Department of Drinking Water Supply and Sewerage Development under the State Agency of Architecture, Construction, Housing and Communal Services

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Issyk-Kul Wastewater Management Project

SLUDGE MANAGEMENT PLAN

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international ENGINEERING SERVICES INC.

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Issue and Revision Record

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Org-Draft: Includes alternatives of dewatering, desludging, disposal, stabilization/treatment and end use of sludge using up to date information from site visits.

Revision A: The document is revised according to the PMO comments indicated in a mail on 26.03.2022. The original version is revised by the collected topographical survey, climate, seismic, hydrological information. Possible sludge management alternatives are determined for each site.

Revision B: The document is revised according to the ADB comments indicated in a mail on 03.10.2022. Draft report is revised according to ADB's SMP specialist Mr. Hose Maria comments and suggestions agreed during his visit.

Revision C: Section 5 Rev. B is revised by PMO and updated from evaluation of SMP alternatives and selection of final alternative to action plans for selected alternatives.as a result discussion of the materials submitted and decisions given in the meetings held on 20.02.2023 and 06.06.2023 by the DSC, PIU, ME "Vodokanal" and Ak-Suu DWMD.

EXECUTIVE SUMMARY

This report is an updated version of the draft SMP report. The decisions for alternatives of dewatering, desludging, disposal, stabilization/treatment of sludge are given using up to date information. Moreover, this report can be used as guideline to follow required analysis, surveys, design criteria, machinery, operation plan and monitoring of environmental aspects.

There are 6 lagoons in Balykchy WWTP, that are located in an area of approximately 8 ha. The depths of these lagoons are 1.5 m-2.5 m. These lagoons were designed to operate as facultative and aerobic maturation ponds in three series of two ponds. The received water is reported to be mostly residential. The wastewater treatment plant in Karakol is not operational, and currently, untreated wastewater directly comes to Karakol Wastewater Stabilization ponds at a flowrate of 7500 m^3/d. Only one industrial entity discharges wastewater to WWTP, which is a dairy factory that discharges into the sewage system..

The sludge accumulated in the ponds should be removed for several purposes. The main reason for removing the sludge is to restore the original capacities of these ponds and to remove pathogenic sludge, avoiding the contamination of the treated water resulting from the WWTP. Anticipated purpose of the ponds and lagoons after the upgrading of the WWTPs of Balykchy and Karakol is to use them for oxidation purposes, in order to remove chlorine from treated water and as a reserve volume of storage in case of emergency of WWTP malfunction.

The sludge accumulated in the bottom of these ponds contains organically stabilized portions of the treated wastewaters. The stabilized sludge can be used for land application purposes, if they comply with the criteria indicated in the legislation of the country. Sludges can be applied to land if they do not contain heavy metals and pathogens and contain sufficient amount of nutrients and organics, and they are dry enough to be easily applied to land. The legislation that is followed by Kyrgyzstan for sludge use and disposal consists of Russian GOST R 17.4.3.07-2001 “Requirements for sewage sludge use for fertilization” and SanPiN 2.1.7.573-96 “Hygienic requirements for the use of wastewater and its sludge for irrigation and fertilization”. These regulations are used as references for heavy metals, pathogens, nutrient content, dry matter and, organic matter content.

This report summarizes the current situation in the Balykchy WWTP Ponds, Karakol WWTP Ponds, and Ak-Suu BSR Irrigation Pond (Section 2). Literature review of current methods that are applied for sludge management operations are reviewed, an emphasizing pathogen removal methods for the use of these solids in land application practices. General rules and procedures in land application are summarized with emphasis on agricultural fertilizer, use and legislations of the United States, European Union, and Russia were listed and compared. The most stringent legislation was found to be the Russian legislation in terms of pathogenic contamination of the sludges. These legislations were also similar in most of the heavy metal threshold limits. Russian legislation also required additional parameters to be satisfied for the land application of the sludges (Section 3).

The sludge management plan was structured based on the previously conducted sampling practices and the Sampling Evaluation Report that was approved by ADB, where heavy metal levels and leaching tests were evaluated to be suitable for the management of the sludge. Most of the ponds are reported to contain sludges are contaminated by helminth eggs, which are a persistent form of pathogens. Several of these ponds in Balykchy were reported not to contain pathogens, however, since the ponds are still active, the sludges in these ponds should also be considered pathogenic. Re-evaluation of the sludges for various aspects such as heavy metals, pathogenic organisms, nutrient content, and dry matter content should be carried out if necessary before the sludge management operations (Section 4).

The report aimed to present the most suitable management options for the sludges, based on the previous evaluation reports, and to present a guideline on the execution of this plan. The management options in the report were also structured based on the local authorities' capabilities to conduct these operations. Alternatives were presented for each site, in order to provide flexibility to the operations and adapt to the changing conditions with re-evaluation of the sludge characteristics that is going to be conducted before management practices begin. Alternatives were also provided to adapt to the use of these ponds as treated water storage or emergency case storage ponds for new WWTPs.

The ponds that are investigated generally contain solids content of more than 20%, and therefore, removal in the solid phase is preferred. In order to conduct the sludge removal operations, the supernatant waters should be removed before conducting sludge removal operations. De-sludging operations can start after the irrigation season while the water level is minimum, and this is especially important for the Irrigation Pond. Contamination of the nearby streams should be avoided and water quality parameters of the discharged waters and the current status of the streams should be evaluated carefully. In Karakol, the surface waters (supernatants) in the Ponds may not be discharged to the nearby Karakol River since it discharges to Issyk Kul. Therefore, sludge management options should consider water diversion and treatment from these ponds. As an alternative, until new WWTP will be commissioned, surface water can be discharged to irrigation pond after treatment. The sludges are to be removed via earth removal machinery (excavators) and can be carried via tractors/trucks to the disposal or treatment locations.

The existing ponds in Balykchy can be utilized as drying beds for extended dry stabilization. Stabilizing the sludges in the existing ponds is a straightforward and cost-efficient option. Subsequently, these sludges can be used for land application purposes after meeting the pathogenic organism criteria in the legislation following the extended storage for pathogen stabilization. The sludge from Irrigation Pond can be stored in a dedicated site with a high depth due to the high volumes of the sludge in the ponds, lack of land availability, and the considerably long time needed for the sludges to stabilize. The management options with alternatives were evaluated, and considered final alternatives were reported in Section 5.

The report also defines the possible environmental impacts of the sludge management alternatives (Section 6) and required technical analysis along with the design criteria/minimum requirements for new infrastructure that is needed for the sludge management operations. Machinery requirements, along with an example operational plan, is provided along with the monitoring requirements to track the environmental performance of the sludge management operations (Section 8).

1 INTRODUCTION

1 This Sludge Management Plan is developed by a Design and Supervision Consultant according to the Terms of Reference (clause.2, iv and clause.11, (i) sludge management to de-sludge the ponds in WWTP area including ponds of 39 ha in Karakol and Balykchy and disposal of uncontaminated sludge) within Issyk-Kul Wastewater Management Project funded by ADB.

2 This sludge management plan for the Issyk-Kul region describes how the sludge from the WWT plant and irrigation ponds could be taken, dewatered, stabilized, and temporally stored in the proposed disposal areas. Possible alternatives indicated in the draft report are evaluated using collected data. After comparing alternatives in terms of economy, environmental impacts and ease of operation, most suitable alternatives are determined for each step of sludge management plan.

This report covers the following information in the light of collected data until today:

- Determination of dewatering method for the removal of supernatant from the ponds
- Providing water quality parameters that need to be analyzed for discharge of the supernatant the waters
- Information on how to determine the discharge rates to the nearby streams with consideration of environmental quality
- Determination of sludge removal method proper for each pond site
- Determination of volume of the sludge to be removed and disposed of
- Determination of Pathogen removal method for contaminated sludge
- Application criteria for the future use of the sludge, if land application is considered, including parameters for the analysis that are required by the local legislation, such as heavy metals, nutrients and organic matter content
- Design criteria for the sludge storage areas, including required geological studies of the lands that are considered for sludge storage
- Design criteria for the sludge storage area construction and measures for the preservation of environmental quality
- Design criteria for disposal area platforms and access roads
- Machinery requirement with specifications
- Operation plan for sludge removal
- Monitoring of ecological aspects

2 DESCRIPTION of EXISTING PONDS

2.1 Balykchy Wastewater Stabilization Ponds

3 Sewage deposited into the lagoons at the Balykchy is primarily residential (80%), since there are limited industrial activities in the vicinity. The biological wastewater treatment system consists of aeration tanks followed by secondary sedimentation tanks. There are six lagoons with 62 m (W) x 250 m (L). The ponds are established on an area of approximately 8 ha (Figure 2-1). The depths of these lagoons are 1.5 to 2.5 m. These lagoons were designed to operate as facultative and aerobic maturation ponds in three series of two ponds. The received water is reported to be mostly residential.

4 The existing wastewater treatment process is extended aeration activated sludge (Non-functional). Plant was designed for full mechanical and biological treatment with a design capacity of 34 000 m^3/day but was not commissioned. The current functioning components of the activated sludge system includes 16 mm coarse screens with manual cleaning (only one in use), vortex de-gritting with manual cleaning (two units, one used at a time) and primary sedimentation (two units, one used). The aeration tanks and secondary clarifiers have never been used and reportedly leak and likely the utilized primary clarifier tanks also do. After primary sedimentation the flow is bypassed to the ponds. Overflow from the primary sedimentation tank is directly fed to the lagoons.

5 The lagoons were originally designed to operate in three series of two ponds each: a facultative/aerobic pond, followed by a maturation pond. The first series is about 64 m wide by 160 m long, each pond; the second series is 75 m wide x 160 m long, each pond and the third series 83 m wide by 160 m long, each pond. The third series (the most southern) actually is hydraulically connected to the second series through pipes on the 160 m long side and is not directly fed. There are therefore actually only two series of lagoons that are directly fed from the primary sedimentation tanks.

6 Existing ponds are used as reserve volume of storage in case of emergency. Besides water accumulated in ponds are used as winter storage for irrigation of nearby fields. After upgrading they will be used for the same purpose and as oxidation tanks in order to remove chlorine from treated water.

