to an increasingly complex world.

Our main, although not exclusive, geographical area of focus is the catchments of north-eastern South Africa, including the Olifants River Basin.

For further information, see *http://www.award.org.za*

NatSilt: Training & Capacity Development

Siltation management has been largely fragmented in South Africa. The development of a Siltation management strategy for dams in South Africa will provide a new framework, models and protocols to manage dam siltation in a holistic manner. The multi-disciplinary and sector approaches will provide the opportunity to simultaneously develop new skills, learning materials and create a community of practitioners. Training and capacity development that is inclusive of experienced dam managers, young professionals identified as potential successors (supporting, but not limited to, the Department of Water and Sanitation's Learning Academy trainee engineers, scientists and technicians), Catchment Management Agencies, as well as local community representatives, will contribute to better long-term dam siltation management. Embedded training and capacity development will enable organisations and individuals to adapt to the technological changes and challenges by effectively adopting new ways of managing siltation in rivers.

The WRC has developed the Water Infrastructure Manager Qualification (NQF 8) under the FETWater Programme, that has been registered by SAQA on the National Qualifications Framework under the Occupational Qualifications Sub Framework. The rationale for this qualification is to enable the effective management of physical assets throughout their lifecycle to ensure optimal return on investment, minimising infrastructure related risks and costs over the entire life-cycle. DWS together with its sector partners is in the process of developing an implementation plan for the provision of a Water Infrastructure Manager Qualification that focuses on identifying key qualification service providers, establishment of accredited assessment centres and to provide relevant workplace training. There is a need to determine how to effectively pilot this qualification, get market up-take within the workplace and in the process certify DWS staff, to carry out the required occupational responsibilities.

An understanding of specific dam siltation management skills needs and supporting institutional structures will allow for the development of appropriate and relevant training and capacity development through the Water Infrastructure Manager Qualification. In addition to infrastructure training, training and awareness toolkits must also be developed for stakeholders living and operating in proximity to the dam basin. These training modules will be developed for stakeholders (decision-makers and citizens) that will ensure that the riverine environment or the catchment is not degraded and to ensure local economic development through catchment restoration and beneficiation (ecosystems services and economic uses of dredged sediment).

There is a need to determine how to effectively pilot this qualification, get market up-take within the workplace and, in the process, to certify DWS staff to carry out the required occupational responsibilities. This sub-project (4) emphasises developing an occupational qualification as fundamental to contributing to better long-term dam siltation management (DSM) by practitioners in South Africa. Here capacity development is inclusive of experienced dam managers, young professionals identified as potential successors (supporting, but not limited to, the Department of Water and Sanitation's Learning Academy trainee engineers, scientists and technicians), Catchment Management Agencies, as well as local community representatives. Embedding the planned training in a qualification will grant practitioners the opportunity to gain recognition for their competences and skills. The proposed curriculum framework (with standards) will enable organisations and individuals to understand new standards and thus adapt to the technological changes and challenges by effectively adopting new ways of managing siltation in rivers.

Table of Contents

List of Figures

List of Tables

1 Introduction

Dams are installed as long-term assets to guarantee water and energy security for decades, if not centuries. However, the effect of siltation undermines dam's sustainability because it significantly reduces its original capacity (Landwehr et al., 2020). Training and capacity development have been identified as key components to effective long-term dam siltation management.

Capacity is the emergent combination of individual competencies, collective capabilities, assets and relationships that enables a human system to create value (Baser & Morgan, 2008) and capacity development, the process whereby individuals, organizations and society as a whole unleash, strengthen, create, adapt and maintain the capabilities to set and achieve their own development objectives over time (UNDP, 2009; FAO, 2015). Capacity development is based on the principle that people are best empowered to realize their full potential when the means of development are sustainable – home-grown, long-term, and generated and managed collectively by those who stand to benefit.

2 Background

Experienced professionals are leaving public institutions to work in the private sector and in foreign countries due partly to the inability of public sector institutions to attract and retain such staff. Mentoring of new entrants into the water sector has become a major challenge due to shortage of experienced personnel in the public sector. Impact assessments are hardly ever conducted, allowing little evidence of the actual impact of capacity building and skills development interventions in the sector. Primary planning data, which under ideal circumstance should be generated through the workplace skills planning process, is poor. Limited water and sanitation sector occupations are listed in the Organising Framework for Occupation (OFO), as these workplace skills plans from employers are not standardised and reflective of the actual needs/gaps. This contributes to inaccurate prioritisation and allocation of funding for interventions. The ongoing retirement of a large cohort of older, experienced workers is leaving significant gaps in skills and experience in the sector. There are new capability requirements to meet the emerging demands of climate change, environmental management, new technologies, and the multi-disciplinary nature of sustainable water management. The DWS Staff Skill Portfolio reflects a mere 13% of engineering related personnel (Figure 1) .

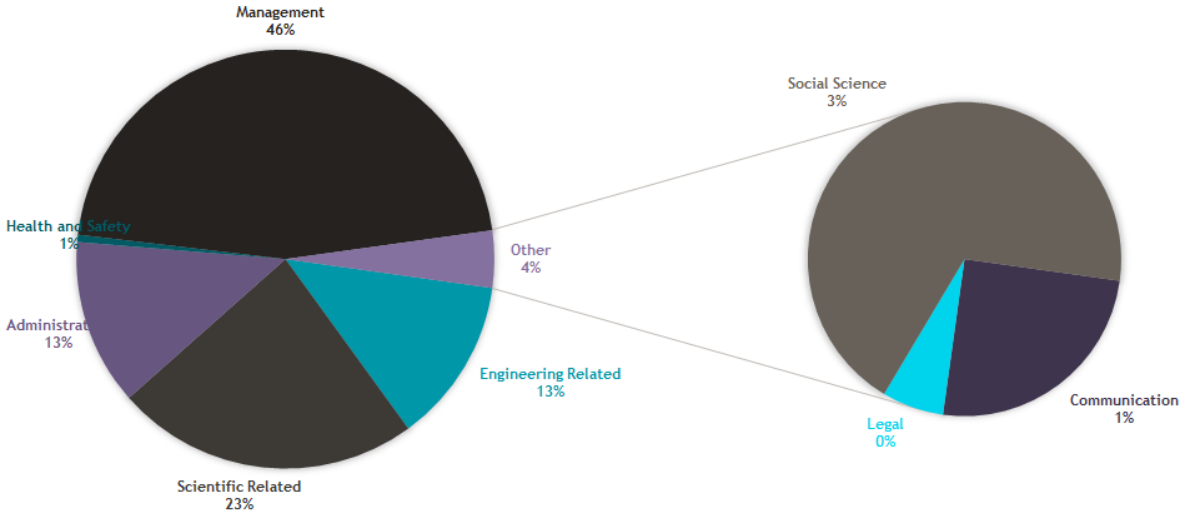

Figure 1: DWS staff skill portfolio (DWS, 2021).

Resource constraints and the low capacity to engage with the water sector, hampers the updating of materials, and the generation of new courses relevant to emerging needs and to deliver industry-relevant education and training. There are low levels of entrants and completions in education and training programmes relevant to the water sector, including sciences and engineering. (DWS, 2018).

According to the National Water and Sanitation Master Plan (NWSMP) (DWS, 2018) trends which influence skills availability and retention within the water sector include the following:

- Extensive corporatisation and the contracting out of many functions of water utilities in the 80s and 90s, and a resulting reduction in the level of inhouse training provided by the state
- The overall shortages of technical skills in the South African economy, the strong competition for human resources within the infrastructure/ mining sectors in particular and an extended period of low investment in curriculum development
- Demand from the mining and construction industries for a limited pool of scientists and engineers
- Changing/evolving job roles, definitions and qualifications make it difficult to choose a specific career path in the water industry
- Changing expectations from younger members of workforce who expect greater flexibility in working hours, the opportunity to achieve a work/life balance and better optimised career paths than is offered by industry and
- Variable connectivity of universities with industry resulting in less employment-relevant curriculum. (DWS, 2018).

What is needed in the water sector is human resources with the necessary qualifications, knowledge, attitudes, competencies and capabilities to improve the water sector planning and management processes. In addition, an enabling environment with appropriate policy and legal frameworks; institutional tools, systems and processes including public participation, partnerships and intergovernmental relations is also required. This effectively translate into a well-skilled and adaptable water sector work force; an attractive sector that competes with other sectors for skills and can retain skilled staff in the water sector; accountable and strong governance structures focused primarily on monitoring and evaluation of new and existing training/skills development programmes and funding available for scarce skills throughout the skills development pipeline. (DWS, 2018).

Key areas identifed are number of vacancies in critical areas especially engineering; development of new skills for a changing environment; and development of functional skills for incumbents in water sector institutions (DWS, 2018).

