Winnipeg | Water and Waste
Eaux et déchets

April 30, 2021

Client File No.: 1071.1
Our File Nos.: EMS
020-17-08-11-00
020-17-08-11-0N

Manitoba Conservation and Climate
Environmental Stewardship Division
Environmental Approvals Branch
1007 Century Street
Winnipeg, MB R3H 0W4

Attention: Shannon Kohler, Director

RE: NORTH END WATER POLLUTION CONTROL CENTRE – INTERIM PHOSPHOROUS REDUCTION PLAN – ENVIRONMENT ACT LICENCE NO. 2684 RRR

The City of Winnipeg is submitting a Notice-of-Alteration as required by Manitoba Conservation and Climate on March 12, 2021. Below are responses to the enquiries included in the March 12, 2021 letter.

1. **A description of the analysis of the capacity of existing clarifiers and digesters to support the conclusion that the ability to reduce phosphorous is limited by the current capacity of these processes. This description should include seasonal impacts on this capacity (e.g. solids washout in spring) to support the conclusion that available capacity decreases during high flow months.**

Primary clarifiers capacity is based on removal efficiencies for total suspended solids, and biological oxygen demand as well as parameters such as surface overflow rate. Previous works to assess primary clarifier performance have concluded that a sludge blanket depth of 60 cm or less is needed for the NEWPCC to prevent solids from washing into the bioreactor. This has historically corresponded with an average NEWPCC sludge thickness of 3.5% which was used for the Interim Chemical Phosphorous Removal model.

During spring the flowrate into the primary clarifiers increases. This can raise the sludge blanket and increases the risk of solids washing out into the bioreactor; if the solids wash into the bioreactor it can cause bacteriological upset in the high-purity-oxygen reactors, leading to licence exceedances. Higher sludge blankets are also exacerbated by higher solids loading in spring, when the large flows flush the sewer system; solids that can settle during the winter low-flow period are flushed to the sewage treatment plant during this period.

Digester capacity is based on a variety of parameters including solids retention time (SRT), solids loading, volatile solids loading, sludge thickness, tankage size, volatile solids destruction rate, alkalinity, and historical digester performance. The guidelines from the United States Environmental Protection Agency (USEPA), the Ontario Ministry of the Environment (MOE), and the Water Environment Federation (WEF) specify the desired operating ranges for these parameters.

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For the purposes of this study a target SRT of 15 days was used in keeping with the above mentioned guidelines. A review of the historical operating parameters showed that with the additional sludge loading from chemical phosphorous removal, the SRT dropped below the target 15 days SRT during high spring flows. Solids loading to the digesters is also greatest during spring flows when the sewers are flushed and puts additional strain on the digesters.

2. **A summary of the modelling work that has been carried out to support the conclusions that a phosphorous concentration of 1.0 mg/L cannot be achieved and that the interim phosphorous process cannot be carried out during maximum month flows.**

This was described in the City of Winnipeg's previous submission to the Province entitled 'Temporary Phosphorous Removal at NEWPCC'. It was submitted to Manitoba Conservation and Climate on July 30, 2019 and can be found on the Provincial registry here: https://www.gov.mb.ca/sd/eal/registries/1071.1/2019-07-30_newpcc_noa_submission_package_file1071.10.pdf

3. **A description of the proposed bench scale tests that have been/will be carried out during high flows including the potential impact on phosphorous removal.**

A description of the bench scale tests conducted for Interim Phosphorous Removal can be found in the appendices of the December 17, 2020 'NEWPCC Interim Phosphorous Removal Detail Review and Benchscale Testing' report that was submitted to Manitoba Conservation and Climate in December 2020.

Sludge samples (pre-and post digestion) as well as primary clarifier influent/effluent samples were tested before and after ferric chloride was dosed at various concentrations. The tested parameters included solids content, pH, alkalinity, phosphorous concentration, solids content etc. These tests were repeated with wastewater samples that have been collected in max month conditions in March 2021. The max-month data is currently being reviewed and a final memo on the maximum month testing will be available by June 2021.