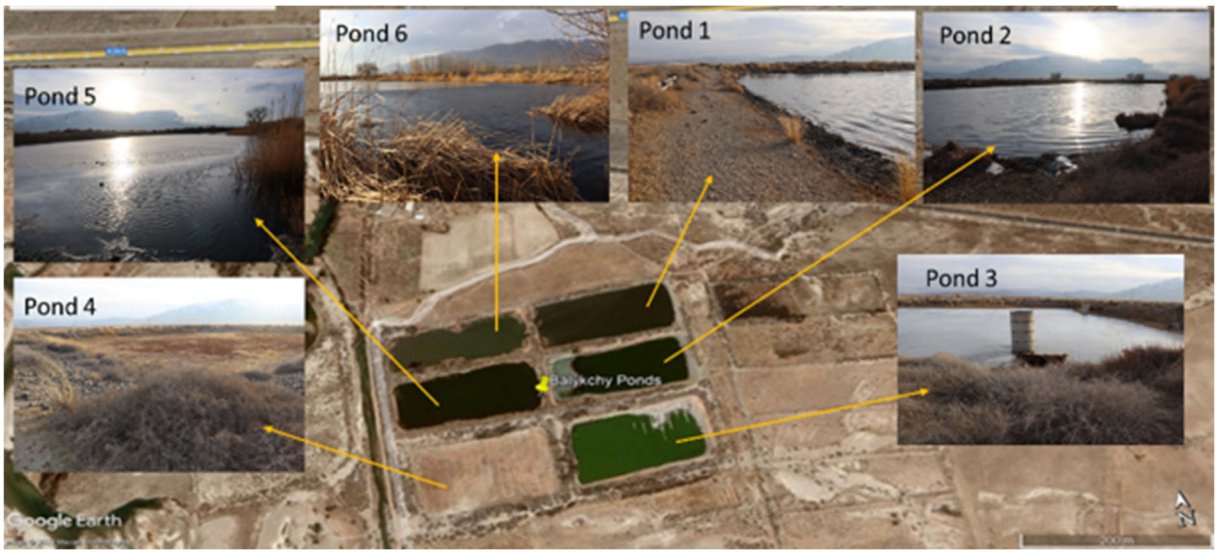

Figure 2-1. The overview of Balykchy wastewater stabilization ponds

2.2 Karakol Wastewater Stabilization Ponds

7 The wastewater treatment plant in Karakol is not operational and currently, untreated wastewater directly comes to Karakol Wastewater Stabilization ponds at a flowrate of 7,500 m^3/d. Only one industrial entity discharges wastewater to WWTP; it is a dairy factory. The dairy factory does not have industrial water treatment (pre-treatment facilities) on the premises. It discharges untreated wastewater to the city sewage systems. It is estimated that the Karakol WWTP ponds have an approximate area of 3.5 ha (Figure 2-2). The ponds have around 1.5 m depth.

8 Existing plant design capacity is 34,000 m^3/day. The treatment process used is extended aeration activated sludge, followed by impoundment in lagoons for polishing before discharge. The flow enters the inlet works and passes through a single coarse screen before entering a diversion channel to one of two vortex de-gritting units. This is followed by three primary sedimentation tanks, of which only one is in service. Flow enters the aeration tank after the PSTs but is not aerated. The concrete in the aeration tank appears particularly degraded in a number of areas. Four clarifiers of which one is functional follow the aeration tank. The lagoons are apparently inter-connected but do not work in series or in parallel. Only one of them is involved before the final discharge.

9 As it was the case for Balykchy WWTP, in Karakol WWTP Ponds are also designed to be used as oxidation tanks, in order to remove chlorine from treated water. These ponds will function serving the same function and as reserve volume of storage in case of emergency after upgrading of the WWTP.

10 It has also been indicated that the ponds are in the habitat of Central Asian frogs. Since after sampling analysis works, it is found out that sludge is contaminated and to be removed from ponds, Central Asian Frogs in these ponds are relocated on April 5-20, 2023 from these ponds to the places corresponding to their natural habitats as indicated in action plan agreed on November 5, 2020 in order to protect this species.

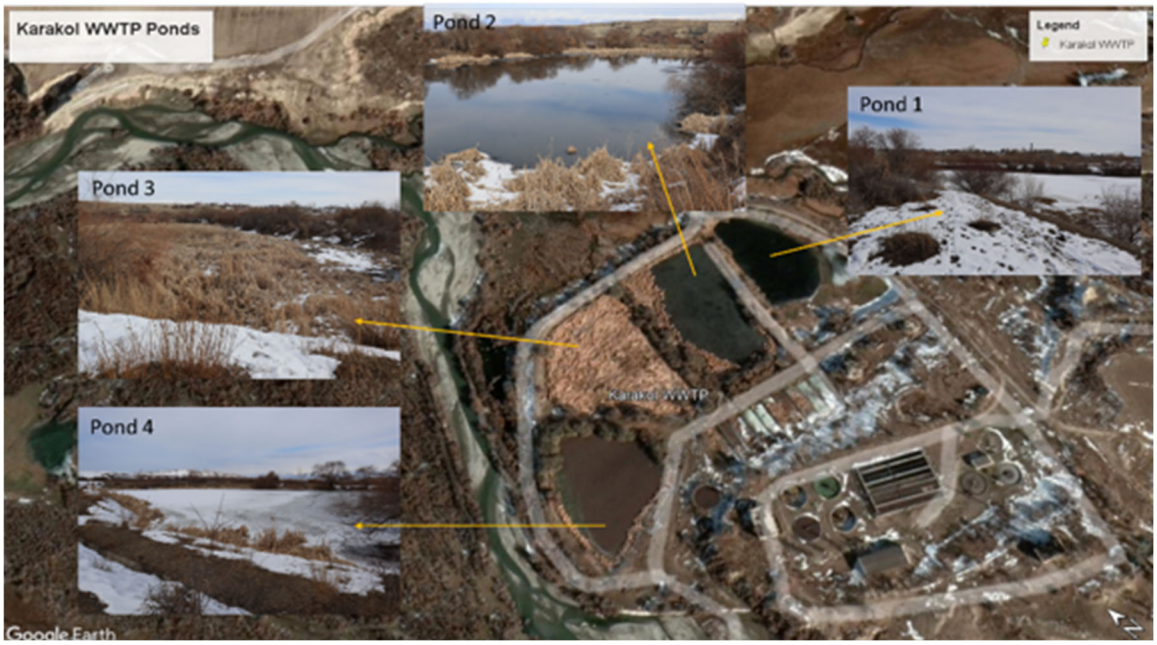

Figure 2-2. The overview of Karakol wastewater stabilization ponds

2.3 Irrigation pond (or BSR as a Russian acronym) of Ak-Suu District Department of Water resources

11 A gravity pipeline transmits the treated water from Karakol WWTP ponds to the Irrigation Pond. The water collected in the irrigation pond is transmitted to the irrigation area by pumping during irrigation season. A pump station pumps stored water into an irrigation channel where it is mixed with irrigation water, supplying water for 620 hectares of fields.

12 Currently, an average of 6,000 m^3/d in winter and 12,000 m^3/d in summer, treated wastewater is discharged into the irrigation pond. Besides, pond is fed with several small creeks which dilutes the wastewater. The active operating volume of the irrigation pond is around 1.5 million m^3 on an area of 39 ha (Figure 2-3).

13 The Irrigation Pond stores the treated effluent during non-irrigation periods to avoid disposal of the effluent to the Karakol River during these periods. However, it appears to have never been de-sludged, hence now the storage capacity of the pond is reduced by the settled sludge in the bottom of this reservoir. Reducing the storage volume also decreases the retention time in these ponds.

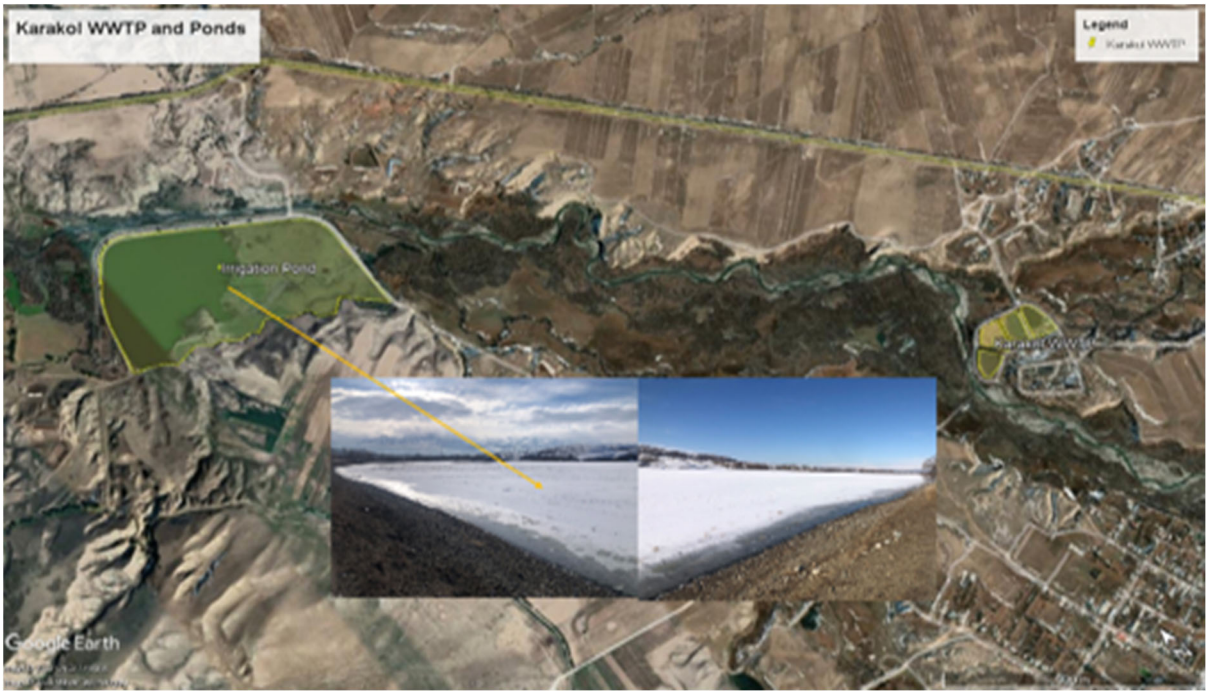

Figure 2-3. The overview of the irrigation pond

3 SLUDGE MANAGEMENT APPROACHES

14 Sludge from the ponds that have accumulated over time needs to be handled in a manner that is both environmentally safe and accomplishable by local capabilities. In order to empty the ponds, waters that are on the surface of the ponds and sludge that have accumulated at the bottom of the ponds can be separately handled to the extent that the situation in the field allows. Dewatering the ponds by removing the waters on the surface, the removal of supernatants, should be conducted as much as possible to decrease the volume that needs to be transported elsewhere. The dewatering options will differ depending on whether these waters being contaminated or not. Subsequently, de-sludging of the ponds (removing the sludge) can be executed depending on the solids content of the sludges. If the sludge has high water content, dredging and other methods can be used, or the sludge should be dewatered. If sludge has a higher solids content, it can be removed with heavy machinery such as excavators when it has a texture that allows it to be carried by trucks or tractors—higher the solids content, easier the emptying of the ponds and the transport of the sludges.

15 According to the legislation followed by Kyrgyzstan, sludges that can be used for land application purposes (including agriculture, forestry, parks, and recreation, and as such, end uses along with landfilling) should comply with several requirements. The heavy metal content of the sludges should be suitable for application and sludges should have no pathogenic organism content. They also must comply with several other requirements such as dry matter content, nutrient concentrations, and organic matter content limits. If sludges comply with all other conditions, but they contain pathogens, they should be treated for removal of pathogenic organisms. Removal of pathogens can also be achieved with several methods. These methods can differ between each other in cost, efficiency, the duration for pathogen stabilization and in various other aspects. The dewatering, and desludging methods, along with pathogen removal methods and possible end use options in the literature will be discussed in this section.