While the present needs are urgent, and solutions are required in a corresponding short-term framework, the solution will take time. Both the water sector and the education sector operate in long timeframes, with gestation periods of years and decades. Addressing skills needs across these sectors requires a long-term perspective, balanced with the need for urgent action. There are significant current commitments to education and training places, and recent further commitments announced. Some of the actions identified by EWSETA Sector Skills Plan 2017- 2022 are as follows: (DWS, 2018).

- Develop new skills and leadership for Hydrologists, Hydrogeologists and Ecologists, to drive groundwater use at local level and improve artificial recharge of aquifers;

- Build human and institutional capacity to better manage water databases, create communication and awareness and project the cost implications of utilizing alternative sources of water and the development of green processes and technologies;
- Expand high-level knowledge and quality research in areas such as groundwater use, desalination, water treatment, and the role of women in water in rural areas and informal settlements;
- Facilitate the War on Leaks training programme;
- Align skills development interventions to support green jobs and initiatives;
- Mainstream issues of sustainability and environmental ethics into education and training programmes;
- Develop high level of technical and research skills that underpin technological advancement and innovation;
- Up-skill and retain the existing labour force that participate in varying capacities within the sector to address changing skills needs linked to technological advancement;
- Develop industry-research / skills development partnerships with research institutions, science councils and universities of technology in areas identified for innovation;
- Train women involved in accessing and distributing water in rural areas and informal settlements in the safe and efficient usage of water and sanitation. (DWS, 2018);

It is to this end that the prioirty actions as outlined in Table 1 need to be implemented.

TABLE 1: DWS PRIORITY ACTIONS (DWS, 2018).

ACTION	RESPONSIBILITY	COMPLETION DATE
Establish regulations on required qualifications and experience for senior and technical positions in DWS, CMAS, Water boards and municipal services institutions (Volume 3, Action 2.3.1)	DWS, CoGTA, SETA	2023
Develop and implement programme for recruiting experienced technical and managerial staff in first South Africa and then internationally (2.3.2)	DWS, CoGTA, DIRCO	2030
Define (and reinstate in some cases) career paths with defined training and on the job experience to build a knowledgeable sector of professionals (2.3.3)	DWS, WSAs, WBs, CMAs	2023
Develop and implement a mandatory, modular hands-on qualification for municipal water managers (technical manager) to be run over 18 months and accredited by EWSETA to include aspects such as asset management, tariffs and revenue management, drought management, stakeholder engagement and customer relations (2.3.4)	DWS, EWSETA, Institutions of Higher Learning	Ongoing
Partner with institutions to fund training of water sector practitioners in the curation, management and use of data as well as the associated technologies (2.3.5)	DWS, EWSETA	Ongoing
Initiate a focused research capability initiative in water sector economics to address this existing skills gap (2.3.6)	DWS, WRC, CSIR, DST	Ongoing
Continue to develop high end skills (post graduate) to ensure a future science, technology and innovation capability in South Africa (2.3.7)	DWS, DST, NRF, WRC, CSIR, the dti (THRIP)	Ongoing
Continue to support programmes that enable development of critical skills and exposure to emerging innovations (e.g. Young Engineers Programme) (2.3.8)	SALGA, DST, WRC, CSIR, DWS, CoGTA, MISA	Ongoing

3 Dam siltation management

Dams and reservoirs are useful tools to control water resources, but storing water in dams also lead to unintended consequences which affect the erosion/transport processes through watersheds. Rainfall runoff, snowmelt, and river channel erosion provide a continuous supply of sediment that is hydraulically transported and deposited into dams. Dams have very low velocities and tend to be very efficient sediment traps (Mehendale, et al., 2017). Dam siltation and related issues are receiving growing attention due to the aging of water-storage infrastructure and an increase of the sediment loading below the dam can trigger a suite of undesired ecological effects in the downstream river reaches (Espa, et al., 2019). As time passes, a dam storing water will continue to fill with sediment, causing storage loss, reducing water supply reliability, and impacting infrastructure (Kimbrel, Collins, & Randle, 2015). The trapping of sediment in dams interrupt the continuity of sediment transportation through rivers which results in not only loss of dam storage but reduced usable life, and depriving downstream reaches of sediments essential for channel form and aquatic habitats. With the acceleration of new dam construction globally, these impacts are increasingly widespread (Kondolf, et al., 2014). Furthermore, siltation poses a significant threat to the longevity, usefulness and sustainable operations of dams which in turn negatively affects reduces the reliability of domestic and irrigation water supply and flood management (Annandale, Morris, & Karki, 2016).

A growing risk to water security, economic growth, social development and poverty eradication is the sustainable supply of bulk water, which has been compromised by loss of storage capacity and reduction in water quality associated with dam siltation. Siltation management has been largely fragmented in South Africa and training and capacity development have been identified as key components to effective long-term dam siltation management.

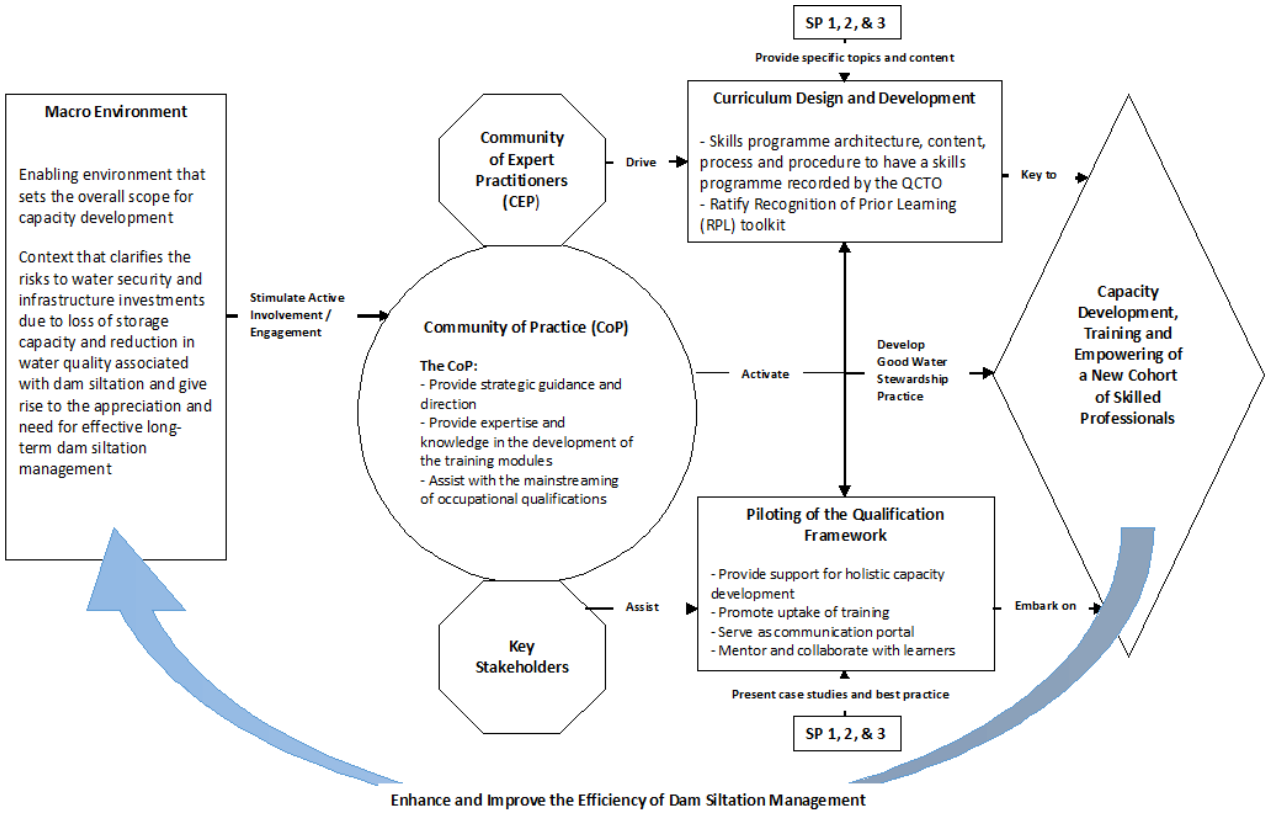

Figure 2: Capacity Development Conceptual Framework Model.

Our overarching framework is to adopt a systemic, social learning approach as the basis for designing a workplace-based process that can be considered for a qualification under the NQF (see Figure 2). This SP4 Project is committed to assist with the implementation of the priority actions (see Table 1) through operationalising an expansive learning and capacity development process to foster the formation of an empowered new cohort of skilled professionals and citizens to enhance and improve the efficiency of dam siltation management in a holistic manner.

