Fact Sheet on PUB's Thematic Request for Proposal (RFP) 21/01 on Recovering Chemicals & Minerals from the Water Loop

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Background

1. The Competitive Funding for Water Research (CWR) is a competitive funding scheme under the Urban Solutions & Sustainability (USS) domain. The aim of the CWR is to fund basic / applied R&D projects, which possess recognisable potential for developing into innovative solutions for the water industry.

Present call

2. Singapore is a water stressed country. While it has built up a diversified water supply through its Four National Taps, Singapore's water demand is projected to increase and double by the year 2060. Amidst the projected increase, coupled with climate change and other uncertainties in the global context, it is critical to ensure that Singapore's water supply remains resilient and sustainable to continue supporting the nation's growth.

3. As a small city state, Singapore has always been aware of the need to balance economic development and environmental sustainability. Reducing waste and adopting a circular economy approach will benefit the environment and create economic opportunities. This thematic RFP hence solicits technologies and solutions that can recover the following two categories of useful resources:

    i) Chemicals needed in water and used water treatment processes from local waste streams (including, but not limited to, waste streams produced by PUB).
    ii) Rare metals relevant to industries (e.g. lithium, caesium, barium, etc.) from seawater desalination brine.

4. To facilitate proposal preparation, information on (i) the chemicals used in PUB's water and used water treatment processes, and (ii) the waste streams produced is provided in **Appendix A**. Please note that the information is indicative, and separate sampling tests can be arranged for shortlisted proposals subsequently where applicable.

    a. Table 1: Chemicals typically used in PUB's water and used water treatment processes
    b. Table 2: Specifications of chemicals to be recovered
    c. Table 3: Typical waste streams produced in PUB

    The applicants may refer to **Appendix B** for information on the typical water and used water treatment processes in PUB.

5. Some information on the recovery of metals and minerals from seawater desalination brine is provided in **Appendix C** for reference. Applicants are free to propose the technologies shown there, or any other technology suitable for the metal(s) being recovered.

6. The Applicant shall clearly indicate the details of the waste streams used, the specific area of application and the target specifications of the recovered resources.

7. The anticipated performance of the technology to recover the chemicals or metals (e.g. cost of recovery, quality, quantity, etc) is to be articulated in the proposal and will form part of the project deliverables. In addition, for proposals involving chemicals used in PUB, it should be noted that on-site recovery and reuse is preferred, and so the footprint of the proposed technology will be an important consideration. A techno-economic analysis should also be provided in proposals submitted for recovering rare metals for industry.

8. Proposals with industry collaborators are encouraged. With other factors being equal, such proposals will be preferentially selected.

9. All the proposals submitted shall articulate the advancement of the proposed technology against the current global state-of-the-art at the system level. The Technology Readiness Level (TRL) of the proposed technology has to be stated in the proposal. At the end of the project, the TRL is expected to progress by at least two levels, unless otherwise justified in the proposal. Please refer to **Appendix D** for the definitions of TRLs.

10. All research activities have to be carried out in Singapore. Cross-disciplinary and multi-disciplinary research proposals are strongly encouraged, as well as proposals from research consortia involving partners drawn from different private and public organisations and academic institutions, including international collaborations with renowned experts to introduce new research capabilities and transfer of technical expertise to Singapore. Proposals with industry collaborators and commitments in the form of industry spending will be viewed favourably.

11. R&D proposals already funded by other agencies or being considered for funding by other agencies will not be considered under the present call. Applicants will need to declare other funding sources in the application.

Eligibility Information

12. This call is open to Institutes of Higher Learning (IHLs), public sector entities and private sector companies based locally in Singapore. Under this Thematic RFP, IHLs and public sector entities will qualify for 100% funding support of approved qualifying costs and 30% overheads. Funding support for non-Singapore entities is up to 30%, Large Local Enterprises up to 50%, Singapore Small Medium Enterprises, start-ups and not-for-profits up to 70%.

Application Procedure

13. To apply, the Applicant must submit the proposal using the 'CWR Research Proposal Form', which can be downloaded from the online Integrated Grant Management System (IGMS)[1]. Please refer to **Annex A** for detailed guidelines for the submission of the Proposal and **Annex B** for guidance on creation of account in IGMS.

[1] https://researchgrant.gov.sg

14. The proposal shall include, but not limited to:

    i. Scientific principles

    ii. State-of-the-art comparison, including a technical review of the technology proposed against the latest technologies.

    iii. Full technical details on the methodology and technological development of the proposal, e.g. whether the technology will be developed starting from bench-, to pilot-, or demonstration-scale, and/or to eventual commercialisation. The applicant should also consider the proposed technology holistically from a system perspective (i.e. the requirements of the technology as a system if it is to be implemented).

    iv. Commercial viability of the project, including target markets for application of the technology or findings from the project.

    v. Clear description of a general business plan that addresses items, such as, but not limited to, competitive analysis, go-to-market strategy, revenue model, commercialisation plan, as well as manufacturing and validation at scale. The plan should also highlight how the Intellectual Property (IP) created will be owned and commercialised, and how the benefits from these commercialisation plans can be accrued to Singapore.

    vi. The proposed team members' expertise, previous related work and experience (2-page CVs shall be submitted for the Lead Principal Investigator, as well as for all co-PIs and collaborators).

    vii. Detailed budget required for the project (broken down into individual categories of manpower, equipment, consumables, travel, consultancy services, others).

    viii. Timeline for the project, showing intermediate milestones to be achieved.

    ix. Expected research outputs and outcomes and proposed key performance indicators (KPIs) for the project.