3.1 Dewatering Alternatives

16 Waters (supernatant waters/surface waters) that are diverted/removed from the ponds should be evaluated for contamination. If the surface waters in the ponds are contaminated, a better solution might be diverting these waters to an additional pond, dewatering via geotubes or utilizing another wastewater treatment method before discharge. However, this will increase the area required for sludge management operations but result in a better environmental performance since contaminated water will not reach natural streams. Further on-site dewatering can be achieved if the surface waters are diverted from the ponds before the dry season and sunshine are provided to the sludge in the ponds. This option should be optimized for operation in the selected site.

17 If the waters are to be discharged to nearby streams. The waters from the ponds that have measured quality parameters lower than the upper limits of the legislative standards and do not contain any pathogens above the threshold limits should be transmitted to nearby surface streams by calculating the flow rates in these streams and the concentrations of pollutants in

these waters. The maximum discharge rate is determined for the emptying operation from these data.

3.2 Desludging Alternatives

18 Methods for de-sludging the ponds will be evaluated, and the selection of the most suitable alternative for sludge disposal will be based on available data in this report. If sludge solids content is less than 7-10%, it can be removed by pumps, pipelines, and tankers. If it contains 10-25% solids, it can be removed by auger-type conveyors and then transported by trucks; however, the trucks should be adequately sealed for leakage. If the solids content is 50% and above, it can be directly taken from the ponds via earth removal machinery and transported with trucks. If solids content is around 30-50 %, then the sludge can be removed in the same way, but the removal operation can be more difficult due to the texture of the sludge, and volumes will be larger.

19 Depending on the local requirements, sealing of the trucks can be required. Sludge containing lower solids content (<10%) can also be dewatered before removal, reducing volumes for transportation operations. Figure 3-1 summarizes the removal options for the de-sludging of ponds. Methods for de-sludging the ponds will be evaluated and selected subsequently based on the sludge management alternative.

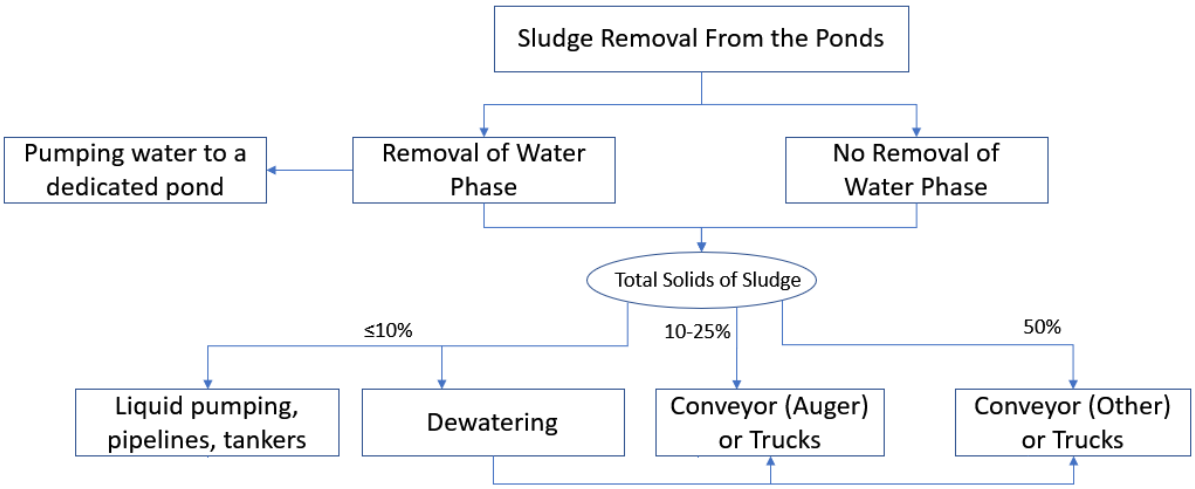

Figure 3-1. Sludge removal options

20 Dredging of the ponds can also be conducted for the removal of sludges (or mixtures) with solid content lower than 10-15%. However, the operation can be expensive compared to other alternatives. Additionally, as they require a more diluted characteristic, mechanical scrapers and dredging operations will result in more sludge volume (Table 3.1). This would lead to increased transport costs or additional dewatering requirements.

Table 3-1. Comparison of sludge removal techniques in stabilization ponds

Method of Removal	Status	Ease of operation	Execution Time	Volume of Sludge	Cost
Mechanical Removal by earth removal machinery and tractors	+++	+++	+++	+	++
Mechanized Scraping and Pumping	+++	++	+++	++	++
Dredging	+++	++	++	+++	+++

Scale; Larger to Smaller : +++ to +

3.3 Pathogen Removal and Other Pre-Treatments Alternatives for Land Applications

21 In general, based on Russian legislation - GOST R 17.4.3.07-2001 Nature protection. Soils. Requirements for sewage sludge use for fertilization and SanPiN 2.1.7.573-96 Hygienic requirements to wastewater and sewage sludge used for land irrigation and fertilization, sludge application to land for various purposes -including use as topsoil in landfills- requires the stringent absence of pathogens No helminth eggs and none to 1000 fecal coliforms per g sludge are required for any kind of sludge to be applied to land. Therefore, a pathogen removal step will be necessary for sludges extracted from the ponds that are under investigation. The methods that can be utilized are listed below. The methods' implementation criteria and pathogen removal efficiencies are summarized in Table 3.3 and 3.4, respectively.

3.3.1 Extended Storage/Drying Beds

22 Sludge that is dried to an extent (which is not in slurry form) can be stored in a drying bed in order to further dry and stabilize. Drying beds consist of sand filters with a drainage system. Water liquid separation occurs via natural forces; percolated water is drained from the bottom, and dried sludge is removed from the bed.

23 The problem with this method is the uncertainty in pathogen removal efficiency. As much as removing other pathogens is effective, helminth eggs require months to years of storage in these beds to be effectively inactivated. The inactivation is highly dependent on sludge thickness, climate conditions, and, most importantly, temperatures. Storage duration of around one year is required at 35^{o}C whereas at 20^{o}C, this duration increased to 2 years, and below 10^{o}C, the helminth removal in the drying bed takes a long time to achieve.

24 Moisture is another critical parameter; if the humidity is high and the beds receive rainfall, pathogens may re-grow with increased humidity. If sludge is to be covered to prevent precipitation or other moisture, the storage period should be at least 18 months in the best case to remove helminth eggs. Stormwater should also be diverted from the beds with drainages around the cells.

3.3.2 Solar Drying

25 Solar drying beds placed in greenhouse-type structures covered with translucent materials can be used to dry the sludge and achieve a higher stabilization. Ventilation is necessary to remove the moist air above the sludge and supply dry air. Natural ventilation or fans can be used, though the latter also aids in preventing the rising of hot air from the sludge beds. The sludge must be turned regularly to increase evaporation.

26 Water content and depth of the sludge, solar radiation available, ambient temperature, and relative humidity are important in this process. Required times for efficient dewatering can be as short as a week, as the criteria above are thoroughly accounted for. Solar drying reduces pathogens, but the extent of this reduction is highly variable. Given the uncertainty about the degree of pathogen reduction achieved the solids produced by solar drying should be approached carefully. It can be said that they may not be used for agricultural purposes without careful analysis of the end product and perhaps additional sanitation steps.

27 Mechanical equipment should be in working condition; a greenhouse cover should be maintained in order to let sunlight penetrate the structure, and parallels of the automatic beds should be available for maintenance purposes. Floor heating of the facilities (additional thermal energy) may support pathogen removal. However, it should be thoroughly investigated for the field of application.

3.3.3 Chemical Stabilization

28 Alkaline stabilization can be used to inactivate pathogens in sludge. During this operation, pH of sludge is raised to 12 which stops microbial activity. This pH causes the hydrolyzation of fats, carbohydrates, proteins, and ammonia. Lime or quicklime can be used in the process. However, the latter vigorously increases temperatures and can be hazardous and difficult to maintain. Therefore, hydrated lime is more preferred.

29 pH rises to 12 or higher for 72 hours, for 12 hours at 52^{o}C or allowing open-air drying above 50% solids after pH rise is advised for lime stabilization. Lime is quickly used by sludge, and pH can drop in time. Therefore, excess lime should be added to sludge to maintain stabilization and prevent the re-vitalization of pathogens. Lime should be mixed with sludge, at least 30% of the volume of the treated sludge in order to achieve pathogen stabilization according to SanPin 2.1.7.573-96 and up to 50% of the volume of the sludge can be required in cases with the addition of excess lime.

30 This method requires well mixing, which may be complicated with sludges with lower water contents. Lime stabilization methods without applying heat may not be enough to produce Class I biosolids. Moreover, the resulting mixture is highly alkaline and cannot be applied to alkaline or neutral soils, and its use should be evaluated carefully while applying it to non-acidic

soils. Lime stabilization can also increase solids because the amount involved can reach up to 50% of sludges (based on dry weight).

3.3.4 Composting

31 Composting is the decomposition of organic matter by thermophilic and mesophilic organisms. In the thermophilic stage of the composting, pathogen inactivation can be achieved with the aid of temperatures reaching up to 70-90°C. Essential requirements of composting are the presence of enough organic matter, carbon to nitrogen ratio balance (20:1 to 30:1), enough moisture (40-60%), air supply (5-10% O_2) (or turning), particle size, and prevention of heat loss during the process. Co-composting with other materials such as household organics or green wastes with a high amount of carbon can aid in balancing the C:N ratio and reaching thermophilic temperatures. If all stages of compost are completed, the resulting material (humus) can be used as a fertilizer or soil amendment in various uses, including agriculture, reclamation, parks, and recreation.

32 There are two types of composting; windrow (open) and in-vessel (closed). Composting is a process that requires pre-cautions, including odor control, process moisture and temperature control, turning control, and leachate management. Poor management of these parameters may result in insufficient pathogen removal or environmental pollution. The process is slightly more expensive if conducted in vessel aerated mode and dependent on experienced personnel both in vessel and window.

3.3.5 Pasteurization

33 Pasteurization is heating the sludge up to 70°C for 30 minutes and cooling it down to 4°C. Heat can be applied via vapor injection. However, the process is reported as susceptible to re-growth of salmonella species; therefore, a follow-up of anaerobic digestion or thermal treatment may be required. Infrared radiation exposure can be used with heat increase to increase the system's performance.

3.3.6 Pyrolysis

34 Organic material undergoes thermochemical decomposition in the absence of oxygen at elevated temperatures in defined time periods. This process is called pyrolysis, and is an irreversible process, which changes in the chemical composition and physical state of organic matter. Pyrolysis thermochemically transforms the biomass and other waste into bio-oil, biochar, and syngas. An illustration of a full-scale sludge pyrolysis plant is given in Figure 3-2. During pyrolysis, how different variants within the main operating parameters affect the yield and product distribution are provided in Table 3-2.