4. **A description of the proposed interim phosphorous removal plan with a detailed schedule/timelines for all aspects of the plan including operational changes, design and construction of additional infrastructure, and development and implementation of monitoring and reporting plans.**

A schedule was provided in the December 17, 2020 report for the construction and commissioning of NEWPCC interim phosphorous removal infrastructure. The schedule submitted in October 30, 2020 to Manitoba Conservation and Climate has been updated and expanded based on this and is provided in Appendix 1.

Further detailed timelines and schedules will be developed in the next phase of work as part of the design and commissioning process. The City will evaluate the performance of the existing digesters after the SEWPCC upgrade has been completed, design and construct an additional the ferric chloride/sodium hydroxide chemical storage building at NEWPCC, and then begin full

scale testing of interim phosphorous removal Scenarios 2 and 3 as described in the December 17, 2020 report.

5. **A detailed discussion on how the new infrastructure proposed to be installed in Item #4 above can potentially be re-used in the final upgraded facility.**

After the North End Sewage Treatment Plant Upgrade is complete ferric chloride will be required for trimming phosphorous from the new bioreactors. Ferric chloride will also be required for high rate clarification during wet weather flow. The City intends to continue using the existing chemical storage facility, including the new additional ferric chloride tanks for these processes. The ability to dose ferric chloride into the primary clarifiers will be maintained so that it could be used to support primary clarification if/when units are taken out of service for maintenance.

It may be possible to reuse the sodium hydroxide pH adjustment tank for additional ferric chloride storage or for other chemical storage purposes. During the design phase for the Interim P upgrades at the NEWPCC, the consultants will review specifications for the tanks to determine how the pH adjustment tank can best be reused as part of the overall NEWPCC upgrade.

6. **A table summarizing the expected annual per cent reduction of phosphorous concentrations and load in the effluent from the NEWPCC for 2023, 2024, 2025, 2026, 2027, and 2028 and the assumptions used to calculate the reduction. The assumptions must include consideration of expected rural, industrial, and city growth and the resultant impact on the ability of the interim solution to reduce phosphorous in the effluent.**

Please see Tables 1 and 2 below. These estimates are preliminary and subject to process performance in full scale testing, as well as population and industrial growth as digester capacity is consumed.

In Table 1 the first row of data is the total phosphorous that is removed from the NEWPCC (e.g. influent raw sewage phosphorous versus final effluent phosphorous). The second row of data below it is the same but assumes Interim Phosphorous Removal Scenario 1 and the maximum estimated phosphorous removal from Scenarios 2 or 3; Scenario 2 and 3 are expected to perform similarly to each other. Table 2 is the estimated reduction in phosphorous loading to the Red River, relative to the 'no change' current configuration in its representative year.
Example calculations are provided below the tables.

Table 1 TP Removal at NEWPCC, Interim P Removal and No Change Scenarios (2023- 2028)

Year	2023	2024	2025	2026	2027	2028
TP Removal at NEWPCC (%)- No Change Scenario	61	60	59	59	58	57

TP Removal at NEWPCC (%)- Interim P Removal Scenario	65[1]	69	68	67	66	65

Notes:

1 *For the year 2023 it is assumed 4 months operation of Interim P Removal and 8 Months of No Change Scenario (Interim P Removal Implementation by the end of August 2023)*

Table 2 Reduction in TP Load and Concentration (2023-2028)

Year	2023	2024	2025	2026	2027	2028
Reduction in TP Loads and Concentration (%)- Interim P Removal[1]	9[2]	22[3]	21	21	20	19

Notes

1 *Reduction associated with Interim P Removal compared with No Change Scenario*

2 *For the year 2023 it is assumed 4 months operation of Interim P Removal and 8 Months of No Change Scenario (Interim P Implementation by the end of August 2023). If Interim P removal starts in January 2023, the reduction in TP load will be approximately 23%.*

3 *Example of Load reduction calculation for the year 2024:*

Phosphorus input to NEWPCC:

NEWPCC raw wastewater influent TP 1109 kg/d

WEWPCC sludge TP 127 kg/d

SEWPCC Sludge TP 461 kg/d

Phosphorus Outputs to the River:

NEWPCC Effluent TP (No change scenario) 674 kg/d

NEWPCC Effluent TP (3 months S1only and 9 months S1+S2 or S3) 525 kg/d

TP Removal at NEWPCC- No Change Scenario:

$$TP\ Removal\ (\%) = \frac{(1697 - 674)}{1697} \times 100 = 60\%$$

TP Removal at NEWPCC- Interim P Removal Scenario:

$$TP\ Removal\ (\%) = \frac{(1697 - 525)}{1697} \times 100 = 69\%$$

Reduction in TP load to the River (Comparing No change scenario against Interim P):

$$TP\ Reduction\ (\%) = \frac{(674 - 525)}{674} \times 100 = 22\%$$

The estimate includes population from the City of Winnipeg, the RM of West St Paul, and the RM of St. Andrews. It assumes that the City's historical residential growth rate of 1.4% continues. West St. Paul and St. Andrews growth is assumed to be primarily residential and at the same rate as historical City growth. Allowances do not include heavy industrial growth which occurs sporadically.

The estimated flows and loads from the Rural Municipality of Rosser are not included. The City of Winnipeg cannot make projections for the CentrePort Development because the development is not following its original servicing review. The Government of Manitoba 'CentrePort Regional Water and Wastewater Servicing Review (August 2012)' originally assumed that CentrePort Lands would contain light industrial land and mixed land use but recent development and rezoning applications have included heavy, wet industry. The City has requested future flows and load projections from the RM of Rosser but has not yet received the requested information.

7. **A discussion on how much dosing of ferric chloride can be increased immediately with current infrastructure and a plan with timelines for doing so. This plan must be included in the schedule reference in Item #4 above.**

Currently the City doses ferric chloride in two locations, in the digesters and into the centrifuges upstream of the sequencing batch reactors. The pumps that dose ferric chloride into the digesters are operating near capacity (e.g. at 90%). The next phase of construction will include increasing pumping capacity of ferric chloride into the digesters.

Regarding the sequencing batch reactors, in Scenario 1 of the December 17 2020 report, the centrate effluent was shown in the BioWin model to have a total phosphorous (TP) effluent concentration of 8.4 mg/L. This assumes 99.9% removal of phosphorous and is an aggressive target for real world conditions. The City's current phosphorous concentration in centrate effluent is on average 19 ± 7 mg/L TP, which results in a total phosphorous load in the centrate that is below licence requirements for centrate.

There may be opportunity to decrease the total phosphorous concentration in centrate effluent but the degree to which this can be done will depend on the following:

- Responsiveness of the instrumentation in the ferric chloride dosing system to changes in flows and loads from the digester system
- Efficiency of ferric chloride in real world conditions: the model assumed 99.9% removal efficiency but impurities and or unforeseen chemical reactions may decrease its effectiveness in real world conditions
- Impact on nitrogen removal: adding ferric chloride and reducing the alkalinity may impact the degree to which ammonia is removed from centrate treatment system
- Supply of ferric with the limited storage tankage

Wastewater Services will gradually increase ferric chloride dosing into the centrate treatment system and the digesters and monitor the overall health and performance of both the digesters and sequencing batch system (i.e. the centrate treatment system). Operating parameters such as pH, alkalinity, soda ash capacity, ammonia removal, total nitrogen removal, and phosphorous removal will be monitored to determine the maximum phosphorous removal possible with the NEWPCC's current infrastructure.

8. **A description of the option identified in the December 17, 2020 report to dose ferric chloride at the West End and South End facilities, including what additional work would need to be done to investigate this option, expected benefits and timelines.**

This option represents some flexibility in ferric chloride delivery for Scenarios 2 and 3 as described in the December 17 report. It won't accelerate the implementation of Scenario 2 or 3 because these scenarios still require process piping to the primary clarifiers/HPOs within the NEWPCC, and pH adjustment in the digesters.

The December 17, 2020 report identified ferric chloride delivery as a constraint and recommended additional tankage to store ferric chloride. If railway delivery is delayed and the tankage storage begins to run low it may be possible to compensate for this by dosing some ferric at the other treatment plants.