15. The deadline for the Proposal submission is on **26 November 2021, 4:00 pm** (Singapore time, GMT +08:00).

Evaluation Criteria

16. Proposals received shall be sent to international peer reviewers for technical/scientific merit review. If appropriate, proposals from academia may also be sent to Industry Resource Persons (for commercial viability) and relevant national agencies (for national relevancy) for review. This is then followed by evaluation by CWR's Project Evaluation Panel (PEP), which comprises local and international experts as members. The PEP shall evaluate the proposal based on the criteria given in Para 17, referencing

reviews from international peer reviewers, and make a recommendation whether to fund it.

17. All Proposals are evaluated against the following criteria:

    i. Excellent science and cutting-edge technology with proposed activity involving innovative and cutting-edge research that seeks to bring together the best R&D talent available.

    ii. Significant economic or social benefits to be accrued to Singapore through either tangible measures (creation of intellectual property, start-up companies, spin-out enterprises, etc) or potential for commercialisation into new products, services or technologies deployed to solve national needs.

    iii. Robust management and governance with adequate checks and balances, a clear structure of accountability, as well as reasonable milestones and deliverables.

    iv. Reasonableness of the proposed budget.

Estimated Budget

18. Funding support for each Research Proposal awarded will not exceed **S$2 million**. The Applicant should contribute in-kind services, cash, or a combination of the two towards the proposed project. In-kind services can include labour, materials, and other services. In-kind contributions demonstrate the participation and commitment of the applicants to the project.

Maximum Project Duration

19. The maximum funding period for each Research Proposal is **3 years**.

Point of Contact

20. For more information, please contact Dr Peng Na (PENG_Na@pub.gov.sg) from PUB Singapore.

~ End ~

Appendix A: Chemicals typically used in water and used water treatment and the waste streams generated

Table 1: Chemicals typically used in Singapore's water and used water treatment processes

S/N	Chemical	Concentration	Total usage (tonne/yr)^	Main Application
1	Sodium Hypochlorite	6%	17,000	Chlorination; Membrane cleaning
		12%	7,000	
2	Hydrated Lime	92%	5,000	pH adjustment
3	Aluminium Sulphate	8% (solution)	8,000	Coagulation; Phosphate removal
		17% (rock)	1,000	
4	Sodium Hydroxide	50%	6,000	Membrane cleaning; pH neutralisation
5	Ammonium Sulphate	25% - 30%	2,000	Chloramination
6	Low Bromide Sodium Chloride	99.5%	1,000	Electrochlorination
7	Ferric Chloride	38%	500	Coagulation; H_2S control
8	Citric Acid	35% / 50%	600	Membrane cleaning
9	Aluminium Chlorohydrate	50%	1,000	Coagulation

^Figures provided are rounded and indicative and may vary across time period.

Table 2: Specifications of chemicals to be recovered

Table 2.1 Sodium Hypochlorite

Characteristics	Requirement
Concentration	In water w/v of 5% -6.5% chlorine
Free NaOH	< 2.5% w/w
Iron	< 1.5 mg/L
Bromate	SPAC of 3.5 µg/L
Chlorate	SPAC of 300 µg/L
Perchlorate	SPAC of 5 µg/L
Antimony	SPAC of 0.6 µg/L
Arsenic	SPAC of 1 µg/L
Barium	SPAC of 200 µg/L
Beryllium	SPAC of 0.4 µg/L
Cadmium	SPAC of 0.5 µg/L

Characteristics	Requirement
Chromium	SPAC of 10 µg/L
Copper	SPAC of 130 µg/L
Lead	SPAC of 1.5 µg/L
Mercury	SPAC of 0.2 µg/L
Nickel	SPAC of 20 µg/L
Selenium	SPAC of 5 µg/L
Thallium	SPAC of 0.2 µg/L

*SPAC: Single Product Allowable Concentration

Characteristics	Requirement
Concentration	In water w/v of 10% -14% chlorine
Free NaOH	< 5% w/w
Iron	< 3.0 mg/L

Table 2.2 Hydrated Lime

Characteristic	Requirement
Calcium Oxide (as CaO)	69.6% w/w minimum
Calcium Hydroxide ($Ca(OH)_2$)	92% w/w minimum
Grading Test	Minimum 92% passing BS 410 sieve (75 microns)
Total Carbonates (as $CaCO_3$)	6% w/w maximum
Arsenic (as As)	10 ppm maximum
Lead (as Pb)	5 ppm maximum

Table 2.3 (a) Aluminium Sulphate - liquid

Characteristic	Requirement
Water soluble aluminium compounds as alumina (Al_2O_3)	> 8% w/w
Compounds as Al	> 4.23% w/w
Basicity, as free Al_2O_3 %	0.1% (w/w) max
Free acid, as H_2SO_4	0.05% (w/w) max
Insoluble matter	0.2% w/w max
Iron, as Fe_2O_3	0.35% w/w max
Heavy metals as Pb	100 ppm max
Arsenic, as As	40 ppm max
pH at 25°C	Between 1.8 – 2.5 in 8% solution