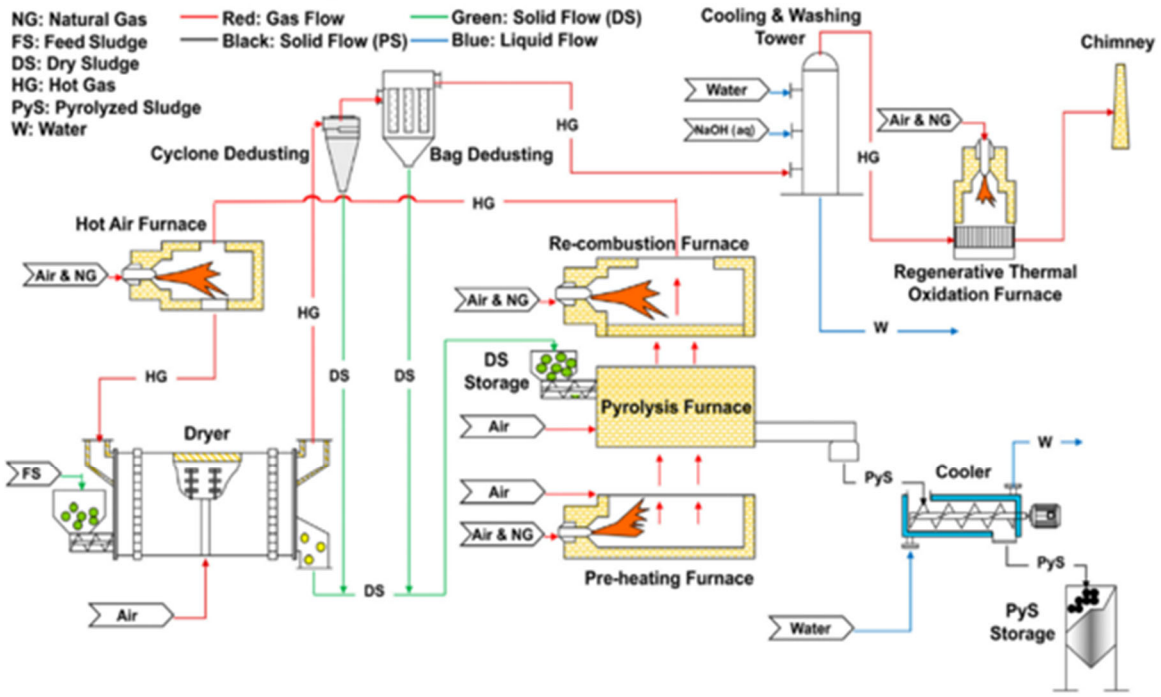

Figure 3-2. Illustration of a full-scale sludge pyrolysis system (Adopted from Luo et al., 2021)

35 The advantages and disadvantages of pyrolysis can be listed as follows:

- The barrier to pyrolysis application is the system's financial viability and the processing equipment's relative complexity.
- Skilled operators and qualified staff are needed for the operation of the plant
- Operation costs are also expensive because of the energy demand, especially with systems that require pre-drying of the feedstock
- The energy balance of the pyrolysis of sewage sludge is negative. The overall process, from the drying of the mechanically dewatered sewage sludge to the final treatment of the flue gases, needs more energy than can be recovered from the process
- A pilot plant should be operated first, in order to minimize the risk of success of the selected process with the feedstock at hand

Table 3-2. Range of the main variants with main operating parameters and characterization for pyrolysis methods (Adopted from Zhang et al., 2017; Callegari and Capodaglio, 2018)

Parameter	Slow Pyrolysis	Flash Pyrolysis	Gasification	Fast Pyrolysis
Temperature	>400 °C	800–1300 °C, under pressure	800–1200 °C	500–1200 °C
Heating rate	ΔC < 1 °C/s	ΔC > 1000 °C/s	ΔC < 1 °C/s	10 < ΔC < 300 °C/s
Residence time	>7 min	<0.5 s	>15–20 min	<20 s
Products (by mass)	35% biochar 35% syngas 30% bio-oil	60% biochar 40% volatiles	85–95% syngas 5–15% char traces of bio-oil	50–70% bio-oil 10–30% biochar 15–20% syngas
Vapour separation	Usually not	Yes	No	Yes
Heat recovery	Usually not	Usually yes	Yes	Yes
Exhaust	To atmosphere, as is, or combusted	Controlled	Controlled	Controlled
Energy generation	From exhaust combustion	From volatiles	From syngas	From syngas
Use	Mostly developing countries (charcoal) Limited substrates applicability	Maximization of biochar production. Applicable to a wide variety of feedstocks	Maximization of syngas.	Maximization of biooil. Applicable to a wide variety of feedstocks.

36 The economic viability of pyrolysis could be substantially improved if oil yields could be further enhanced and if high value-added products could be effectively produced from pyrolysis chars. Pyrolysis gas can also be used as a fuel as the char. In contrast, pyrolysis oil can be used as a raw material for chemical production or as fuel after refining processes. The economic viability of pyrolysis of sewage sludge is also determined by the process scale, selected technology, sludge collection, transportation costs, and sludge characteristics.

37 Several studies that have investigated the pyrolysis of sewage sludge reported various cost figures. In China, a plant that processes fresh sludge >300 tons/day with 80% moisture reported running and investment costs that total 360-460 USD/ton of dry sludge processed. In another study in China, the reported expenses for a facility that processes 100 tons of fresh sludge/day reported 270-370 USD/ton of dry sludge. In contrast, another study from the EU reported a cost of 183-525 EUR/ton of dry sludge processed. The Chinese study reported that operation costs decrease with increased dry matter and organic matter content, which the data support overall.

3.3.7 Mobile/ Pilot-Scale Pyrolysis

38 Thermochemical conversion can occur across broad ranges of temperature, pressure, heating rate, oxidation conditions, and residence time. The mobile pyrolysis system that can be used in this study was engineered to produce biochar from biomass, including sludge (Figure 3-3). This small-scale mobile pyrolysis system produces biochar with high fixed carbon content and high sorption using an exothermic reaction at temperatures between 350°C and 750°C. Gas

and heat are generally considered co-products of biochar production. Though a fraction of the gas stream could technically be condensed into bio-oil, the system does not produce a liquid output.

39 Pyrolysis system costs are estimated on a dollar per ton of sludge basis using costs broken into two categories: sludge preparation and pyrolysis conversion. Sludge preparation includes feedstock grinding, screening, and loading operations. Each operation requires machinery, such as a tub grinder, rotary screener, loader, and pyrolysis system. The cost of each operation can then be estimated using sludge volume, dry matter content of the sludge, and planned daily/yearly capacity.

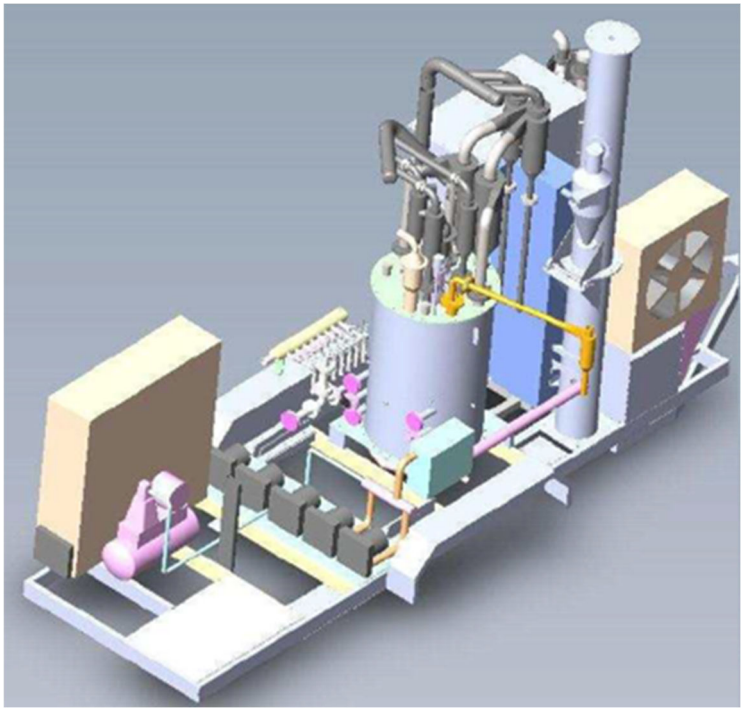

Figure 3-3. Sludge pyrolysis equipment for mobile plant

3.3.8 Hydrothermal Carbonation

40 In hydrothermal carbonation (HTC), organic material such as sewage sludge is carbonized into an HTC coal within a few hours at a temperature of about 180-200°C and a pressure of 20 to 35 bar under the exclusion of air and the addition of a catalyst (Figure 3-4). The process takes place in an aqueous environment so that no drying of the input material is necessary. The process is particularly suitable for water-rich residual materials and sludges. After downstream dewatering, the HTC coal contains hardly any water and, thanks to its high energy content, can be used for climate-friendly energy generation in coal-fired power plants or as a substitute for fossil fuels in cement plants or waste incineration plants. The HTC delivers the water extracted from the bio waste as a different product. This HTC filtrate is low in pollutants, sterilized, and rich in nutrients. However, this system cannot be installed as a mobile plant, and the daily capacity of the plant is 60 tons.

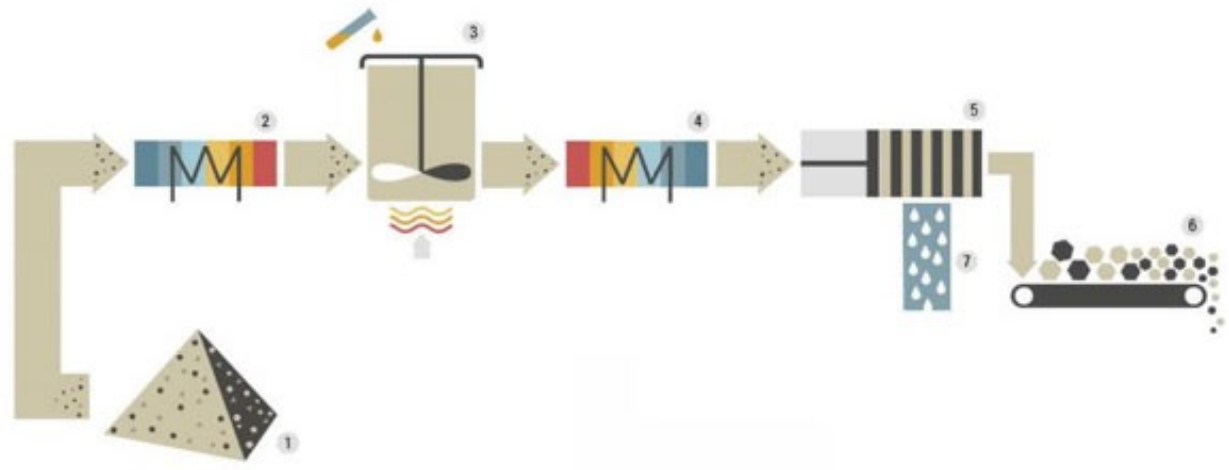

Figure 3-4. HTC system flow chart

41 The process can be explained as follows: Dewatered sewage sludge or shredded biowaste (1) with a dry matter content of 5-30% is fed into the input heat exchanger (2) through a high-pressure pump. The preheated biomass is carbonized in a stirred reactor (3) with the addition of catalysts at up to approx. 200°C for about 5 hours. The stirred reactor is jacket-heated by a thermal oil circuit. The heat source can be, for example, the exhaust gas heat of a combined heat and power plant. The resulting carbon slurry is cooled via the output heat exchanger (4). The heat energy extracted in the process is fed back to the input heat exchanger (2) via a separate thermal oil circuit. In a dewatering unit, for example, a fully automated chamber filter press, the coal is dewatered to a dry substance content of 65-70% (5). HTC coal (6) is automatically removed from the press and can optionally be dried in a downstream low-temperature, exhaust air-free drying unit. The HTC filtrate (7) separated during dewatering can be used to recover phosphorus, nitrogen or biogas in subsequent treatment stages.