4 Capacity development process

Capacity development (planning to implementation) happens within the National Qualification Framework (NQF), and its sub-framework of quality councils (e.g Quality Council for Trades and Occupations (QCTO)) and structured pipeline bands. This form of capacity is exclusive to individual capability and knowledge to fill a particular occupation. It is important to develop and implement mandatory, modular hands-on qualification and experience for senior and technical positions in DWS, CMAs, water boards and municipal water services, accompanied by a programme for recruiting and retaining experienced technical and managerial staff with technical qualifications in South Africa and internationally. The definition of career paths with defined training and on-the-job experience will help to build a cadre of sector professionals. (DWS, 2018).

The building blocks for qualification developemnt is depicted in Figure 3.

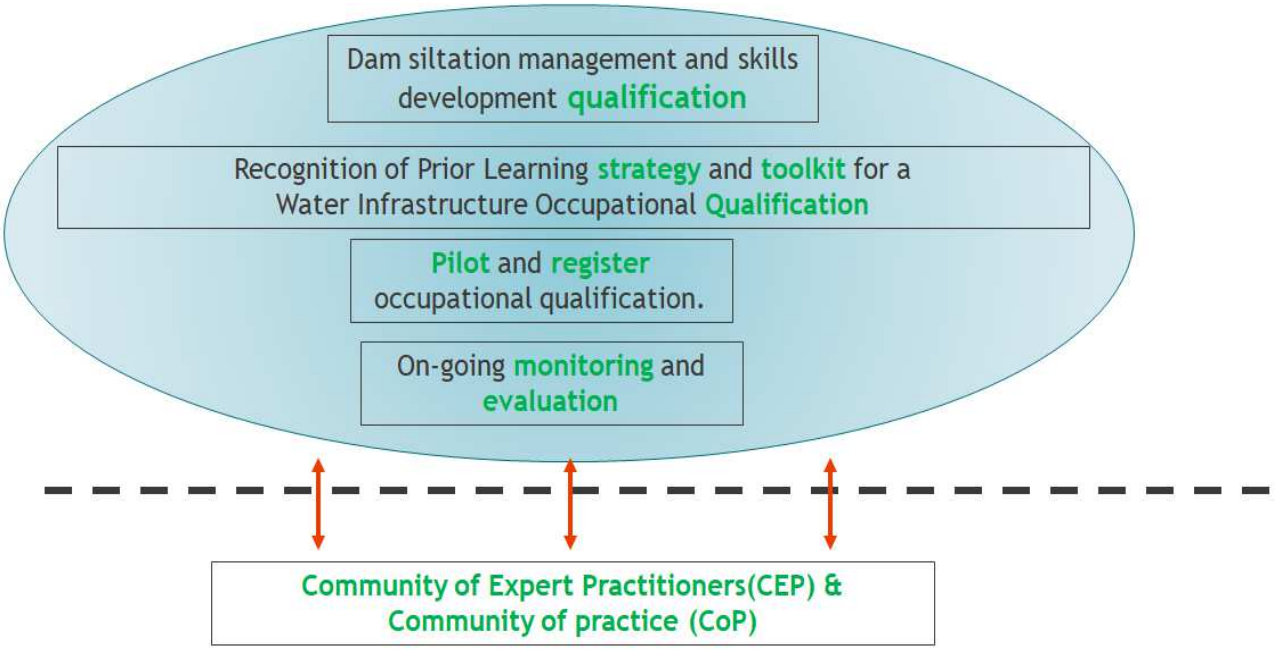

Figure 3: Building blocks for qualification development.

Expanding on the building blocks, SP 4's capacity development process follows a six-step cycle to organise programming work to empower new cohort of skilled professionals and citizens to enhance and improve the efficiency of dam siltation management (see Figure 4).

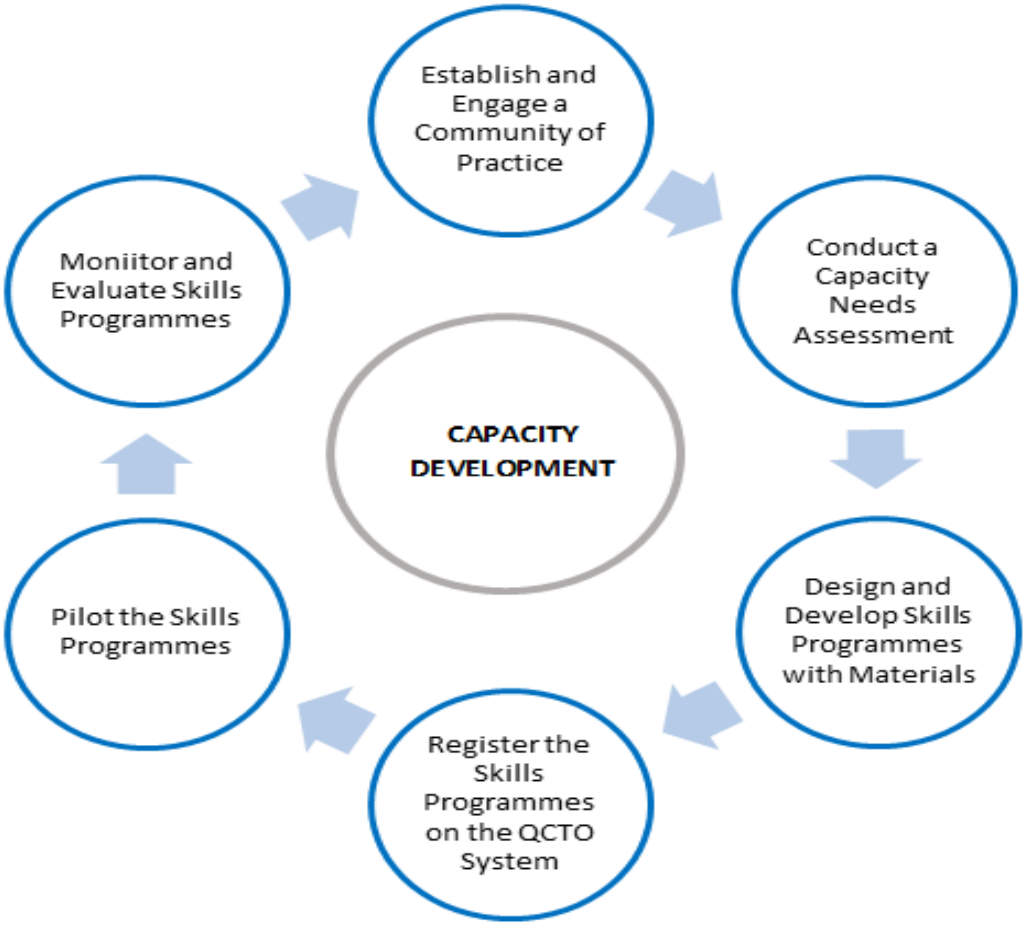

Figure 4: Capacity development process (Source: Adapted from UNDP, 2009).

4.1 Establish and engage a community of practice

The establishment of a Community of Practice (CoP) is critical for understanding the complex systems and dynamics behind siltation challenges. It is also an essential aspect to holding the nature and evolution of the skills development programmes under the Water Infrastructure Manager qualification after the project is completed. There are three elements to the CoP as designed by SP4 and will be elaborated upon in Deliverable 2 in detail. Suffice to say that the CoP will provide a social and professional fabric for holding the will qualification as well as provide strategic guidance and direction to the capacity development process whilst the project is underway. The three components to the CoP are:

a. Key stakeholders
b. The Community of Expert Practitioners (CEP)
c. The DSM communications network

4.1.1 Key stakeholders

The key stakeholders will assist with moving the capacity development process forward so that it leads to ownership, changing mind-sets and attitudes towards effective siltation management. The key stakeholders will be sourced from entities depicted in Figure 5.