Table 2.3 (b) Aluminium Sulphate - rock

Characteristic	**Requirement**
Matter insoluble in water, % (w/w), maximum	0.5
Water soluble compounds as alumina (Al_2O_3), % (w/w), minimum	17.0
Iron as Fe_2O_3, % (w/w), maximum	0.75
Combined sulphuric anhydride (SO_3), % (w/w), minimum	38.0
Free acid (as H_2SO_4), % (w/w) maximum	0.1
Heavy metal, % (w/w), maximum	0.01
Arsenic, % (w/w), maximum	0.01

Table 2.4 Sodium Hydroxide

Characteristics	**Requirement**
Concentration	≥ 48% w/w
Arsenic (as As)	Not more than 3 mg/kg, calculated on the basis of sodium hydroxide determined in the Assay
Carbonate (as Na_2CO_3)	Not more than 3.0%, calculated on the basis of sodium hydroxide determined in the Assay
Heavy Metal	Not more than 0.002%, calculated on the basis of sodium hydroxide determined in the Assay
Lead	Not more than 10 mg/kg, calculated on the basis of sodium hydroxide in the Assay
Mercury	Not more than 1 mg/kg, calculated on the basis of sodium hydroxide determined in the Assay

Table 2.5 Ammonium Sulphate

Characteristics	**Requirements**
Concentration, as $(NH_4)_2SO_4$	≥ 25% w/v
Pyridine, Maximum	12.5 mg/kg
Ether-Soluble Matter, Maximum	7.5 mg/kg
Cyanide	None Detected
Caprolactam, Maximum	0.05% by weight

Table 2.6 Low Bromide Sodium Chloride

Characteristics	**Requirement**
Dry Sodium Chloride (NaCl)	> 99.5 %
Insolubles	< 0.01 %
Moisture	< 2.5 %
Calcium (as Ca)	< 0.03%
Magnesium Chloride	< 0.06%
Magnesium Sulfate	< 0.02%

Characteristics	Requirement
Aluminium (Al)	< 0.5 mg/kg
Arsenic (As)	< 0.5 mg/kg
Copper(Cu)	< 2.0 mg/kg
Lead (Pb)	< 2.0 mg/kg
Cadmium (Cd)	< 0.5 mg/kg
Mercury (Hg)	< 0.5 mg/kg
Iron (Fe)	< 4.0 mg/kg
Fluoride	< 0.1 mg/kg
Manganese (Mn)	< 0.5 mg/kg
Bromide (Br)	< 120 mg/kg

Table 2.7 Ferric Chloride

Characteristics	Requirement
$FeCl_3$	≥ 38% w/w
$FeCl_2$	≤ 2.5% w/w of total Fe
Free Acid Express as HCl	≤ 1.0 % w/w
Total insoluble Matter	≤ 0.2 w/w

Table 2.8 Citric acid

Characteristics	Requirement
Concentration	≥ 35% w/v
Arsenic	≤ 1 ppm
Calcium salt	No precipitate formed in the solution
Iron	≤ 1.75 ppm
Heavy metals	≤ 1.75 ppm
Chloride	≤ 5.25 ppm
Oxalate	≤ 35 ppm

Table 2.9 Aluminum chlorohydrate

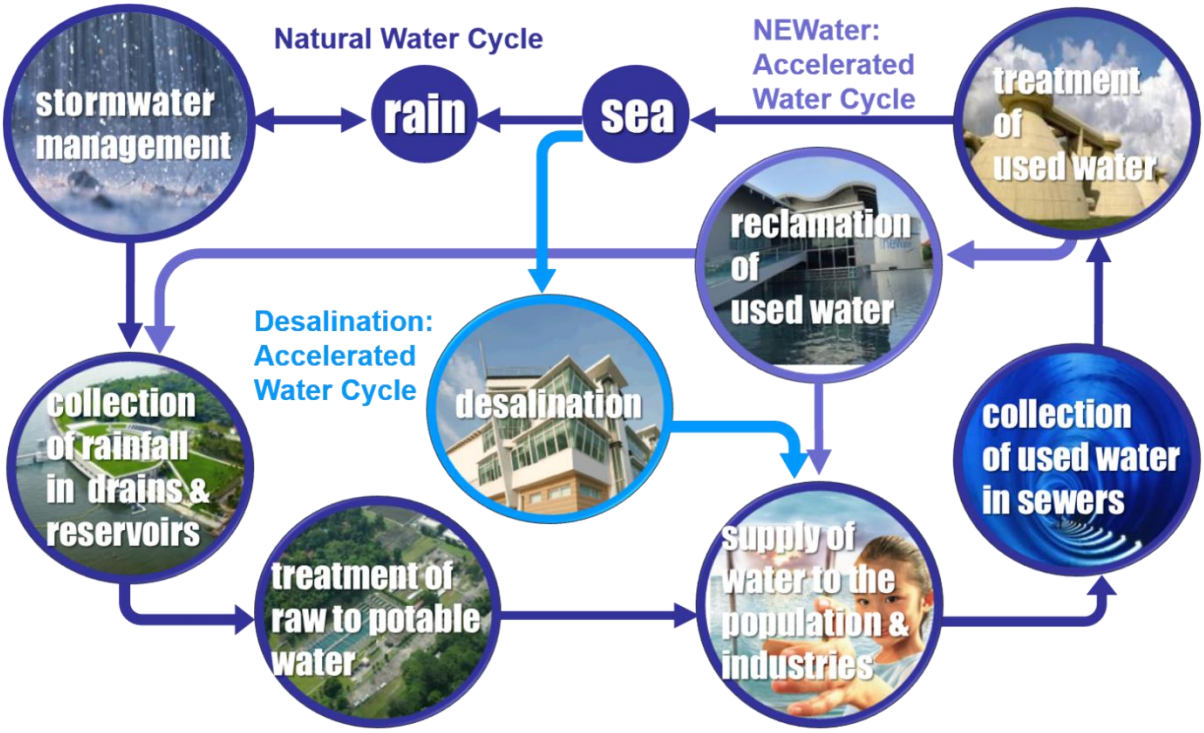
Characteristics	Requirement
Total Aluminium as alumina (Al_2O_3)	22% w/w minimum
Total Aluminium as Aluminium Chlorohydrate, $Al_2(OH)_5Cl$	48% minimum
Chloride (Cl^-)	< 8.5% w/w
Basicity	80% minimum
Iron	100 ppm maximum
pH at 25ºC (Diluted to SG 1.08)	3.0 to 5.0