For SEWPCC, chemical trimming will be in place for the first phase of the commissioning process while the fermenters required for biological phosphorous removal are constructed (the old bioreactors will be repurposed as fermenters). The lessons learned during the SEWPCC trimming operation could be applied to WEWPCC if required. It should also be noted that the ferric chloride for SEWPCC and WEWPCC are also small, relative to the ferric requirements for Scenario 2 and 3, so they would not offset the tankage requirements.

The West End Sewage Treatment Plant (WEWPCC) is currently capable of dosing ferric chloride into its bioreactor to trim phosphorous. The WEWPCC phosphate concentration in the effluent is, however, too low for trimming. Introducing chemical phosphorous trimming would require the WEWPCC to decrease its biological nutrient removal performance (biological phosphorous removal), which may impact other nutrient removal parameters such as ammonia and total nitrogen removal. The City can consider chemical trimming at WEWPCC after the City has gained some experience in operating a chemical/biological nutrient removal process at SEWPCC. SEWPCC chemical trimming is expected to start when the SEWPCC bioreactor is seeded in summer/fall of 2021.

9. **A description of the proposed process for ongoing optimization of the interim phosphorous reduction plan. The description will include the plan for gradual increasing of ferric chloride dosing, what operational changes are required, parameters to be monitored and how the monitoring results will be used to assess the impacts on plant operations, how high flow months will be incorporated into the operation, and a plan for reporting ongoing optimization. For certainty, the plan may reference a target phosphorous concertation but optimization shall not be limited by this target.**

The plans developed to date were submitted to Manitoba Conservation and Climate in the December 17, 2020 report. Further plans and commissioning activities will be developed as part of the next phase of work. Below is a description of the future plan requirements. Some steps will occur concurrently as illustrated in the schedule in Appendix 1.

i. Scenario 1: Gradually increase ferric chloride dosing into the NEWPCC sequencing batch reactors and digesters to target a centrate effluent total phosphorous concentration of approximately 8 to 9 mg/L

    i. Monitor and adjust alkalinity as required in the Sequencing Batch Reactors
    ii. Monitor ammonia and total nitrogen removal, as well as other process parameters for centrate treatment performance (e.g. mixed liquor concentration)
    iii. Monitor digester performance parameters (solids loading, volatile solids destruction, alkalinity, etc.)
    iv. The assumed 99.9% removal efficiency may be difficult in real-world conditions but will be targeted so long as it does not harm ammonia or total nitrogen removal in the centrate treatment system or the performance of the digesters

ii. Commission the SEWPCC plant to nutrient removal

    i. Ferric chloride will be dosed at the SEWPCC plant while the SEWPCC high purity oxygen (HPO) bioreactors are converted to fermenters for biological phosphorous removal
    ii. The NEWPCC digester performance will be monitored; via parameters such as pH, alkalinity, ammonia concentration, volatile solids loading, total solids loading, volatile solids reduction efficiency, digester gas content, etc.
    iii. If alkalinity drops below target levels in the digesters, the ferric chloride dosing in the digesters and centrate treatment will be adjusted to compensate (e.g. decrease ferric chloride dosing in the digesters to preserve alkalinity; some phosphorous may bleed into the centrate influent which would be removed by ferric chloride dosing in the centrate/sequencing batch reactors. In this situation the theoretical 8.4 mg/L phosphorous concentration in centrate effluent may be impacted.)

iii. Scenario 2 and 3: Construct and commission ferric chloride storage tanks and sodium hydroxide pH adjustment system, as well as process piping and necessary safety equipment for chemical phosphorous removal as described in Scenario 2 and 3 of the December 17, 2021 report. Ferric chloride will be gradually and slowly dosed into the primary clarifier and/or HPO reactor, pending further consultant review and recommendation.

    i. The NEWPCC digester performance will be monitored via the parameters as described above; other recommended parameters, as identified by the successful consultant for the next phase of work, will also be monitored
    ii. The NEWPCC primary clarifier performance will be monitored via the parameters as described previously; other recommended parameters, as identified by the successful consultant for the next phase of work, will also be monitored.

iii. The NEWPCC bioreactor and secondary clarifier performance will be monitored (solids removal, soluble oxygen utilization rate (SOUR), carbon removal, oxygen purities and/or other recommended parameters, as identified by the successful consultant for the next phase of work).