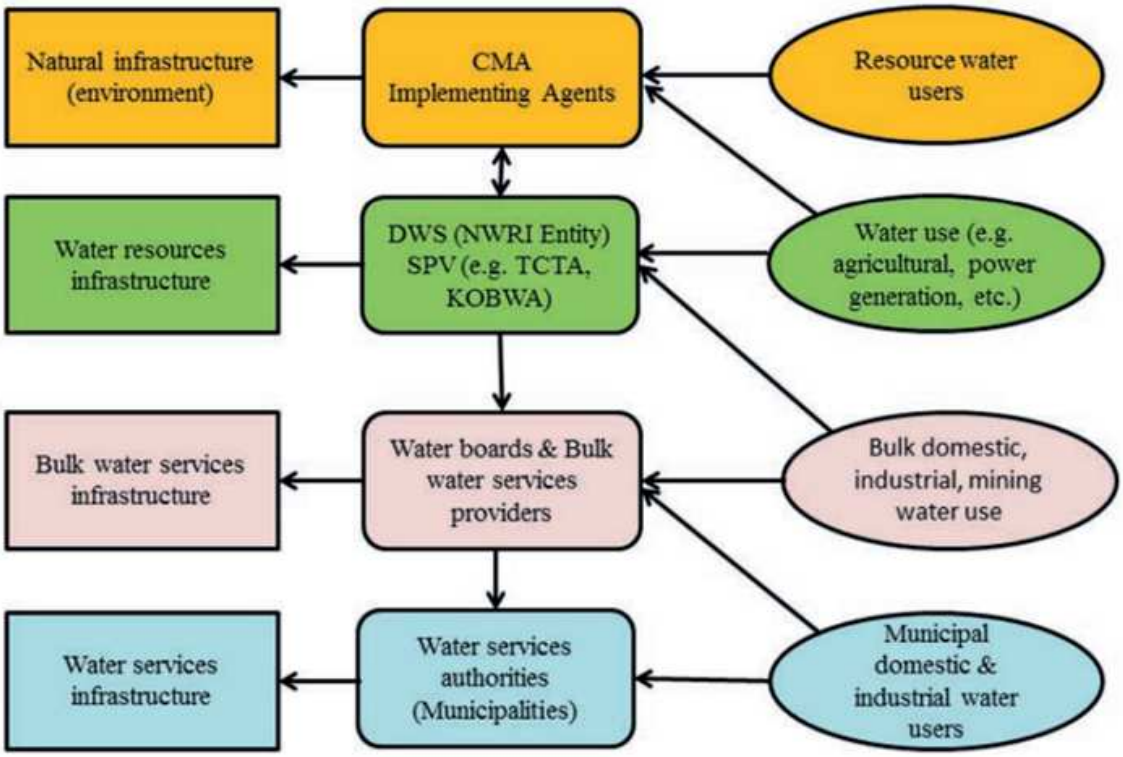

Figure 5: Stakeholder entities (Ruiters & Matji, 2015).

The key stakeholders will:

- Liaise with other stakeholders;
- Assist with coordination;
- Provide support for holistic capacity development;
- Review operational scenarios;
- Contribute to materials development;
- Promote uptake of training;
- Serve as learning portal;
- Assist with the mainstreaming of occupational skills programmes;
- Mentor and collaborate with learners.

Key stakeholders are interested parties that are engaged in, stand to influence or benefit from one or more activity associated with DSM practice.

4.1.2 Community of Expert Practitioners (CEP)

The Community of Expert Practitioners (CEP) is a group of people qualified in the relevant occupation (siltation management) with a minimum of at least 5 years' minimum number of current

relevant years of experience in that particular occupation or are recognised by the practitioners of the occupation as experts. The CEP will be responsible for the occupational skills programme architecture, content, process and procedure in order to have a skills programmes recorded by the Quality Council for Trades and Occupations (QCTO). They will also ratify the Recognition of Prior Learning (RPL) policy and toolkit. The CEP is transitory in that the CEP will be disbanded after the skills programmes have been developed and tested. In that sense this group provides an extended reference group of professionals who will assist the team in the development of the skills programmes with a very specific function limited to qualifications development, materials development, RPL Toolkit and QCTO registration. Members of the CEP will resort back to the Key Stakeholder groups that constitute the overarching CoP.

The CEP will:

- Play a leading role in designing the knowledge & application components, curriculum and assessments.
- Facilitate the recording of Skills Programmes.
- Ensure that Skills Programmes are relevant and advance knowledge and innovation.
- Develop Purpose and Rationale of the Skills Programmes.
- State the minimum requirements to obtain the Skills Programmes.
- Create a basis for and promote lifelong learning (RPL).

4.1.3 DSM Communications Network

This component of the CoP is to facilitate the discourse on dam siltation management through engaging civil society members and the media in topics of relevance. Its purpose also is to provide a platform for opportunities associated with DSM.

4.2 Capacity needs assessment

The capacity needs assessment will analyse the current skill sets and important skills required for effective dam siltation management. The focus will be on what capacities and whose capacities to need to be developed and for what purposes.

Specifically, the capacity need assessment will assess:

- Existing capacity assets;
- Areas of broad capacity gaps and needs identified;
- What kinds of capacities need to be developed;
- The desired level of capacity anticipated;
- Which groups or individuals need to be trained and empowered;
- How the capacity will be applied over time.

TABLE 2: DATA COLLECTION SITES (SOURCE: ADAPTED FROM CSIR, 2016)

CATCHMENT	DAM	ESTIMATED 2016 STORAGE CAPACITY (X 103 M3)	ESTIMATED 2016 LOSS IN STORAGE CAPACITY	LEVEL OF SEDIMENTATION (AS % OF	CLASSIFICATION ACCORDING TO TOTAL LOSS IN

				(X 10^3 M^3)	STORAGE CAPACITY)	STORAGE CAPACITY
SUNDAYS	1	Nqweba	75556	3268	> 40	Critical
	2	Darlington	268542	59093	> 40	Critical
GREAT FISH	3	Grassridge	73577	17399	> 40	Critical
	4	Elandsdrift Weir	1865	10314	> 40	Critical
	5	De Mistkraal	1730	2343	> 40	Critical
	6	Kommandodrift	70338	3126	20 - 40	Very High
GOURITZ	7	Floriskraal	45860	21577	> 40	Critical
	8	Gamkapoort	32666	22270	> 40	Critical
	9	Prinsrivier	-3863	8453	> 40	Critical
	10	Stompdrift	42448	19284	> 40	Critical
ORANGE	11	Welbedacht	37561	73443	> 40	Critical
	12	Bethulie	-956	7628	> 40	Critical
	13	Rooiberg	1248	5892	> 40	Critical
	14	Boegoeberg	16204	18456	> 40	Critical

Other regions with critical affected by sedimentation are:

CATCHMENT		DAM	ESTIMATED 2016 STORAGE CAPACITY (X 103 M3)	ESTIMATED 2016 LOSS IN STORAGE CAPACITY (X 10^3 M^3)	LEVEL OF SEDIMENTATION (AS % OF STORAGE CAPACITY)	CLASSIFICATION ACCORDING TO TOTAL LOSS IN STORAGE CAPACITY
LIMPOPO	15	Vischgat	625	44	> 40	Critical
	16	Susandale	124	398	> 40	Critical
VAAL	17	Roodepoort	618	1242	> 40	Critical
MZIMVUBU	18	Gilbert Eyles	-604	2040	> 40	Critical
MVOTI	19	Shongweni	1395	10666	> 40	Critical
THUKELA	20	Driel Barrage	2658	12673	> 40	Critical

4.3 Skills programme design and development

4.3.1 Proposed skills programmes

The following skills programs are proposed (see Table 3):

- Dam Siltation Manager
- Dam Siltation Controller
- Networks and Partnerships Coordinator

Networks and Partnerships Coordinator

TABLE 3: SKILLS PROGRAMMES

TARGET GROUP	PROPOSED SKILLS PROGRAMME	ALIGN TO THE REGISTERED OCCUPATIONAL QUALIFICATION		RESPONSIBLE SETA
DAM MANAGERS	Dam Siltation Manager	Water Infrastructure Manager	NQF 08	LGSETA
DAM OPERATORS	Dam Siltation Controller	Water Process Controller	NQF 03	LGSETA
		Water Works Management Practitioner	NQF 06	EWSETA
STAKEHOLDERS LIVING IN PROXIMITY A DAM	Networks and Partnerships Coordinator	Community Development Practitioner	NQF 05	ETDPSETA (Community)

The Skills Programmes will follow the main processes, as set out by the Quality Council for Trades and Occupations (QCTO), during the development of occupational qualifications.

4.3.2 Components of the skills program design and development process

The skills programmes will comprise of the following:

4.3.2.1 Skills Programme Information

- Title
- Sub-title
- Alternative Titles used by industry
- Related Occupational Skills Programme
- Purpose
- Rationale

4.3.2.2 Content

- Knowledge
    - Topics
    - Total Credits (Duration)
- Application
    - Topics
    - Total Credits (Duration)

4.3.2.3 Minimum entry requirements

- Criteria will be set as to what is needed from prospective learners to enter the skills programmes.

4.3.2.4 Assessment

- Assessment Criteria on Continuous Assessment
- Assessment Criteria on Supervised Assessment
- Exit Level Outcomes on Continuous Assessment

- Exit level Outcomes on Supervised Assessment

4.3.2.5 Further learning pathways (articulation)

- A description of what and how learners, who completed the skills programme, can access other horizontal and vertical qualifications.