3.3.9 Combined Thermal Systems (Gasification and Pyrolysis)

42 Solid fuels are based on carbon, oxygen, and hydrogen compositions. Gasifiers, on the other hand, decompose the biomass at high temperatures. The Gasification Process is divided into four stages (in areas indicated by green, yellow, red, and grey tones) on the reactor (Figure 3-5).

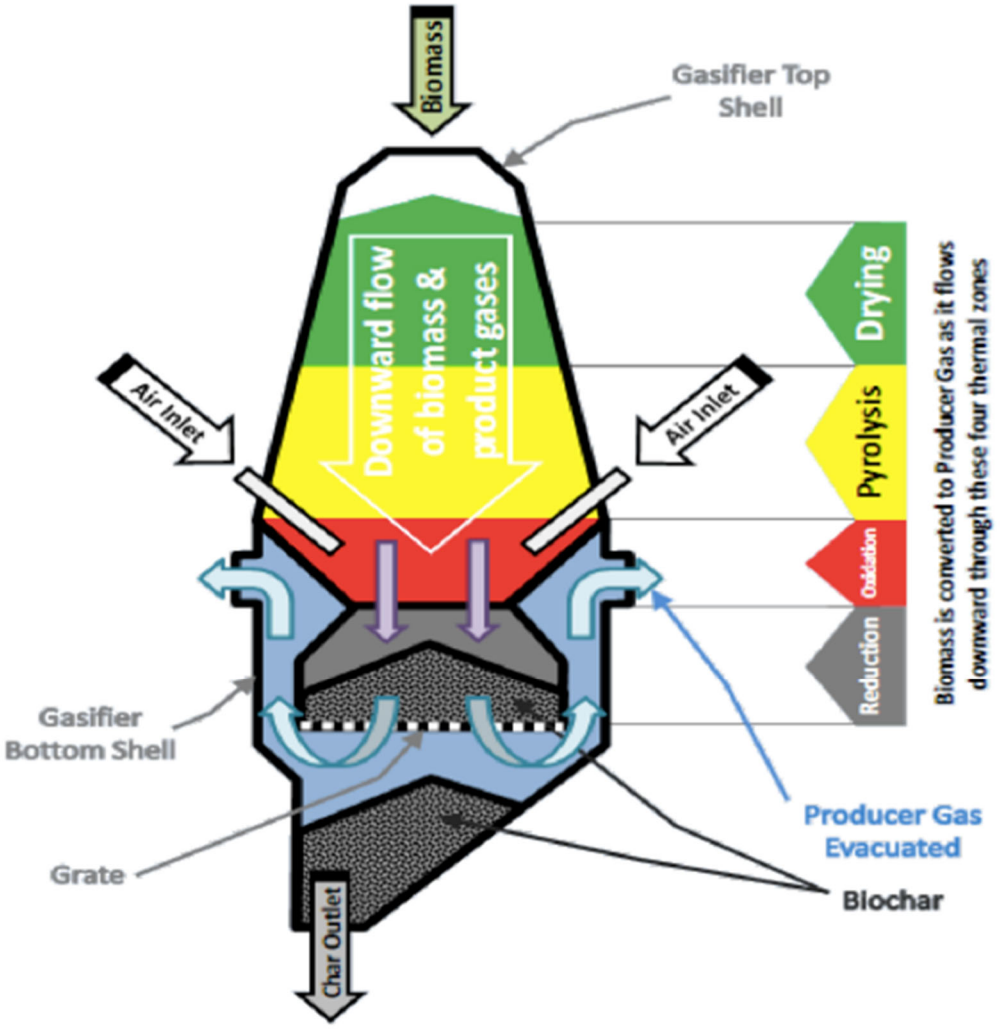

Figure 3-5. The Gasification Process

a) Oxidation

$C + O_2 = CO_2 + heat$

$H + O_2 = H_2O + heat$

43 Organic biomass molecules, carbon (C) and hydrogen (H), oxidize and release heat energy following the above reactions. These reactions are exothermic reactions in which heat is released. These turn into carbon dioxide and water vapor, respectively. As a result of combustion, ash containing non-combustible inorganic minerals is also removed.

b) Pyrolysis (Distillation)

44 The thermal decomposition process that occurs when organic materials are heated in an oxygen-free environment is called pyrolysis. For heating up to 900-1.000°C in an oxygen-free environment; gas components, volatile condensable, biochar, and ash are released. Gas components and wood gas are released when it rises to too high a temperature. The pyrolysis process takes place as follows: In an oxygen-free environment, complex organic molecules

decompose in the temperature region of 900-1,000°C: combustible, non-combustible gases, tar, and pitch are released.

c) Reaction (Carbonization)

45 In carbonization, organic substances undergo chemical decomposition in an airless environment. This process occurs in different temperature regions (150 - 500ºC). The following gas components are released due to carbonization: 50% CO_2, 35% CO, 10% CH_4, 5% other carbons and H_2.

46 **d) Gasification (Reduction)**

47 In the gasification of organic substances, the process up to a temperature of about 500 °C is the pyrolysis stage; carbon, gases (calorific value can be up to 20 MJ/m^3) and tar are obtained. When the heating is up to 1000 °C, the carbon reacts with the steam to produce CO and H_2. Depending on the variable oxygen ratio in the raw material, additional oxygen input may not be required for the gasification process.

48 This system can be installed as a mobile plant. The calculation is based on the capacity of the plant; in this case, we assume the daily capacity of the plant by 160 tons (4*40 tons reactors) of dry sludge.

3.3.10 Thermal Drying

49 Thermal drying is the application of heat to evaporate the moisture contained within the sludge. The process results in 65-95% dry (depending on the feedstock moisture and applied treatment temperatures/durations). This process results in a significant volume reduction, pathogen removal with direct contact with high heat, and overall chemical stabilization of the sludge. These end properties result in more accessible storage due to pathogenic inactivity and easier transport due to volume reduction. Due to its final properties, the end product can be used in all land use options. Apart from land-use cases, the end product can also be used as fuels in cement kilns, power plants, and incinerators. However, despite being relatively straightforward, the process is expensive both initially and operationally due to high energy requirements. The process requires experienced staff, and maintenance is essential. Flue gases and liquids resulting from the evaporation of moisture should also be managed during the process.

50 The summary of implementation criteria and efficiencies of pathogen removal for the alternative methods are summarized in Table 3-3 and Table 3-4, respectively.

Table 3-3. Comparison of pathogen removal performances of the technologies

Process	Area	Skilled Personnel	Power Requirement	Chemicals	External biomass	Construction Cost	Operation and Management Cost
Composting (windrow)	+++	+	+/++	+	+++	+	+
Composting (in a vessel)	++	++	++	+	+++	+/++	++
Pasteurization	++	++	+++	+	+	++	++
Alkali Treatment	++	+/++	+	+++	+	+	++
Incineration	+	+++	+++	+	+	+++	+++
Air Drying	+++	+	+	+	+	+	+
Solar Drying	++/+++	+	+/++	+	+	++	+/++
Pyrolysis	+	+++	+++	+	+	+++	++/+++
Hydrothermal Carbonation	+	++	+++	+	+	+++	++/+++
Thermal Drying	+	+++	+++	+	+	+++	+++
***+++: Significant, ++: Moderate, +: Little or none (Double values represent that one of those values can be true or the cost can be in between the two values**							

Table 3-4. Comparison of pathogen removal performances of the technologies

Process	Effect against pathogens			Stability of Product	Decreasing Reduction	Odor Potential	Notes
	Bacteria	Viruses	Eggs				
Composting (windrow)	++/+++	+/++	++/+++	++/+++	▲	+++	Mixture and temperature are important.
Composting (in a vessel)	+++	++/+++	+++	+++	▲	++	Mixture and temperature are important.
Pasteurization	+++	+++	+++	++	+	++	Must be previously stabilized
Alkali Treatment	++/+++	+++	++/+++	+/++	▲	++/+++	pH maintenance is essential (excess)
Incineration	+++	+++	+++	+++	+++	+	Total stabilization and inactivation
Air Drying	+/++	+	+/++	+	+/++	+++	Climate and temperature are important.
Solar Drying	++/+++	+/++	+/++	+/++	++	++	Climate and temperature are important.
Pyrolysis	+++	++/+++	++/+++	+++	++/+++	+/++	Method of pyrolysis and feedstock materials dictate end products.
Hydrothermal Carbonation	+++	++/+++	++/+++	+++	+++	+	Stabilization efficiency is high.
Thermal Drying	+++	+++	+++	+++	+++	+	Total stabilization and inactivation

***+++: Significant, ++: Moderate, +: Little or no effect, ▲: volume increase (Double values represent that one of those values can be true or the effect can be in between the two values depending on the success of utilization of important parameters for the processes.**

3.4 Land Application Alternatives

51 Various alternatives are available for sludge accumulated at the bottom of the stabilization ponds. These options can be grouped as beneficial uses of sludges as biosolids or their disposal. Land application for agricultural use as fertilizer is one of the significant beneficial end-uses. However, the requirements for agricultural use are stringent in many countries. The limitations become more stringent if crops are grown on land or beneath the land. In contrast, crops that harvested parts are above the land or industrial crops are subject to less stringent quality parameters.

52 Other methods include land application where sludge is applied to soils in parks and recreational areas, golf courses, and landscaping. Land application for soil rehabilitation and land reclamation can also be conducted with stabilized sludges. Sludge can also be applied to topsoil, including landfill cover soils. Forest fertilization is also another method for its utilization. Sludge can be dried to pellets and can be used as solid fuels in several incineration facilities. If there are no viable end-use for the sludges extracted or are not financially appropriate or sustainable, surface disposal or landfilling of the sludge can be conducted. However, surface disposal is not advised in a large area since it can cause significant environmental pollution. Therefore, landfilling in a controlled area could be selected. Possible management options are given in the flow diagram, considering the various management practices with respect to sludge properties, in Figures 3.6 (1/2 and 2/2).

53 Using sludge on soils involves a balance between supplying the soil and crops with vital nutrients and organic matter and taking advantage of the assimilative capacity of the soil, so that trace amounts of heavy metals or chemicals do not cause harm. According to the toxic materials content and sanitary properties of the soils, the land application uses of the sludge may vary. The feasibility of land application of sludge depends on physical-chemical and microbiological characteristics, encompassing pathogen dissemination risks and soil metal accumulation. The parameters to be evaluated are specified in the particular local legislations. These parameters are (i) Agronomic parameters (N, P, K, Ca, Mg, S, C/N, pH), (ii) Metals (Cd, Cr, Cu, Zn, Pb, Ni, Hg, As, Se, etc.), (iii) Pathogen density (viable helminth eggs, fecal coliforms etc.) and (iv) Stability (volatile organics content, ash content).