Table 3: Typical waste streams generated

Facility	Waste streams	Quantity	Composition		
			Parameter	**Unit**	**Quantity^**
Water Reclamation Plants	Sewage Sludge (Dewatered)	200,000 tonnes/yr	C H N S Ca Fe TKN	% % % % mg/kg mg/kg mg/kg	40 6 6 1 30,000 9,000 60,000
	Sewage Sludge (Dried)	30,000 tonnes/yr			
	Dewatering Centrate	10,000 m^3/day	COD TKN Ammonia	mg/L	840 1,200 1,000
Waterworks	Freshwater Sludge	16,000 tonnes/yr	Cl SO_4 Al Fe Na	% % mg/kg mg/kg mg/kg	0.7 7.5 200,000 8,000 300
Desalination Plants	Seawater RO Brine	120,000 m^3/day	Ca Na Fe Cl NH_4 SO_4	mg/L	900 20,000 1.0 35,000 0.4 5,000
NEWater factories	NEWater Brine	60,000 m^3/day	Cl SO_4 Ca	mg/L	300 240 100

^Figures provided are indicative and may vary across plants and time period.

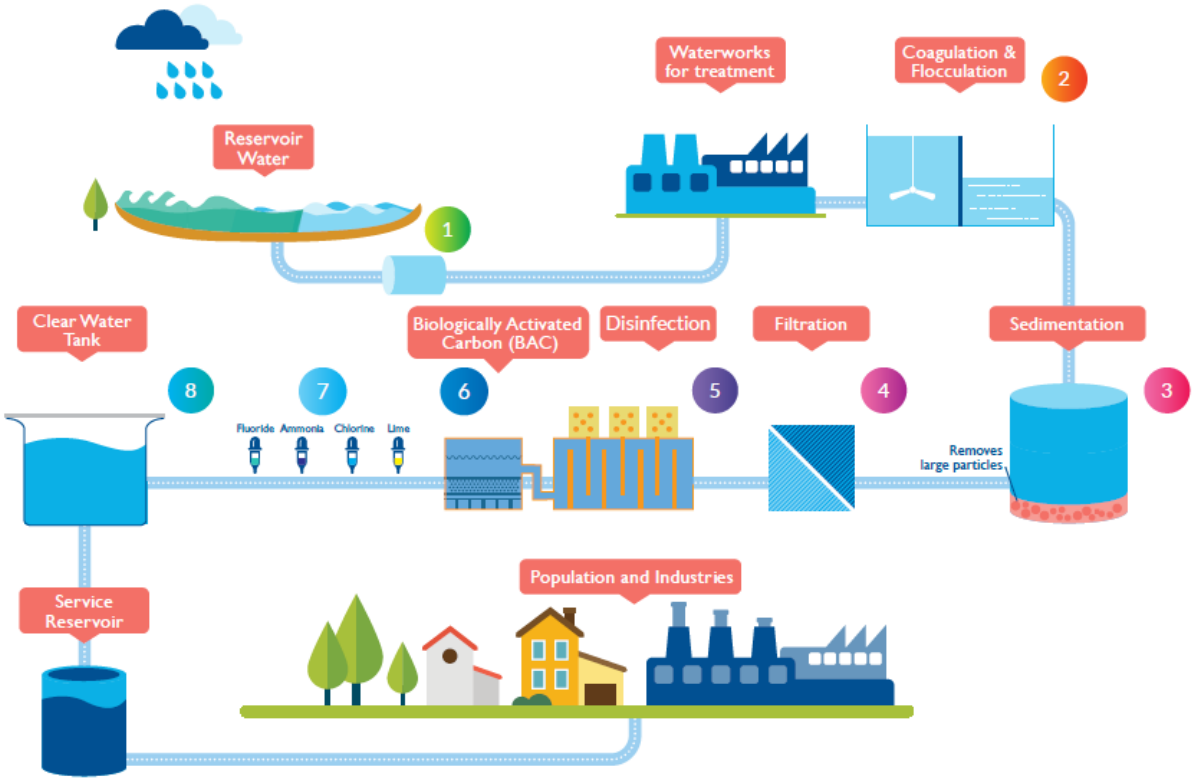
Appendix B: PUB's Water Loop and Typical Water/Used Water Treatment Processes