4.3.2.6 Work opportunities

- A Description of which employments opportunities existed for learners who completed the skills programme.

4.3.2.7 Provider accreditation requirements for the skills programme

- As stipulated in the accreditation of Skills Development Provider Policy.
- An extension of scope process will be conducted to a Skills Development Provider that has a valid accreditation status.

4.3.2.8 Physical requirements

- Space and venue needed to offer the skills programmes. This include occupational health and safety requirements.

4.3.2.9 Human resource requirements

- Competent personnel needed to offer the skills programmes.

Title: The title will comply with the Skills Programme.

Level of the Skills Programme: The SAQA published level descriptors will be used to help determine the level of the Skills Programme.

Credits: The credits will be calculated on the basis of one (1) credit being equal to ten (10) notional hours of learning. The minimum credit allocation for a Skills Programme will comply with the requirements for the Skills Programme type as determined within the relevant Sub-framework of the NQF.

Rationale will:

- Provide details of the reasoning that led to identifying the need for the Skills Programme;
- Indicate how the Skills Programme meets specific needs in the sector for which it is developed;
- Identify the range of typical learners and indicate the occupations, jobs or areas of activity in which the qualifying learners will operate;
- Indicate the learning pathway where the Skills Programme resides; and
- Indicate how the Skills Programme will provide benefits to the learner, society and the economy.

Purpose will:

- Describe the context of the Skills Programme and what it is intended to achieve in the national, professional and/or career context.
- The purpose statement should capture what the qualifying learner will know and be able to do on achievement of the Skills Programme.

Minimum Entry Requirements: The minimum entry requirements to the Skills Programme will be stated. The entry requirements will be aligned to the approved institutional/provider admissions policies.

Assessment Criteria and Exit Level Outcomes

- The exit level outcomes: The exit level outcomes which are framed against the level descriptors, will indicate what the learner will be able to do and know, as a result of completing the Skills Programme. These competencies relate directly to the competencies required for the further learning and/or the work for which the Skills Programme was designed.
- Assessment criteria: Assessment criteria are written for the Skills Programme to indicate the nature and level of the assessment associated with the Skills Programme and how the exit level outcomes could be assessed in an integrated way. The criteria can be given as a comprehensive set derived from the level descriptors.
- Assessment (Continuous and Supervised): The assessment undertaken to determine the learners' applied competence and successful completion of learning in the Skills Programme must be stated. This could include reference to formative (continuous) and summative (supervised) assessment; ratio of assignment work (continuous assessment) to supervised assessment; the role of work integrated learning; other forms of integrated learning; and its assessment.

Recognition of Prior Learning (RPL): Institutional RPL (QP or SDP) policies must clearly state how RPL will be applied to gain entry to or achieve the Skills Programme. The RPL policies of QPs and/or SDPs must be made available to QCTO upon such request. The RPL policies of QPs and/or SDPs must be aligned to the QCTO or national SAQA RPL Policy.
Related Qualification/s: The registered qualification/s that is related to the Skills Programme, will be stated.
Work Opportunities: Possible work opportunities or self-employment opportunities after completing the Skills Programme will be stated.

Further Learning Opportunities: If the Skills Programme has further learning opportunities, then this will be stated.

4.3.3 Materials development

The approach to developing the learning materials is depicted in Figure 6.

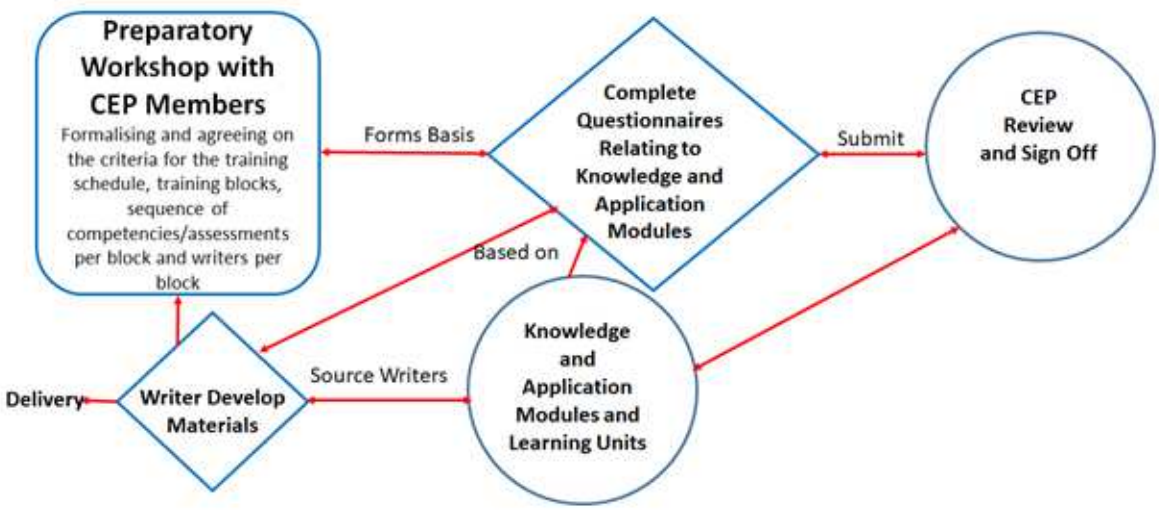

Figure 6: Approach to materials development.

The materials writing team will be identified from the Community of Experts Group (CEPs) and workshops will be held to formalise and agree the training blocks, sequence of competencies/assessments, and writers per block. Once the materials are written, it will be circulated for external review and comment.

In designing the materials, emphasis will be put on:

- What is to be taught?
- How it is to be taught?
- How it is to be assessed?

The learning materials will be developed, through a series of workshops, in accordance with the Guide to Developing the National Occupational Curriculum Content for Apprentices of the 21st Century (NOCC-A21). This guide sets the foundation for writing materials for occupational qualifications that have recently been developed by the Quality Council for Trades and Occupations (QCTO) and registered by the South African Qualifications Authority (SAQA).
The learning material will centre around what the Dam Siltation Manager, Dam Siltation Controller and Networks and Partnerships Coordinator respectively need to do competently and confidently. This will be achieved through the application of work related Learning Areas (which becomes the various training blocks) and Learning Projects (which becomes the various training modules).
The Learning Areas and Projects will be link back to the Occupational Profile and its core Occupational Tasks, plus additional critical skills sets considered relevant in order to achieve the desired learning outcome.

Competence Packages (Units) for each Learning Project will be developed. The learning content and teaching methodology of each Learning Project are defined in detail through these competence packages. The competence packages clearly demonstrate the practical skills modules, underpinning knowledge modules and work experience modules required, and thus once again ensure the link back to the original QCTO Curriculum Framework. This assures that Practical Skills Modules, Underpinning Knowledge, and Work experience modules are viewed as a connected learning unit and not perceived and taught in isolated, separate units. These competence packages form the basis for the aim, outcome, study objectives and content of each Module. The competence packages further provide guidance on the applicable teaching methodology, resources required and assessment criteria associated with the learning project.

Further workshops will be held to develop the assessment criteria and methods; module topics to be covered; learning processes and methods; assessment tools and learning resources.

4.4 Register the skills programmes on the QCTO system

The QCTO is the final authority that records Skills Programmes on the QCTO Database. The process in registering the Skills Programmes is depicted in Figure 7.