Annual phosphorous loads from all three sewage treatment plants will continue to be published publicly on the City's website for interested stakeholders: https://winnipeg.ca/waterandwaste/sewage/ProtectingOurWaterways/index.stm

10. A description of the plan for assessing the ability to further reduce phosphorous once the biosolids facilities are upgraded. The plan shall include a schedule and a list of factors that will be included in the assessment.

The City of Winnipeg is required to undertake P3 analysis of both the Biosolids and BNR components of the NEWPCC Upgrade as part of the City's application for funding under the Investing in Canada Infrastructure Program. The review will be conducted but the plan and schedule will depend on procurement methodology.

In any scenario the factors bulleted below will be considered. Other parameters, as recommended by the consultant, will also be reviewed:

- Impacts on digestion operating parameters and chemistry (e.g. pH, alkalinity, sludge rheology, etc.)
- Impacts on infrastructure sizing and capacity (e.g. pipe connections, digester tankage, thermal hydrolysis units, centrifuges, digesters etc.)
- Impacts on ability to reuse biosolids and phosphorous (e.g. struvite recovery, chemistry of biosolids, reuse program etc.)
- Impacts on additional NEWPCC processes (e.g. centrate treatment, co-thickening in primary clarifier, primary clarifier capacity, impacts on HPO bioreactor etc.)

The schedule will depend on the contract structure and the timing for provincial and federal funding. Once these two factors are known a schedule for the above can be developed.

11. With respect to the overall upgrades planned for the North End Water Pollution Control Centre including implementation of Phase 1, 2, and 3 of the project, please provide an update on the status of each phase of the project and the timelines to complete the projects.

The current schedule and status of the projects required for upgrading the NEWPCC are illustrated in Appendix 2 and are as follows:

<u>Project 1: NEWPCC Upgrade: Headworks Facilities</u>

Schedule: 2021 to 2026

Status:

- RFP submissions reviewed, a preferred proponent has been selected
- Waiting on Federal and Provincial Funding agreements to make an award recommendation
- Delayed award of Headworks Design Build Contract as ICIP funding approval not received by March 31

Project 2: NEWPCC Upgrade: Biosolids Facilities

Schedule: 2021 – 2029

Status:

- Pending Provincial approval of procurement strategy
- Detailed Design not yet commenced due to P3 review
- Requires a market sounding to confirm procurement strategy
- Requires Provincial and Federal Funding agreements
- Enhanced Preliminary Design review of current design assumptions required.

Project 3: NEWPCC Upgrade: Nutrient Removal Facilities

Schedule: 2023- 2032

Status:

- Commencement of project is dependent on funding from Provincial and Federal Governments.

Please find attached a Notice-of-Alteration form. Upon approval the City will proceed with its Interim Phosphorous Removal Plan. Should you have any questions on this, please contact me at 204-986-4904 or by email at mpaetkau@winnipeg.ca.

Sincerely,

[redacted]

Michelle Paetkau Acting Branch Head for Wastewater Planning and Project Delivery

Attachment:

Appendix 1 Interim Phosphorous Removal Schedule
Appendix 2 NEWPCC Upgrade Schedule
Appendix 3 Notice of Alteration Form

MP/dr

c: S. Burland Ross, M. Eng., P. Eng., Manitoba Conservation and Climate (email)
Y. Hawryliuk, MSc, Manitoba Conservation and Climate (email)
M. Geer, CPA, CA, Water and Waste Department (email)
T. Shanks, P. Eng., Water and Waste Department (email)
R. Grosselle, Water and Waste Department (email)
C. Carroll; Water and Waste Department (email)
C. Javra, Water and Waste Department (email)