The Concept of a Closed Water Loop

1. Treatment of Raw (local catchment water, imported water) to Potable Water

The product water quality shall meet the Environmental Public Health (EPH) (Water Suitable for Drinking) (No.2) Regulations 2019, with details to be found in following website: https://www.pub.gov.sg/Documents/Singapore_Drinking_Water_Quality.pdf. The current treatment process in PUB's Water Supply Plant (WSP) is shown below.



① Screening:
Water is pumped through self-cleaning screens to remove particles greater than 1mm.

② Coagulation & Flocculation:
Coagulants and coagulant-aids like alum (aluminium sulphate) are added to bind or "flocculate" smaller suspended matter and particles, such as silt and sand, to form larger and heavier clumps. Lime is added to adjust pH prior to coagulation in some plants.

③ Sedimentation:
Particles combine into larger clumped particles that settle to the bottom of the tank and are removed.

④ Filtration:
The water then passes through either rapid sand filter or membranes to remove the finer residual particles of up to 0.02 microns.

⑤ Disinfection:
After filtration, the water is disinfected with chlorine (hypochlorite or electrochlorination) or ozone to kill all harmful bacteria and viruses.

⑥ Biologically Activated Carbon (BAC):

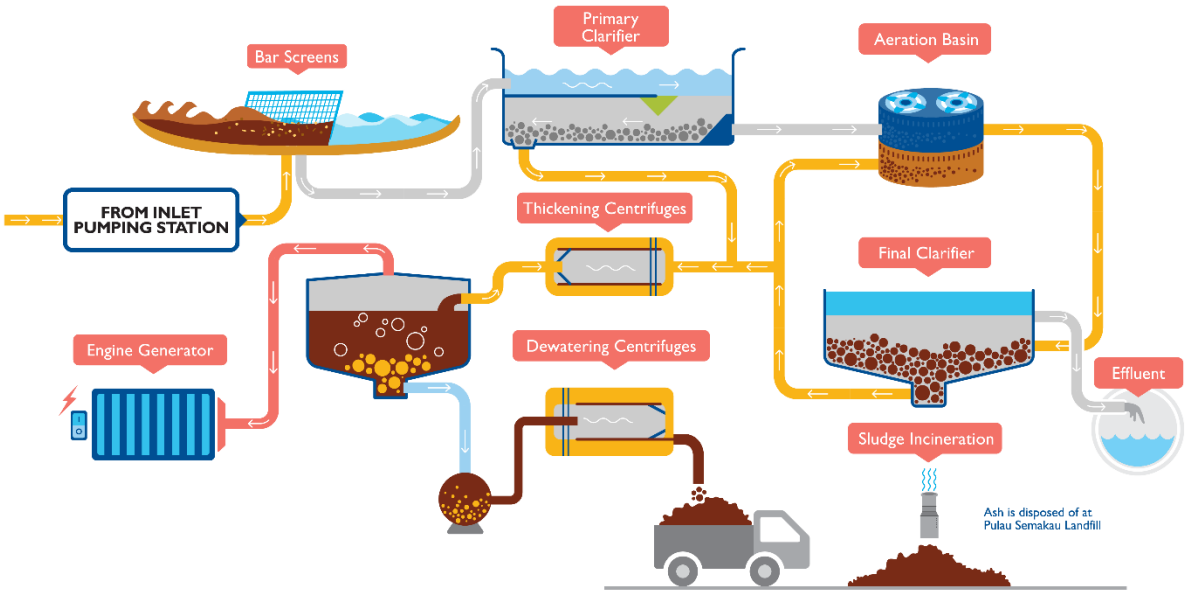
Granular activated carbon filters remove natural organic matter, making the water biologically-stable.

⑦ Residual Treatment:
The water is dosed with lime (to balance the pH of water), chlorine and ammonia (to maintain the water quality in the distribution system), as well as fluoride (to prevent tooth decay).

⑧ Clear Water Tank:
After residual treatment, water is stored in the clear water tank, before pumping to the service reservoirs for distribution to customers.