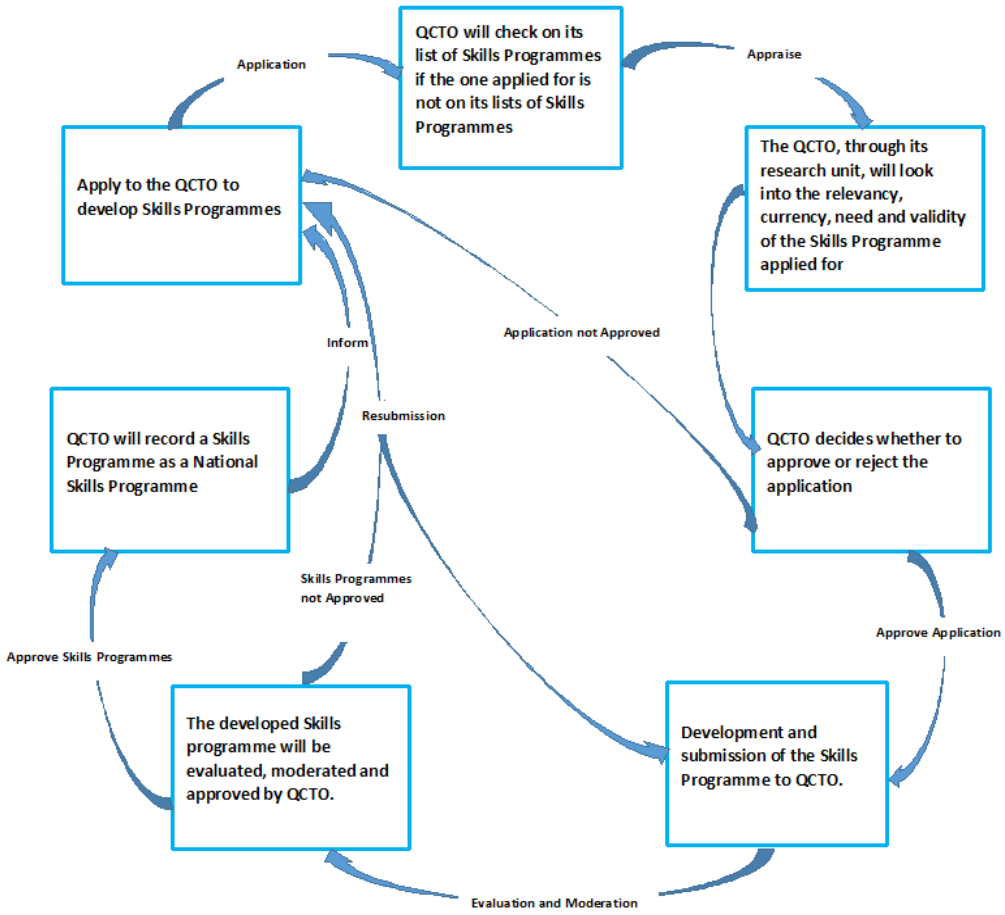

Figure 7: Skills Programmes registration process (Source: Adapted from https://qcto.org.za/index.php?option=com_edocman&view=category&layout=table&id=633).

Application will be made to the QCTO central office requesting the development of the set of skills programmes (see Table 3). Central office will acknowledge receipt of the application. Upon receipt of the application, the QCTO will check on its own List of Registered Skills Programmes if the ones applied for is not on its list. This is primarily done to avoid duplication. Once it is established that the Skills Programmes applied for is not on the list, the research unit of the QCTO, will look into the relevancy, currency, need and validity of the Skills Programme applied for. The QCTO will then subsequently decide whether to approve or not approve the application. If the QCTO decide not to approve the application, then it will then inform the applicant of such decision with valid reasons or recommendations. The applicant may reapply if the recommendations are implemented.

If the decision is to approve the application, the QCTO will inform the applicant who will then embark on developing the Skills Programmes. The developed Skills Programmes will be submitted to the QCTO for evaluation, moderation and approval. If the QCTO decide not to approve the developed Skills Programmes then it will then inform the applicant of such decision with valid reasons and recommendations. The applicant may resubmit once all recommendations are implemented.

Skills Programmes presented at QCTO Occupational Qualifications Committee for recommendation to council for approval. The Skills Programmes are then approved by Council and recorded by QCTO. The outcome is then communicated to the applicant. QCTO will record it as a National Skills Programme, added on the QCTO list of approved skills programmes and placed on the QCTO website. The applicant may now offer the Skills Programmes to prospective learners.

4.5 Pilot the skills programmes

The piloting of the skills programmes will be done at the selected pilot sites in order to move to the finalisation of the qualifications. Piloting will be managed through national systems and processes in order to establish a sense of ownership. The pilot examines how individual and organisational capacities can be enhanced through improved knowledge, personnel competencies and organisational processes, structures and systems. It will assist in acquiring knowledge to better design and implement systems, programs and services at the individual, organisational and institutional levels. The pilot includes carrying out capacity strengthening activities such as human resource development, skills training, introduction of new systems and technologies, and improvements in dam siltation management policies and procedures.

4.6 Monitoring, Evaluation, Reporting and Learning (MERL)

Progress, results and changes in siltation management performance and value created through learning will be measured throughout the project duration including the phase of piloting. The entire project will be complemented by M&E support through our own MERL system (Monitoring, evaluation, reporting and Learning). This is a reflexive M&E approach that specifically builds in reflection and learning. The project will also provide an analysis of data from the start and end of project.

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This is a reflexive M&E approach that specifically builds in reflection and learning and aims to serve a multiple purposes as depicted below:

Internal learning	Strategy and management	Accountability	Communication	External learning
•to guide internal strategy and improve project outputs	•which project processes are fruitful and which are not	•to WRC and DWS, management and partners	•success stories and areas that need attention, buidling a discourse	•to guide development partners, LED and build communities of practice

We propose this framework with the belief that traditional M&E systems often end up being focused on accountability or compliance at the expense of learning – especially when they are imposed as an external requirement (contract, funder etc.). For example, it is common to report almost exclusively against quantitative indicators.

While this makes it easy for funders to aggregate data across projects, it reduces the chance that project implementers will reflect on (and report) unexpected outcomes, including failures, disruptions and contradictions – all valuable opportunities for learning. Also, traditional M&E frameworks tend to assume that what needs to be done is known from the start, and that project activities can therefore be planned in a linear sequence leading to the desired outcomes. They do not consider that understanding of the very nature of the problem may change or emerge along the way.

The MERL framework under SP4 will not separate the monitoring and evaluation functions from the reflection and learning. We recognise that monitoring (routine collection of data) is frequently the task of program implementers while evaluation (sense-making based on the monitoring data) is undertaken by external experts and project reference committee, often only at the end of the project when the final report is submitted. The project will also provide an analysis of data and reflexive learning from the start to end of project as depicted in the figure 8.

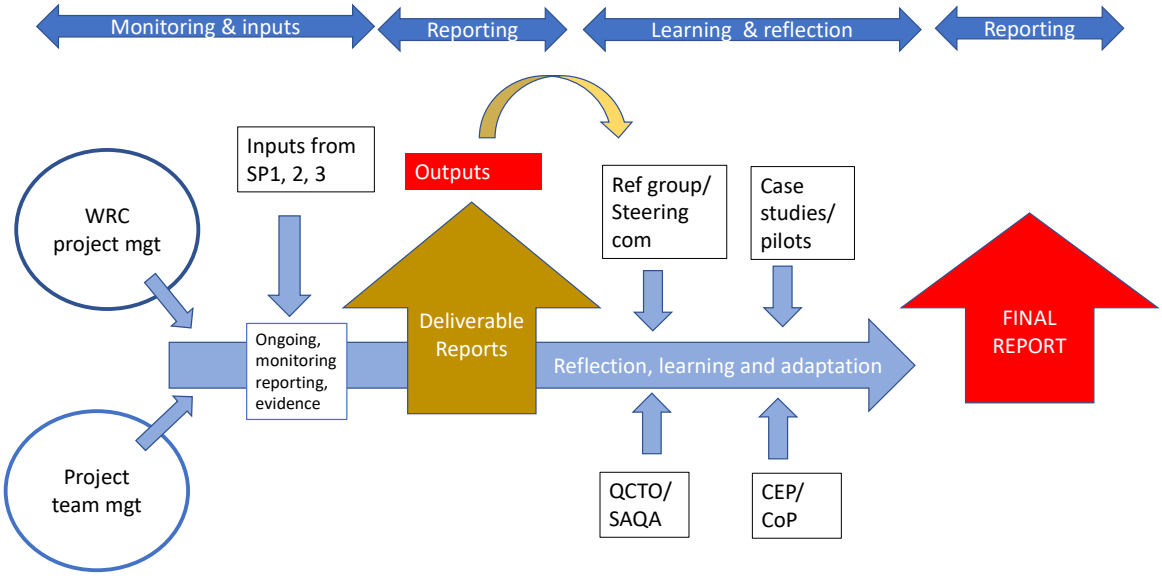

Figure 8: Schematic representation of the Monitoring, Evaluation, Reporting and Learning Framework for SP4 (adapted from AWARD Tech Report 18, 2020).

Theory of change

The theory of change for SP4 is presented below and a series of states that will be influenced by the activities conducted by SP4. The theory of change provides a framework again which SP4 can evaluate progress over life of project. It is also the basis for the development of the results framework below.

FROM:

- Dam Siltation Management not recognised as a integral part of IWRM in South Africa
- No qualified DMS management practitioners available in South Africa
- No qualifications or skills programmes registered for DSM in SA
- No learning materials or learning programmes available in SA
- No mechanisms for training available for DSM in SA
- No active discourse on DSM in SA SMME and civil society

SP4 activities and outputs

TO:

- Dam Siltation Management recognised as a integral part of IWRM in South Africa
- A new cohort of qualified DMS management practitioners available in South Africa
- Two skills programmes registered for DSM in SA
- Learning materials and modules available in SA
- E learning platform registered and functioning for DSM training in SA
- New discourse for the value and importance of DSM in civil society and business in SA

Figure 9: Theory of change for SP4.