Notice of Alteration Form

Manitoba
Sustainable Development

Client File No. : 1071.10	Environment Act Licence No. : 2684 RRR

Legal name of the Licencee: Winnipeg Water and Waste Department

Name of the development: North End Water Pollution Control Centre

Category and Type of development per Classes of Development Regulation:

Waste Treatment and Storage — Wastewater treatment plants

Licencee Contact Person: Chris Carroll
Mailing address of the Licencee: 1199 Pacific
City: Winnipeg Province: Manitoba Postal Code: R3E 3S8
Phone Number: (204) 986-7435 Fax: Email: ccaroll@winnipeg.ca

Name of proponent contact person for purposes of the environmental assessment (e.g. consultant):
Michelle Paetkau

Phone: (204) 619-3874	Mailing address: 1199 Pacific Avenue
Fax:	Winnipeg MB R3E 3S8

Email address: mpaetkau@winnipeg.ca

Short Description of Alteration *(max 90 characters)*:

An alteration for Interim Phosphorous Removal and Biological Nutrient Removal

Alteration fee attached: Yes: ☑ No: ☐

If No, please explain:

Date: 2021-04-30	Signature:
	Printed name: Michelle Paetkau

A complete Notice of Alteration **(NoA)** consists of the following components:

- ☑ **Cover letter**
- ☑ **Notice of Alteration Form**
- ☑ **2 hard copies and 1 electronic copy of the NoA detailed report** (see "Information Bulletin - Alteration to Developments with Environment Act Licences")
- ☑ **$500 Application fee, if applicable** (Cheque, payable to the Minister of Finance)

Submit the complete NoA to:

Director
Environmental Approvals Branch
Manitoba Sustainable Development
1007 Century Street
Winnipeg, Manitoba R3H 0W4

For more information:

Phone: (204) 945-8321
Fax: (204) 945-5229
http://www.gov.mb.ca/sd/eal

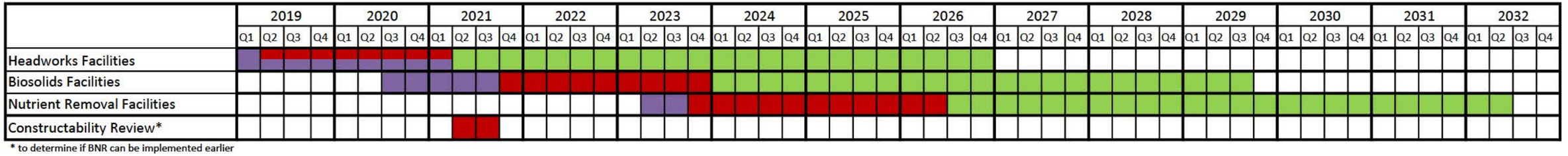
Note: Per Section 14(3) of the Environment Act, Major Notices of Alteration must be filed through submission of an Environment Act Proposal Form (see "Information Bulletin – Environment Act Proposal Report Guidelines")

NEWPCC NOA Application Appendix 1
Interim Phosphorous Removal Schedule
April 2021

	2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Interim Phosphorous Options Report																				
Drafting Notice of Alteration Report																				
Manitoba Conservation and Climate Review for Interim P Study																				
Council Review and RFP Development for Interim P Study																				
Protocols and testing methodology																				
Modeling and testing																				
Evaluation and analysis																				
Summary Report																				
Council Review and Approval																				
Manitoba Conservation and Climate Review																				
SEWPCC BNR Sludge to NEWPCC																				
Digester and Centrate Treatment Monitoring for Process Stabilization																				
Interim Phosphorous Procurement and Design																				
Interim Phosphorous Construction and Commissioning																				
Interim Phosphorous Implementation and Fine-tuning																				

Opportunities to advance the schedule will be reviewed regularly.

Legend	
Study, Review, or Pre-selection of Equipment	
Manitoba Conservation and Climate Review	
Interim Phosphorous Design	
Construction and Commissioning	
Winnipeg City Council Review	
SEWPCC BNR Upgrade Milestone	
Testing and process stabilization	



* to determine if BNR can be implemented earlier

Legend
Preliminary Design and Procurement
Detailed Design, Construction and Commissioning
Funding Applications and Procurement Review