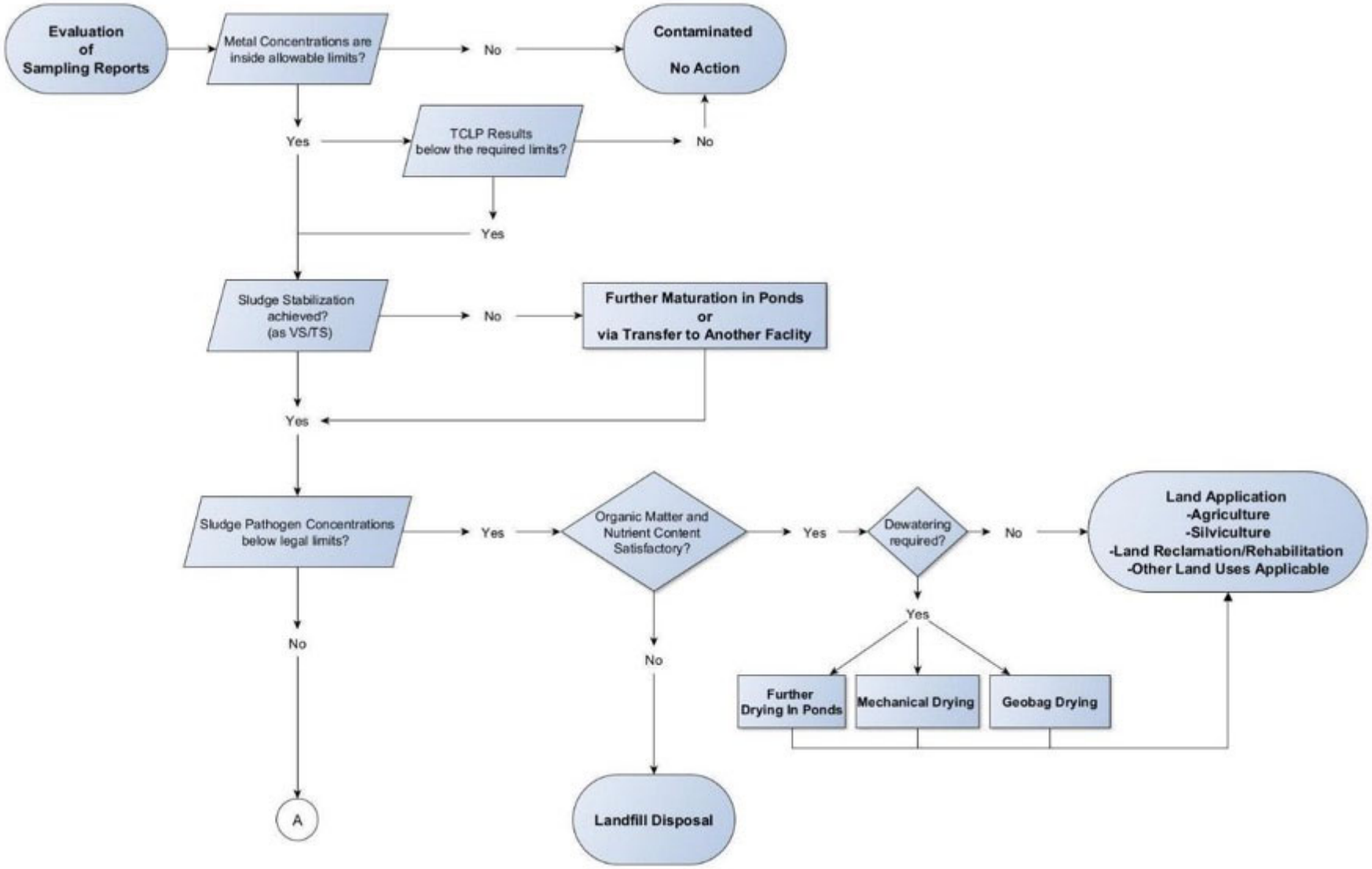

Figure 3-6. Flow Diagram of possible management options (1/2) (Prepared according to GOST R Standards)

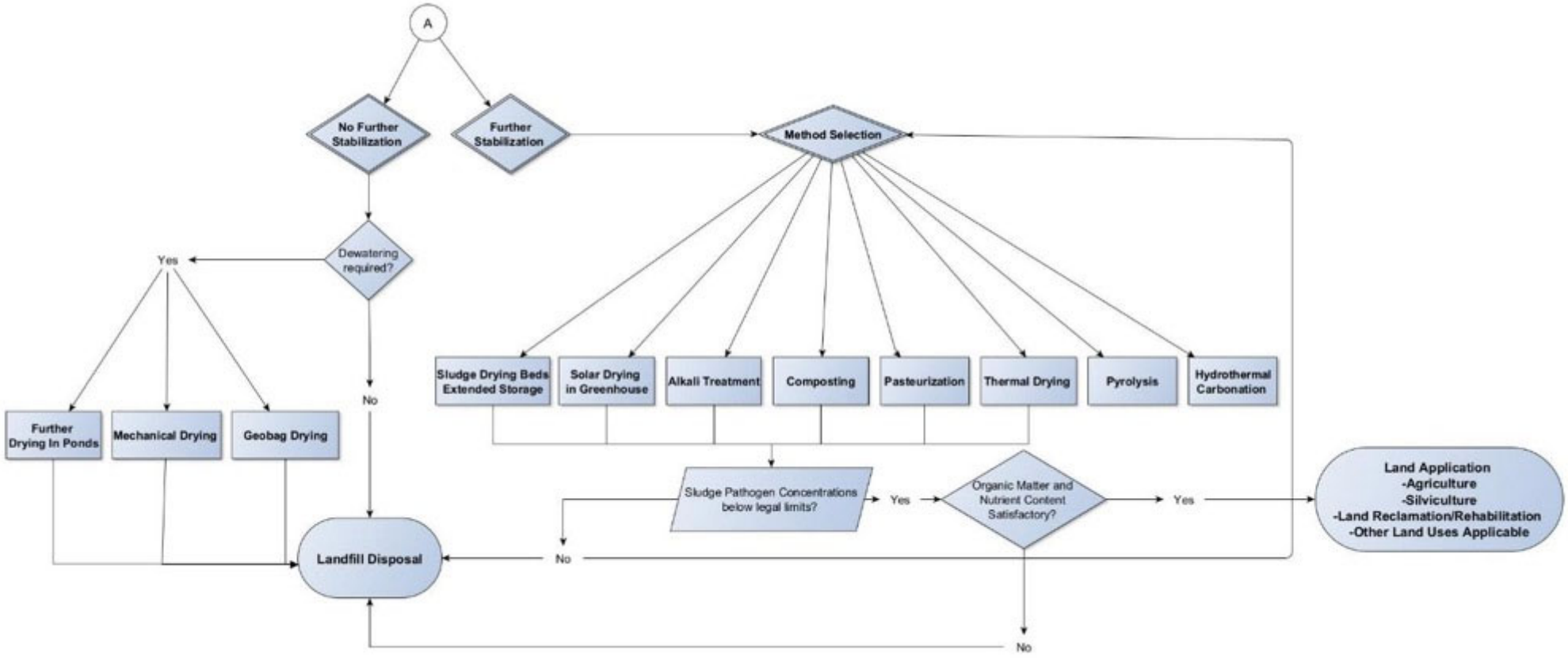

Figure 3-6. Flow Diagram of potential management options (2/2)

54 Moreover, the land that sludge will be applied to should also be evaluated for heavy metal content, pH, and other parameters, along with the plant's uptake of applied nutrients and heavy metals from the soil. Excess heavy metal content can cause reduced plant growth, performance and yields, and leaching, which can also cause pollution in the aquatic environment. With terrestrial and aquatic organisms' uptake, humans can also be exposed to these heavy metals. Leaching tests (TCLP) for heavy metals should be conducted in order to define the extent of heavy metal pollution that can be caused by sludge application.

55 Excess nitrogen application can lead to eutrophication via the leaching of nitrates from the soil. Determination of the nitrogen requirement of the plant and average nitrogen present in the soil, then subtracting these values is the most accurate estimating method. All the above-mentioned parameters also depend on the countries' geographical and climatic properties. Restricting the levels of heavy metals and some organics in sludge or receiving soils and limiting how much sludge is applied at any one time or during any time period (one or several years), reduces any potential for dramatic changes in soil chemistry that could disrupt the soil ecosystem or harm crops, aquatic systems, or animal or human health.

56 Therefore, countries have defined various limits for heavy metal content in sludge, along with application rates of heavy metals on the lands per year, nitrogen application rates, pathogen requirements for using the sludge in agriculture, and beneficial land uses. Toxicity and risk assessments along with tests that monitor the crop uptake and performance in order to determine the suitability of the sludges to the crops that are being cultivated are beneficial for application of the sludges to the soils. These parameters and additional parameters required for land application of sludge should be reviewed to decide which standard is to be adapted for sludge management.

3.4.1 Agricultural Use

57 Sludge with acceptable quality, with respect to the standards adopted for sludge management can be used as fertilizers in agriculture. If sludge to be applied on land has no heavy metal content above the legal limits, does not contain pathogens, and is stabilized, it can be used in the soils as fertilizer. The amount of sludge that can be applied on land is dictated by the nutrient requirements of the plants, type of the soil and the dry matter content of solids in the sludge, pH of the soils, and accumulation potential of toxic substances with the application.

58 Sludge application at excessive rates (more micronutrients than plants can handle) can show toxic effects on the plants. Moreover, they can leach to other environmental compartments. Depending on the operation mode, biochar, an end product of the pyrolysis process, can also be used to remediate soils and increase soil moisture and nutrient holding capacities.

59 Application of sludge on land should consider the risks of groundwater contamination, surface

water contamination via runoff, and contact of humans or animals with the sludge applied. EPA, soils for good sludge application practices have high depth, high infiltration and percolation capacity, fine texture to allow high water and nutrient retention, good drain ability and aeration, alkaline to neutral pH to reduce solubilization and mobility of metals. Water table distances, surface slopes, structure, and readability of the land are also important, to avoid nutrients escaping the soil and causing pollution in another environmental compartment. Animal and human contact with applied sludge soil should be restricted for a time period if the quality of the sludge is low and may constitute a health risk upon interaction.

3.4.1.1 Comparison of Legislations for sludge use in agriculture

60 E.U. directive (86/278 / EEC), US EPA (40 CFR Part 503-7/1/20 Edition), and Russian GOST R (17.4.3.07-2001) are primarily similar in heavy metals to be screened for agricultural land application where the limits of these metals differ with each other. Moreover, the E.U. directive sets the frame for ceiling levels to apply sewage sludges. Members should set their limits lower than the E.U. directive if their geological and climatic properties require it. There is no national regulation in Kyrgyzstan related to using sewage sludge in agriculture. A comparison of these directives is provided in Table 3-5. Overall, Russian standards are more stringent than E.U. and US EPA standards regarding heavy metal content. However, as mentioned, E.U. countries apply different ceiling levels for these pollutants, which can be even more stringent than Russian standards (Table 3.6).