Results framework for Capacity development for dam siltation management in South Africa
The DRAFT results framework for SP4 is presented below. Details and specifics related to indicators will be confirmed at the refence group and steering committee meetings

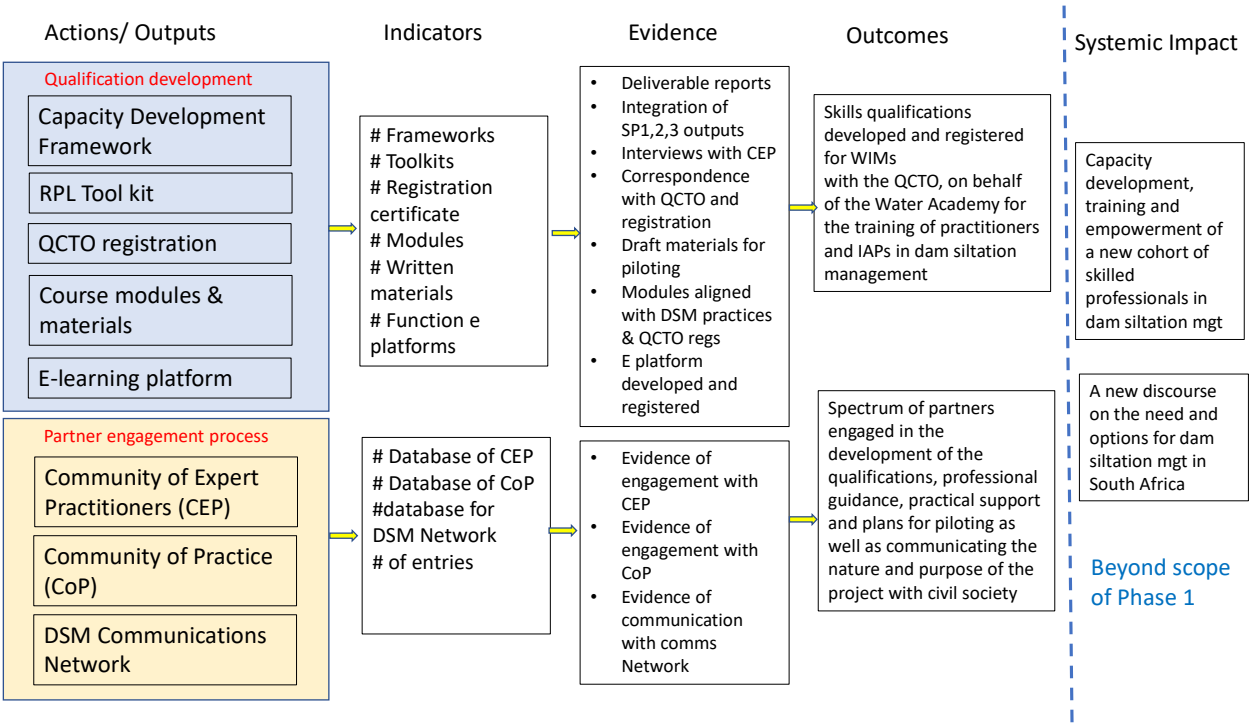

Figure 10: DRAFT results framework for SP4

5 Recognition of prior learning

"Recognition of Prior Learning (RPL) is the formal acknowledgement of the knowledge, skills, expertise and capabilities that people possess as a result of the prior learning that may have occurred through formal, informal or non-formal means – through self-study, work or other life experiences" (https://www.uwc.ac.za/admission-and-financial-aid/recognition-of-prior-learning).

A pragmatic framework and process will be developed to enable individuals to gain credits and enter the Skills Development Programmes, thereby saving time and effort. The RPL toolkit will therefore outline a process of vetting informal and non- formal learning for access and redress and support the acceptance and uptake of the QCTO approved Skills Development Programmes.
The scope of the work in this regard is:

- Set up a legacy qualification equivalence framework based on the commonalities and differences between legacy and new occupational qualification.
- Develop a baseline for the scope and scale of RPL candidates in collaboration with key which will facilitate targeting and implementation of the proposed RPL toolkit.
- Engage stakeholders on RPL targets and context.
- Develop a RPL toolkit appropriate the equivalence framework, the targets and the context to conduct RPL at a particular site.

- Conduct a validation and capacity building workshop on the legacy qualification equivalence framework, proposed RPL toolkit and practical context to prepare for implementation.
- Develop a RPL implementation plan.
- Plan for future RPL capacity building

5.1 Set up a legacy qualification equivalence framework

A desktop study will be conducted to determine commonalities and differences between legacy and new occupational qualification. To determine equivalence, unit standards of the legacy qualifications will be evaluated in relation to the Knowledge component & Application component and the requirements and occupational tasks as outlined in the Skills Development Programmes. The equivalence framework will propose topics and modules for which exemptions may be evident based on the evaluation.

5.2 Develop a baseline for the scope & scale of RPL candidates

Municipalities and Labour will be contacted submit information on candidates who have obtained the Environmental Practice or equivalent environmental related (levels 4 - 5) qualifications. These candidates will be contacted to submit qualifications and experience details for individual classification. These databases will be investigated to develop an appropriate profile of the potential RPL candidates which will inform the targeting and practical roll-out proposed RPL toolkit.

5.3 Engage stakeholders on RPL targets & context

Relevant and appropriate stakeholders will be identified and engaged with to verify RPL targets and context. The RPL targets will be those who have been performing environmental science technician functions without the requisite qualification. They may have undergone short courses, completed aspects of the legacy qualifications, on the job training and have the work experience but lack formal certification. The profile of these RPL candidates will provide the context for the development of the RPL toolkit

5.4 Develop a RPL toolkit appropriate to the context

The toolkit will outline the context and the aims, processes, procedures, quality control and critical elements. Templates as required by the process will also be developed. The toolkit will be developed with a reference group at a local municipality. Engagement with HR practitioners and supervisors will be explored as part of the reference group process to ensure appropriateness for context and uptake. The process for the recognition non-formal training for formal credits will be a key consideration in this regard.

5.5 Conduct a validation and capacity building workshop to prepare for implementation

Once the toolkit has been developed, a validation workshop will be held under the auspices of the LGSETA, Department of Environmental Affairs and Labour to present the findings of the study as well as the RPL toolkit for refinement and validation. The workshop will also provide inputs into a plan for piloting and implementation in the ensuing financial year. During this phase the capacity needed, to implement RPL, will be identified.

5.6 Develop a RPL implementation plan

A RPL implementation plan will be developed with relevant and appropriate stakeholders. The plan will emphasise and concentrate on the:

- Aim and objective of RPL implementation
- Roles and responsibilities of the implementers
- Process for implementing
- Major Tasks: Major milestone activities for implementation
- Implementation Schedule
- Implementation Support/Resources required
- Monitoring performance, and evaluation of implementation

5.7 Develop a plan for future RPL capacity building

A plan will be developed to capacitate potential skills development providers. Relevant and appropriate skills development providers need to be inducted into the RPL process. The inductees must be introduced to the RPL cycle, the task and its sub components, purpose, outcomes and assessments. The skills development providers who lack the capacity needed to implement RPL will have to be trained and assessed.

6 Alignment of the Capacity Development Framework with the outputs of Sp1,2&3

The NatSilt programme under DWS is built on the design of multiple sub projects providing different components to the overall outcome for dam siltation management in South Africa. The complexity of this design means that the outputs, tools and recommendations of multiple research processes need to be aligned form the outset in order to avoid fragmented research outcomes.

The WRC background documentation implies that the National Siltation Management Strategy (developed by SP1) will be designed to enable the other three key sub projects to cross-pollinate. They anticipate that the sub-groups will be comprised of communities (public), engineers, scientists, agencies, consulting firms, industry and academic experience and expertise to be drawn upon. This approach is expected to ensure that the strategy and the implementation plan will enable government departments, Catchment Management Agencies, dam managers/operators, other key sector role players, policy makers and regulators and interested public on dam and catchment sedimentation to ensure improved water security, socio-economic and economic development in South Africa. The schematic for the draft DSM strategy is reflected in figure 11.

Figure 11: Schematic for the draft DSM strategy.

The challenge for SP4 is to ensure that the outputs are aligned with the capacity development and qualifications development processes. And although the WRC project management team and steering committee hold overarching integration functions the nature of sub project 4 intrinsically means that integration and alignment need to be conducted for the DSM qualifications to be developed. This means that various components will need to be extracted from the DSM Strategy and transformed in to curriculum content, skills development and learning processes at the appropriate NQF level.