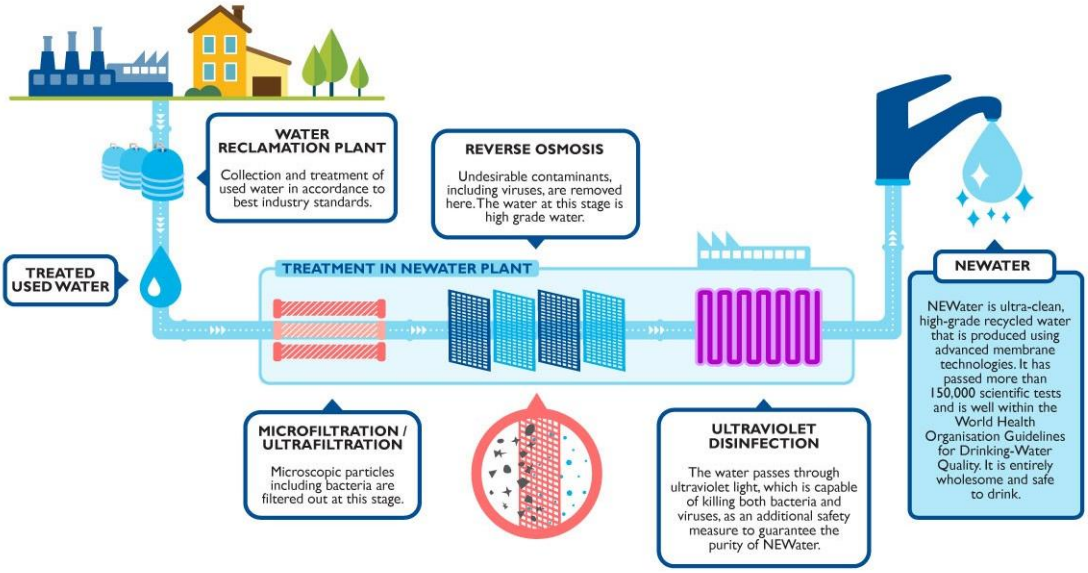
2. Treatment of Used Water

Used water from both domestic and non-domestic sources is treated at four water reclamation plants. Refer to the illustration below for the treatment process.



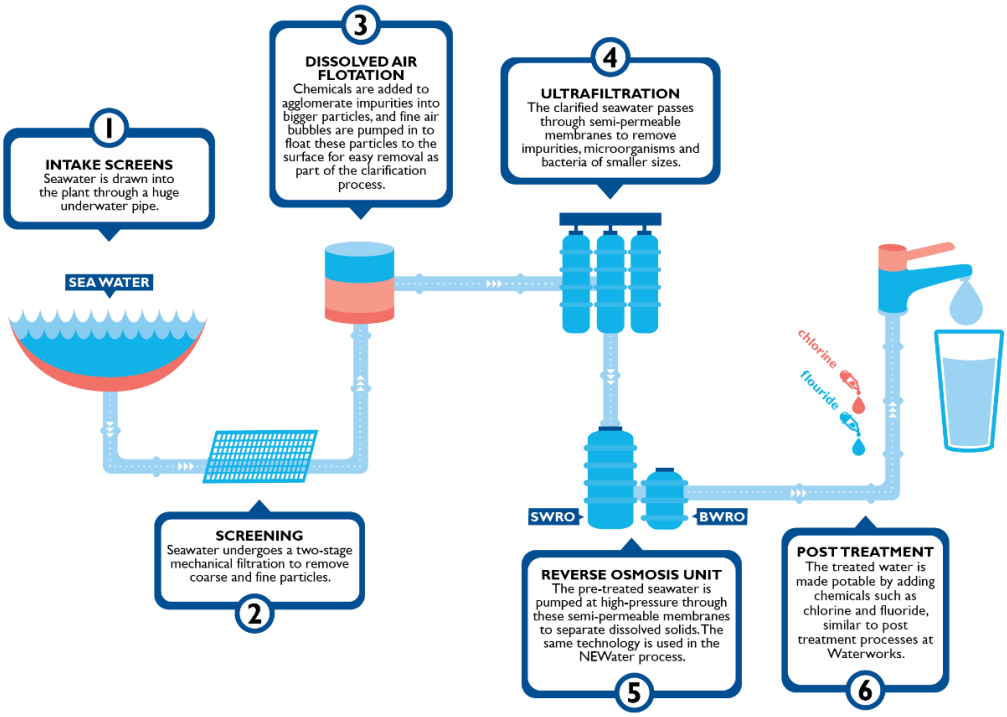
3. NEWater

The NEWater process recycles the treated used water into ultra-clean, high-grade reclaimed water, cushioning Singapore's water supply against dry weather and moving Singapore towards water sustainability.



4. Desalination

As Singapore is surrounded by sea, PUB has turned seawater into drinking water. And we continue to invest in research and technology to find more efficient ways to desalinate seawater. The current desalination process in Tuas Desalination Plant is shown below.



Appendix C: Additional Information on Recovery of Metals/ Minerals from Seawater Desalination Brine

1. Patent Scan on Mineral Recovery from Seawater Reverse Osmosis Brine[2]

Below is a summary of a recent patent scan commissioned by PUB for the Applicant's reference. Applicants are free to either propose technologies listed here or any other technology that is suitable for the metal(s) to be recovered.

Overview

The landscape of players developing Seawater Reverse Osmosis (SWRO) Mineral Recovery inventions is highly fragmented. The 120 inventions published in the last decade were contributed by 86 unique entities. Almost half the inventions were published by research institutes and individuals, which suggests that the technologies may not yet be mature for commercial adoption. This trend corroborates with information from academic literature, which indicated that many of the technologies were still at the stage of lab testing.