Table 3-5. Comparison of permissible heavy metal concentrations for stabilized sludge in land application in E.U. framework directive, U.S. legislation and Russian legislation.

Total Heavy Metals (mg/kg dry matter)	EU (86/278/EEC)	US EPA (40 CFR Part 503 7-1-20 Edition)	GOST R (17.4.3.07-2001)
Lead (Pb)	750-1200	300-840	250-500
Cadmium (Cd)	20-40	39-85	15-30
Nickel (Ni)	300-400	420	200-400
Chromium (Cr)	900-1000	1200-3000	500-1000
Copper (Cu)	1000-1750	1500-4300	750-3500
Zinc (Zn)	2500-4000	2800-7500	1750-3500
Arsenic (As)	-	41-75	Oct-20
Selenium (Se)	-	36-100	-
Mercury (Hg)	16-25	17-57	7.5 -15

61 In US EPA (40 CFR Part 503), lower limits given in Table 3-7 (in mg/kg) are the monthly average concentration applied to agricultural land, forest, a site that has public contact, or a reclamation site. The values can also be used interchangeably for cumulative loading rate kg/ha). E.g., Cd can be applied in a monthly average concentration of 39 mg/kg, or the Cd level shall not exceed 39 kg/ha. If sludge is to be applied on a lawn or home garden, the lower

limit should be used as the monthly average concentration (mg/kg). If the sludge is given away in a bag or container, the annual loading rates (kg/ha.yr) should not exceed the values in Table 3.8. According to E.U. (86/278 / EEC), the annual loading rates (kg/ha.yr) should not exceed Table 3.8. Also, in soils with pH 6 to 7, heavy metal concentrations should not exceed the values in Table 3.9. They should be lowered when pH is below 6 (increased heavy metal mobility) and can be increased by a maximum of 50,% considering the environmental effects. According to GOST R 17.4.3.07-2001, applied heavy metals and chemicals cannot exceed 0.8xMAC (Maximum allowable concentrations).

Table 3-6. Comparison of permissible heavy metal concentrations for stabilized Sludge inland application throughout the E.U.

State	Cd (mg kg^{-1} DS)	Cu (mg kg^{-1} DS)	Hg (mg kg^{-1} DS)	Ni (mg kg^{-1} DS)	Pb (mg kg^{-1} DS)	Zn (mg kg^{-1} DS)	Cr (mg kg^{-1} DS)
Directive 86/278/EEC	20-40	1,000 – 1,750	16-25	300-400	750-1,200	2,500-4,000	-
Austria	2-10	300-500	2-10	25-100	100-400	1,500-2,000	50-500
Belgium	6-10	375-600	5-10	50-100	300-500	900-2,000	250-500
Bulgaria	30	1,600	16	350	800	3,000	500
Cyprus	20-40	1,000 – 1,750	16-25	300-400	750-1,200	2,500-4,000	-
Czech Republic	5	500	4	100	200	2,500	200
Denmark	0.8	1 000	0.8	30	120	4,000	100
Estonia	20	1 200	20	400	900	2,500	1 200
Finland	3	600	2	100	150	1,500	300
France	20	1 000	10	200	800	3,000	1 000
Germany	2*-10	600*-800	1.4*-8	60*-200	100*-900	1,500*-2,500	80*-900
Greece	40	1,750	25	400	1 200	4,000	500
Hungary	10	1 000	10	200	750	2,500	1 000
Ireland	20	1 000	16	300	750	2,500	-
Italy	20	1 000	10	300	750	2,500	-
Latvia	10	800	10	200	500	2,500	600
Lithuania	PTE regulated through limits on soil						
Luxemburg	20-40	1,000 – 1,750	16-25	300-400	750 – 1,200	2,500-4,000	1,000 – 1,750
Malta	5	800	5	200	500	2 000	800
Netherlands	1.25	75	0,75	30	100	300	75
Poland	10	800	5	100	500	2,500	500
Portugal	20	1 000	16	300	750	2,500	1 000
Romania	10	500	5	100	300	2 000	500
Slovakia	10	1 000	10	300	750	2,500	1 000
Slovenia	2	300	2	70	100	1.20	150
Spain	40	1,750	25	400	1 200	4,000	1,500
Sweden	2	600	2.5	50	100	800	100
Brazil	39	1,500	17	40	300	2,800	1 000
United Kingdom	PTE regulated through limits on soil						
China	5-20	800-1,500	5-15	100-200	300-1,000	2,000-3,000	-
Japan	5	-	2	300	100	-	500
Jordania	40	1,500	17	300	300	2,800	900
Russia	15	750	7,5	200	250	1,750	500
$	39-85	1,500-4,300	17-57	420	300-840	2,800-7,500	-
Range in Europe	0.5-40	75-1,750	0.2-25	30-400	40-1200	100-4,000	75-1,750

Table 3-7. Annual Loading Rate in US EPA 40 CFR Part 3

Pollutants	Annual Loading Rate (kg/ha.yr)	Pollutants	Annual Loading Rate (kg/ha.yr)
As	2	**Hg**	0.85
Cd	1.9	**Ni**	21
Cu	75	**Se**	5
Pb	15	**Zn**	140

Table 3-8. Annual Loading Rate in EU 86/278 / EEC

Pollutants	Annual Loading Rate (kg/ha.yr)	Pollutants	Annual Loading Rate (kg/ha.yr)
Cd	0.15	**Zn**	30
Ni	3	**Hg**	0.1
Cu	12	**Pb**	15

Table 3-9. Soil heavy metal limits in EU 86/278 / EEC

Pollutants	Soil Heavy Metals (mg/kg dry matter)	Pollutants	Soil Heavy Metals (mg/kg dry matter)
Cd	1-3	**Zn**	150-300
Ni	30-75	**Hg**	1-1,5
Cu	50-140	**Pb**	50-300

62 Apart from heavy metals, pathogens are also important for the receiving soils to prevent the spreading diseases that might be originating from the sludge. The principal pathogens of concern in WSP sludge are helminth eggs, which are concentrated in the sludge layer due to their high settling velocities. One species, Ascaris, has an extremely high prevalence in most developing countries; it has been estimated that over 1 billion people are infected worldwide (Crompton, 1999). Helminthiasis diseases have different manifestations, but in general, they cause intestinal wall damage, hemorrhages, deficient blood coagulation and undernourishment. Helminthiasis can degenerate into cancer tumors. Protozoan cysts and bacterial and viral pathogens attached to particles may also accumulate in the sludge layer via sedimentation. Rather than measure these pathogens directly, indicator organisms are typically used. Fecal coliform bacteria and enterococci are common indicators of enteric bacterial pathogens, whereas F+ coliphage has been used as an indicator of the enteric virus.

63 US EPA (40 CFR Part 503) categorizes sludges according to their pathogen contents as Class A (safe for direct contact) and Class B (restricted land and crop use). Sludges can be classified as A in several circumstances. If sludge cannot meet all the alternative Class A requirement scenarios, it is classified as Class B and should be used with restriction. Requirements for class A biosolids and restrictions for Class B biosolids are listed in Table 3.10. GOST R 17.4.3.07-2001 classifies biosolids as Group I and II. The classification is given in Table 3.11. E.U. Sludge directive 86/278/EEC does not include pathogenic standards; however, Working Document on Sludge which E.C. published in 2000, offered a standard for pathogens that was not enforced in regulations. E.U. countries apply different pathogenic standards, as shown in Table 3.12. Sludge use in grassland or forage crops if grassland to be grazed or the crops to be harvested before a certain period (which cannot be less than 3 weeks) is prohibited. It should not be used in soils where fruit and vegetable crops are growing, except fruit trees. A period of 10 months should be elapsed before harvesting the crops if the land is intended for fruit and vegetable crops that are eaten raw. A comparison of pathogen requirements in different regulations is provided in Table 3-13.

Table 3-10. US EPA-Part 503 Pathogen Limits of Sludges and Site Restrictions

Class A Biosolids Requirements*:	**Fecal coliform density of < 1,000 MPN/ gram total solids**
	or
	Salmonella sp. Density of <3 MPN/4 grams total solids
Class A Biosolids Additional Requirements:**	Enterovirus <1MPN/4g total solids
	Viable helminth eggs <1 viable egg/4 g TS
Class B Biosolids Requirements:	Fecal coliform density of <2,000,000 MPN/gram total solids
Harvesting Restrictions	
Food crops touching soil/sludge mixture, above ground*	Harvest after 14 months after sludge application
Root crops if 4 months passed after planting	Harvest after 20 months after sludge application
Root crops if less than 4 months passed after planting	Harvest after 38 months after sludge application
Other food, feed or fodder	Harvest after 30 days after sludge application
Lawn turf	Harvest after 1 year after sludge application
Access Restrictions	
Grazing	No grazing prior to 30 days after sludge application
Public Access to land- high Access potential	One year waiting period prior to Access
Public Access to land – low Access potential	30 day waiting period prior to Access.

*: Application after temperature (above 50 °C) and time regimes or Application after successful lime treatment at high temperature, **: Application without heating.

Table 3-11. GOST R 17.4.3.07-2001 Pathogen Limits of Sludges and Uses Defined

Class I Biosolids Requirements:	**Fecal coliform density of < 100 cells/gram sediment, actual moisture**
	No pathogenic microorganisms (incl. Salmonella) in cells/g
	No eggs of helminths and intestinal pathogenic protozoa (ind./kg sediment actual moisture)
Class II Biosolids Requirements:	Fecal coliform density of <1000 cells/gram sediment, actual moisture
	No pathogenic microorganisms (incl. Salmonella) in cells/g
	No eggs of helminths and intestinal pathogenic protozoa (ind./kg sediment actual moisture)
	Use of Sludges
Group I	All types of agricultural crops, except vegetables, mushrooms, greens and strawberries
Group II	Can be used for cereals, legumes, grain fodder and industrial crops
Group I and II	In industrial floriculture, green construction, forest and decorative nurseries, for biological reclamation of disturbed lands and solid waste landfills.
Group I and II	Worked out peatlands with pH<5.5 with liming and soils underlain by sandy deposits
Heavy Metals above Group II and in 4th Hazard class	Restoring productivity or reclamation of disturbed lands for forestry and recreational areas or are subject to placement on specially equipped landfills.