The specific dam-siltation management skills that are needed and the supporting institutional structures, will be foundational to the development of appropriate and relevant training and capacity development tools and processes. This will require continuous collaboration with the other three SPs and CEP to ensure appropriate alignment and development of a Recognition of Prior Learning strategy and toolkit for the Water Infrastructure Occupational Qualification (Figure 12).

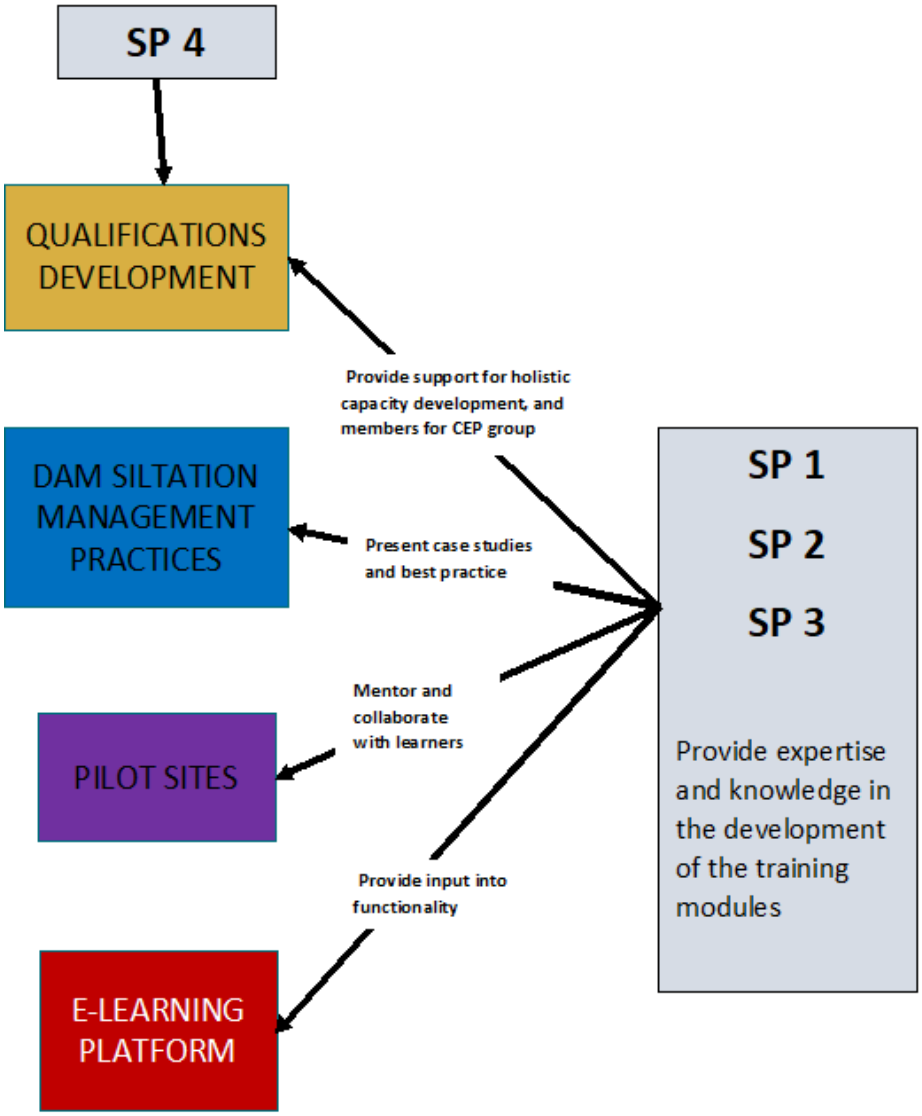

Figure 12: Alignment framework.

The nature of the alignment is specific to the particular tasks conducted under SP4 (see figure 12). The nature of the alignment is expected to be refined as project activities progress. However, there is a need to be clear as the details for alignment so that there is not overlap or the risk of stakeholder fatigue. Figure 12 provides a broad idea of the way that the different SPs will provide inputs into different components of SP4. Table 4 below is the proposed instrument for negotiation of alignment with the other SPs.

TABLE 4: ALIGNMENT OF ISSUES, TOPICS, TOOLS AND PROCESSES WITH SP4

Sub project	Output/Deliverable	Target Date	Deliverable? (Y/N)	Alignment issues/topics/ tools/process es for SP4
All	Workshop 1: Visioning, key issues and other SP visions	April/May		
SP1	Implementation Framework	31-07-2021	Y	TBD
SP1	Community/SMME/Beneficiation Models	31-08-2021	Y	TBD
All	Workshop 2: Alignment with other SPs	September/ earlier?		
SP1	M&E Indicators and Reporting Framework	30-09-2021	N	TBD
SP1	Strategic Risk Management Consolidation and Framework	31-10-2021	N	TBD
SP1	Final Strategy and Implementation Plan	31-12-2021	Y	TBD
SP2	Literature Review	28-02-2021	N	TBD
SP2	Workshop 1: Dam classification tool collaboration	April		TBD
SP2	Dam Classification Tool	30-06-2021	Y	TBD
SP2	Workshop 2: Dam operations model	May		TBD
SP2	Dam Cost Benefit Operations Model	31-08-2021	Y	TBD
SP2	Institutional and Financing Guidelines	31-07-2021	Y	TBD
SP2	Dam operations model pilot testing report	26-08-2021	Y	TBD
SP2	Final report	30-11-2021	Y	TBD
SP3	Literature Review	01-03-2021	Y	TBD
SP3	Model and Protocols	01-06-2021	Y	TBD
SP3	Final Report	30-09-2021	Y	TBD

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Appendix 1

Qualifications terminology

Assessment Quality Partner (AQP)
A body delegated by the QCTO to develop assessment instruments and manage external summative assessment of specific occupational qualifications.

Credit Accumulation and Transfer (CAT)
An arrangement whereby the diverse features of both credit accumulation and credit transfer are combined to facilitate lifelong learning and access to the workplace.

Credit
A measure of volume of learning required for a qualification, quantified as the number of notional study hours required for achieving the learning outcomes specified for the qualification. One (1) credit is equated to ten (10) notional hours of learning.

Development Quality Partner (DQP)
A body delegated by the QCTO to manage the process of developing specific occupational qualifications, curricula and assessment specifications.

Occupational Qualification
A qualification that consists of a minimum of 25 Credits associated with a trade, occupation or profession. It results from work-based learning, consists of three components (knowledge, practical skills and work experience) and has an external summative assessment.

National Qualifications Framework (NQF)
The comprehensive system approved by the Minister of Higher Education and Training for the classification, co-ordination, registration and publication of articulated and quality-assured national qualifications. The South African NQF is a singled integrated system comprising three coordinated qualifications sub-frameworks for: General and Further Education and Training; Higher Education; and Trades and Occupations.

Occupational qualification document
The QCTO methodology document that defines the learning required to be competent to practise an occupation or occupational specialisation.

Qualification
A planned combination of learning outcomes which has a defined purpose or purposes, intended to provide qualifying learners with applied competence and a basis for further learning and which has been assessed in terms of exit level outcomes, registered on the NQF and certified and awarded by a recognised body.

Qualification type
The classification of a qualification within a sub-framework of the NQF.

QC
One of the three Quality Councils established to develop and manage each of the sub-frameworks of the NQF: CHE for the HEQSF; Umalusi for the GFETQSF; QCTO for the OQSF.

QCTO
The Quality Council for Trades and Occupations established in terms of the NQF Act of 2008. It is tasked to achieve the objectives of the NQF and to develop and manage the OQSF.

RPL
The principles and processes through which the prior knowledge and skills of a person are made visible, mediated and assessed for the purposes of alternative access and admission, recognition and certification, or further learning and development.

SETA
A body established in terms of the Skills Development Act to develop and implement sector skills plans and promote learning programmes, including workplace leaning. The QCTO has delegated quality assurance powers to the SETAs.

SAQA
The statutory authority established in terms of the NQF Act of 2008 (which replaced the SAQA Act of 1995) to oversee the further development and implementation of the NQF, the achievement of the objectives of the NQF, and the coordination of the three sub- frameworks.

Sub-framework of the NQF
One of three coordinated qualification sub-frameworks which make up the NQF as a single integrated system: the Higher Education Qualifications Sub-Framework, the General and Further Education and Training Sub-Framework and the Occupational Qualifications Sub- Framework.

Trade
An occupation for which an artisan qualification and relevant trade test is required in terms of the Skills Development Act. SETAs are required to apply to NAMB to have an occupation listed as a trade.

Workplace-based learning
The exposure and interactions required to practice the integration of knowledge, skills and attitudes required in the workplace.