Findings

The number of inventions that involve the recovery of a particular mineral strongly correlates with the mineral's concentration in seawater. Accordingly, the number of inventions that involve the recovery of sodium is the highest, with the exception of lithium which may be attributable to the rapid growth in the demand for the manufacture of lithium-ion batteries as a result of the proliferation of products, such as personal electronic devices and electric vehicles.

In terms of recovery processes, most inventions involve multiple processes. These can be consecutive processes leading to the recovery of one mineral, consecutive processes whereby different minerals are extracted at different stages, or alternative processes for recovering one mineral.

Analysis by Process Type

The most common process used for SWRO Mineral Recovery is evaporation, the traditional method of extracting salt (i.e., sodium chloride) from seawater. This is followed by electrolytic processes, precipitation, and crystallisation, respectively. Additional common (sub)processes include nanofiltration, which is typically employed as the first step in a multi-step process to separate divalent and multivalent metals, spray drying (classified under evaporation), and air stripping.

Beyond the group of evaporation processes, air stripping has also attracted a higher level of commercial research. Air stripping has been the dominant commercial process used to extract bromine from saline water sources, the main commercial source of bromine. The higher incidence use of air stripping by companies for SWRO Mineral Recovery likely stems from the ease in adapting or extending the well-established process to SWRO brine.

In contrast, precipitation processes attracted a lower proportion of commercial research compared to evaporation and crystallisation processes. This might be due to the lower degree

[2] Study on "Recovery of Minerals from Seawater Reverse Osmosis Brine" by IPOS (commissioned by PUB), 2020

of control with precipitation, which tends to result in more agglomeration and polymorphisms in the desired product.

The adsorption-desorption process is another process that has less commercial research. While the use of adsorption is widespread for water treatment, it is typically applied to the pre-treatment of water where the desorption process is aimed at recovering the adsorption matrix, not recovering the minerals. Application of this technology to SWRO Mineral Recovery is hence largely at the laboratory stage.

Similarly, while the use of bipolar membrane electrodialysis and membrane distillation to concentrate RO brine is known, its application to SWRO Mineral Recovery remains largely unexplored and therefore has few commercial exploitation or deployment.

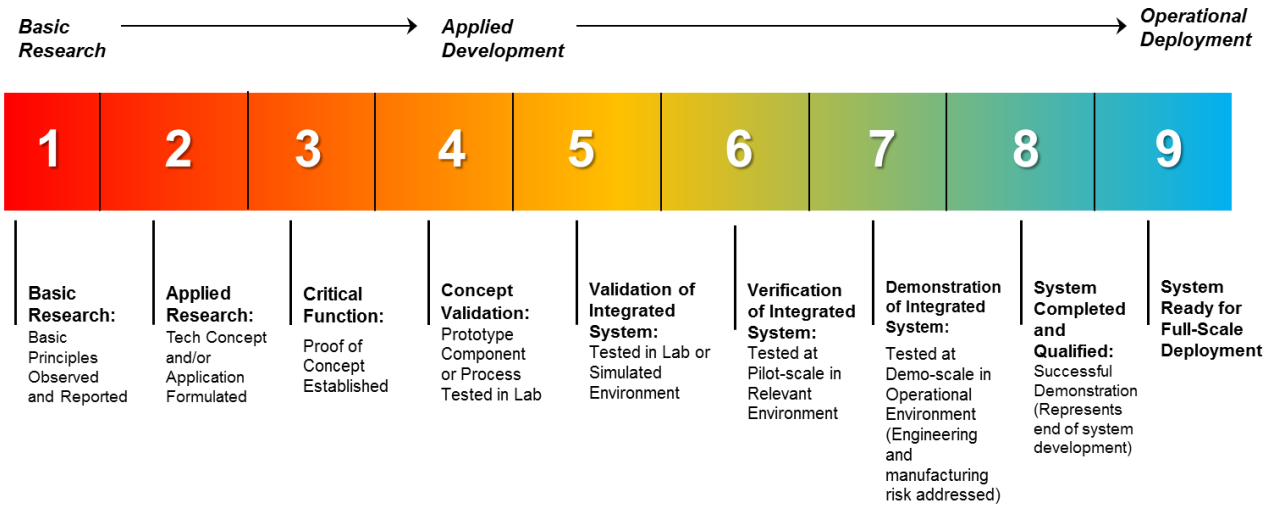
2. Review on Resource Mining from Seawater

Some further information related to resource mining from seawater is available in the following studies, for the Applicant's reference.

i) "Mining valuable minerals from seawater: A critical review", by Paripurnanda Loganathan, Saravanamuth Vigneswaran and Gayathri Naidu; Environmental Science: Water Research & Technology; 2016

ii) "Feasibility of extracting valuable minerals from desalination concentrate: a comprehensive literature review" by Arash Shahmansouri, Joon Min, Liyan Jin and Christopher Bellona; Journal of Cleaner Production, Elsevier; 2015

Appendix D: Technology Readiness Level (TRL) Definitions



TRL	Description	Remarks
0	Idea	Unproven concept, no testing has been performed
1	Basic Research	Basic principles postulated and observed but no experimental proof available
2	Applied Research	Concept and application have been formulated
3	Critical Function	First laboratory test completed; proof of concept
4	Concept Validation	Small Scale Prototype built in a laboratory environment, technology validated in laboratory
5	Validation of Integrated System	Component and/or validation in a relevant environment
6	Verification of Integrated System	System model or prototype tested in intended environment close to expected performance
7	Demonstration System	Operating in operational environment at pre-commercial scale
8	System Completed and Qualified	Manufacturing issues solved
9	Full commercial application	Technology available for consumers

Annex A: Guidelines for Submission of Proposal on IGMS

Closing Date: 26 November 2021, 4:00 pm (Singapore time, GMT +08:00).

1. The preparation of the proposal should be done using the 'CWR Research Proposal Form' which can be downloaded from the online IGMS.

2. Applicants are required to lodge the application via the online IGMS before the stipulated closing date and time for the Request-for-Proposal (RFP). Separate submission outside of IGMS will not be considered. All relevant sections of the IGMS proposal online application form should be filled out completely, with the CWR Research Proposal Form and supporting documents uploaded as separate attachments. **The on-line application process may take time and hence please refer to IGMS website for full details of the application process. For new IGMS user from private companies, account registration is required for first time application. Please refer to Annex B below. New users would need to ensure his/her CorpPass account has been set-up, using his/her SingPass account.**

3. For submission of the proposal, it is necessary for all PIs and Co-PIs to sign up for an IGMS UserID. Co-PIs from the Partner Institutions shall be listed as "Team PI" in IGMS in order for the Partner Institutions to receive funding for the project.

4. Please note that applicants can only submit multiple files with maximum file size of 2MB each in the IGMS.

5. Should there be revisions to the submitted proposal, Lead PI is to delete previous submission(s) and only keep the final proposal in the system. Failing to do so may lead to evaluation of wrong version of the proposal.

6. The link to the online IGMS is given here: https://researchgrant.gov.sg

Annex B: IGMS Account Creation

To facilitate the company accounts' creation, kindly provide the following to Ms. Chay Peck Si (PUB_GLOBALHYDROHUB@pub.gov.sg) by **1 October 2021** to facilitate the registration process.

Details of the New Company to be Created in IGMS

S/N	Full Name of Company	Local Company / Foreign Company?	Public Company / Private Company?	UEN (for Local Company) / Unique Identifier (for Foreign Company)
1				
2				

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Procedures to create a new company account in IGMS:

Once the **new** company account is created in IGMS, the company will need to follow up on registration of the Host Institution (**HI) Admin** in IGMS.

Creation of Users for "Local" Companies

For new "Local" companies, the following steps will need to be done at the company:

(1) The company will need to nominate a **HI Admin**.
(2) The **HI Admin** will need to ensure that his/her **CorpPass** account has been setup.
(3) The **HI Admin** will need to login to IGMS using his/her **CorpPass** account to **register/update** his/her profile inside IGMS. Please note that the IGMS would grant him/her the **Principal Investigator (PI)** role by default.
(4) After the **HI Admin** has been successfully registered in IGMS, the following details will need to be provided so that IGMS can change the role of the person from a **Principal Investigator (PI)** to a **HI Admin**:
    - **Full Name of HI Admin:**
    - **E-mail Address of HI Admin:**
    - **Designation of HI Admin in his/her company:**
(5) Once granted the role as a **HI Admin**, he/she can proceed to assign the relevant roles (i.e. Principal Investigator **"PI",** Director of Research "**DOR**", Office of Research "**ORE**") to the various users within his/her organisation.
(6) The system requires 3 different roles i.e. **PI**, **DOR**, and **ORE** for proposal submission. **HI Admin** and **PI** can be held by the same person, while **DOR** and **ORE** have to be held by 2 different people. As such, there are minimum 3 different personnel required for proposal submission in **IGMS**.

Creation of Users for "Foreign" Companies

For new "Foreign" companies, the following steps will need to be done at the company:

(1) All users from the company (i.e. **HI Admin, DOR, ORE, PI)** will "**Register**" themselves in IGMS, with reference to the bottom of the "**Login for overseas users without CorpPass/SingPass**" section.

(2) After all the users have been successfully registered in IGMS, the **HI Admin** will need to provide the information below so that IGMS can **add** all the users, **tag** them to their foreign company, and **assign** the correct roles to all the users inside IGMS:

a. Full Name of **HI Admin**:
b. E-mail Address of **HI Admin**:
c. Designation of **HI Admin** in his/her company:
d. Full Name of DOR:
e. E-mail Address of DOR:
f. Designation of **DOR** in his/her company:
g. Full Name of ORE:
h. E-mail Address of ORE:
i. Full Name of **PI/s**:
j. E-mail Address of **PI/s**:

(3) The system requires 3 different roles i.e. **PI**, **DOR**, and **ORE** for proposal submission. **HI Admin** and **PI** can be held by the same person, while **DOR** and **ORE** have to be held by 2 different people. As such, there are minimum 3 different personnel required for proposal submission in **IGMS**.

(4) Once the above **Foreign Company users** have been added, tagged and assigned in IGMS, they can then proceed to login to IGMS via the "**Login for overseas users without CorpPass/SingPass**" section.

(5) **Note:** The **HI Admin** in the foreign companies cannot add a new user. However, the **HI Admin** in the foreign companies can change the role of a user, or, delete an existing user in his/her company.