Table 3-12. Sludge Pathogen Regulations in E.U. countries

State	*Salmonella sp.*	Other pathogens
EC (2000)	No occurrence in 50 g	*Escherichia coli* <500 cfu/g
Bulgaria	No occurrence in 20 g	*Escherichia coli* <100 MPN/g *Clostridium perfringens* <300 MPN/g Helminths eggs and larvae, 1unit/kg DM
Czech Republic	No occurrence in 50 g	*Escherichia coli* or Enterococci $<10^3$ cfu/g (4 samples from 5) $<5.10^3$ cfu/g (1 sample from5)
Sludge category I	No occurrence in 1 g CB	Thermotolerant coliforms $<10^3$ cfu/g DM Enterococci $<10^3$ cfu/g DM
Sludge category I	Not determined	Thermotolerant coliforms 10^3-10^6 cfu/g DM Enterococci 10^3-10^6 cfu/g DM
Denmark	No	Faecal streptococci <100/g
Finland	No occurrence in 25 g	*Escherichia coli* <1000 cfu, <100 cfu in greenhouse cultivation where the consumed part is in contact with the substrate
France	8 MPN/10 g DM	Enterovirus <3 MPCN/10 g DM Helminths eggs <3 /10 g DM
Italy	1000 MPN/g DM	
Lithuania		*Escherichia coli* ≤ 1000 cfu/g *Clostridium perfringens* ≤ 100 000 cfu/g Helminths eggs and larvae, 0 units/kg Enterobacteria, 0 cfu/g
Luxemburg		Enterococci -100/g Helminths eggs cannot be contagious.
Poland	No occurrence in 100 g	
Portugal	No occurrence in 50 g	*Escherichia coli* <1000 cfu/g
Austria (Carinthia)	No occurrence in 1 g	Enterococci $<10^3$/g no Helminths eggs
Austria (Lower Austria)	No occurrence in 1 g	*Escherichia coli* <100 cfu no Helminths eggs
Austria (Steiremark)	No occurrence in 1 g	Enterococci $<10^3$/g
Slovakia		Thermotolerant coliforms $<2x10^6$ cfu/g DM Faecal streptococci < $2x\ 10^6$ cfu/g DM

64 According to US EPA (40 CFR Part 503), nitrogen requirement for the crop or vegetation grown on each site during a 365-day period should be monitored and established. An annual application rate of sludge should be determined via AAR=N/0.0026 formula, where AAR is the annual application rate and N is the yearly nitrogen requirement of the soil. Application of sludges should not exceed this rate. E.U. 86/278/EEC also states that the sludge shall be used in such a way that account is taken of the nutrient needs of the plants and that the quality of the soil and the surface and groundwater is not impaired. This also indicates the assessment and monitoring of plant and soil nutrient needs. GOST R 17.4.3.07-2001 also states that applied mineral nitrogen should not exceed the removal with crops harvest. In addition, SanPin 2.1.7.573-96 states that the maximum dose is additionally limited by the amount of total nitrogen introduced with precipitation into the soil, which should not exceed 300 kg/ha year.

Table 3-13. Comparison of Pathogenic Requirements in Different Countries

Organism	US EPA (40 CFR Part 503-1993) 503 7-1-20 Edition)	GOST R (17.4.3.07 -2001)	France	Bulgaria
Fecal Coliforms	<1000 MPN/g TS	<100 cells /gram sediment	Defined	< 500 CFU/g E.coli or C. Perfringens <300 MPN/g
Salmonella	< 3MPN/4g TS	None	8 MPN/10 g TS	None
Enterovirus	<1 MPN/ 4g TS	Defined	3 MPN/ 10g TS	Defined
Viable Helminth ova	<1 viable eggs /4g TS	None	3 viable eggs/10g TS	1 viable egg/kg DM

65 GOST R 17.4.3.07-2001 also lists several other parameters that should be accounted for, which are listed in Table 3-14.

Table 3-14. Additional requirements in GOST R 17.4.3.07-2001

Indicator name	Norm
Mass fraction of organic substances, as %dry matter	≥ 20
The reaction of the medium(pH)	5.5-8.5*
Mass fraction of total nitrogen, as % dry matter	≥0.6
Mass fraction of total phosphorus (P_2O_5) as % dry matter	≥ 1.5
***Precipitation with pH>8.5 can be used on acidic soils as organo-lime fertilizers**	

66 Since GOST R and SanPin regulations are the legislations that are followed by Kyrgyzstan and they are the most stringent methods for environmental protection these legislations are to be followed throughout this report.

3.4.2 Silviculture (Reforestation/Parks and Recreation Areas)

67 After treatment, sludges can be applied to land in parks and recreational areas to improve soil characteristics in these areas and support the growth of tree and shrub plantations. Forestlands that are being planted can be fertilized with the sludges in order to accelerate the growth of the planted trees or increase the tree yield in the area. Under allowed circumstances, sludges can be used as final covers in landfills and other application areas when mixed with soils. GOST R 17.4.3.07-2001 and SanPin 2.1.7.573-96 should be followed with silviculture applications.

3.4.3 Land Reclamation and Rehabilitation

68 Sludges can be used as topsoil in disturbed lands due to mining activities, other industrial activities, or natural disasters in order to rehabilitate the area. The sludge can provide topsoil for supporting vegetation, preventing erosion by stabilizing the slopes and improving the soil's water-holding capacity. Sludge application to cultivated lands for the long-term can be made to allow re-farming in these areas. Several grains and industrial crops or silages can be planted in these areas. Sludges treated with alkaline chemicals can be used for the rehabilitation of acidic soils. Biochar can also be used as a soil amendment, as mentioned above. GOST R 17.4.3.07-2001 and SanPin 2.1.7.573-96 should be followed with silviculture applications.

3.4.4 Use as Fuel

69 Sludges that are transformed into dried pellets can be used as solid fuels. They can be incinerated in cement kilns as supplementary fuels or burned as feedstock. The latter can require additional fuel for incineration, depending on the dry matter content of the sludge. However, suppose calorific values of the materials tested after 70% dryness or more suffice for gathering excess energy from incineration. In that case, it can be a viable option for both sludge management and energy production. However, the process is energy extensive, both drying and incineration operations, and requires stringent air emissions control. The emission control and heat recovery/energy production can make the process feasible for use; however, the initial and operational costs would still be considerably higher than other methods used for sludge management. Biochar from pyrolysis and syngas from pyrolysis can be used as fuel to supply energy to the system and, in some cases, as an external energy source. Hydrothermal carbonation end product (HTC coal) can be used as a substitute for coal.

3.4.5 Landfill and Land Disposal

70 If there are no viable end use for the sludges extracted from the ponds or they are not affordable, the sludge landfill can be conducted in case the sludges do not contain heavy metals above the legal limits defined by Kyrgyz legislation. Landfilling of Sludge can be executed in 2 ways. 1) Dedicated landfill for sludges, 2) Co-disposal with municipal solid waste. The landfill should be close to stabilization ponds, if dedicated landfilling is executed.

71 Trench width can be small (1-3 m) or large (3-15 m) depending on the solid content of the sludge, which can be used with sludges of <30% solids or >30-40% solids, respectively. More extensive trenches can support 1,200-5,500 tons/ha of sludge, whereas smaller trenches can support 450-2,100 tons/ha of sludge. The bottom layer of the disposal area should be comprised of impermeable soils (e.g., clay) and a geomembrane and geotextile to support the impermeability. Landfill leachate drainages should be applied if treatment of the leachates is possible in order to percolate the water stored inside the sludge and to enhance the storage volume of the Pond in the long run. Stormwater drainages should also be constructed to divert the water entering the disposal area. The gas collection system should also be installed, depending on the organic matter available to be composed, to collect the gases that can cause air pollution.

72 According to literature, the solid concentration should be over 20% in co-disposal with MSW. In Turkish regulations, solid content of 50% is required to dispose of sludge in the landfills in separate cells, and they cannot be disposed of commingled with MSW. In Europe, the disposal in landfills is limited with restrictions on organic matter content and minimum requirements for dry matter content in the Netherlands and France. Disposal to an existing MSW landfill is only possible to an extent where 20-25% of the total solids disposed of can be sludges. The sludge

would cause difficulties with the landfill operation if poorly managed. Sludges will also decrease the landfill's lifetime due to poor characteristics of their non-compactable nature, and they can clog the drainages in landfills based on their moisture rates.

73 Siting of the landfill should consider the water table beneath. The distance between the bottom of the landfill and the water table should be as much as possible to minimize the risk of groundwater pollution. The landfill site should not be placed close to residential areas, water sources, or public roads or should not be located in the area of aquifers, and the land should not be of agricultural significance.

4 EVALUATION COLLECTED INFORMATION ON SLUDGE MANAGEMENT

74 In this chapter, evaluation of collected information on sludge removal, disposal, stabilization/treatment and design criteria of disposal areas are conducted and possible impacts of these operations will be assessed.

4.1 Evaluation of Analysis Results and Assessment of Bottom Sludge Application or Disposal

75 As the initial task of SMP, Sludge Sampling and Analysis Plan was prepared. The main objective of this plan was to determine whether the accumulated sludge was contaminated or not, in accordance with the international and local standards and regulations. After approval of the Sludge Sampling and Analysis Plan by ADB, sludge analysis was carried out in order to assess if the sludge is contaminated. The plan investigated following ponds; Balykchy WWTP Ponds (6 ponds), Karakol WWTP Ponds (4 ponds) and Karakol Irrigation Pond (1 pond).

76 The results were evaluated within an Evaluation Report, which was also approved by ADB. Depending on the Evaluation Report, a management plan is developed by the consultants in parallel to the Terms of Reference (clause.2, iv and clause.11) in our Contract. Sludge samples were collected at 21/10/2021. Collected samples were analyzed to determine the content of metal and toxic and pathogenic parameters.

77 A certified lab technician has carried out sampling in accordance with BS EN ISO 5667 (2011) Water Quality-sampling, Part 13-Guidance on sampling of sludges (ISO 5667-13:2011). Standard sampling equipment and containers were used, and sample preservation methods were also followed. Samples were preserved according to BS EN ISO 5667-15 standard. The samples were analyzed by using the procedures defined in Table 4-1. The samples were acid digested by using the method EPA 3051A “Microwave assisted acid digestion of sediments, sludges, soils, and oils,” before metal analysis by ICP-MS. SW-846 Test Method 1311: Toxicity Characteristic Leaching was used for TCLP analysis to detect the leaching of hazardous contaminants from the sludges.

Table 4-1. Analysis methods for the parameters in sludge

Parameters	Units	Limit Value	Method
pH (25°C)	-	-	TS ISO 10390
Dry matter	%	-	TS 9546 EN 12880
Organic Matter (550°C)	%	-	ASTM-D2974 (Modified)
Arsenic	mg/kg DM	≤10	EPA 3051A / EPA 6020B (ICP-MS)
Copper	mg/kg DM	≤750	EPA 3051A / EPA 6020B (ICP-MS)
Mercury	mg/kg DM	≤7.5	EPA 3051A / EPA 6020B (ICP-MS)
Zinc	mg/kg DM	≤1750	EPA 3051A / EPA 6020B (ICP-MS)
Cadmium	mg/kg DM	≤10	EPA 3051A / EPA 6020B (ICP-MS)
Chrome	mg/kg DM	≤500	EPA 3051A / EPA 6020B (ICP-MS)
Lead	mg/kg DM	≤250	EPA 3051A / EPA 6020B (ICP-MS)
Nickel	mg/kg DM	≤200	EPA 3051A / EPA 6020B (ICP-MS)
Selenium	mg/kg DM	≤36	EPA 3051A / EPA 6020B (ICP-MS)

78 Analysis for parasitological parameters “helminth eggs” for sludge accumulated in ponds at Karakol, Balykchy and Irrigation ponds were measured. The results were evaluated based on the regulation “Regulatory Documents for Analytical Procedures; Order of MoH No. 2 dated 11.01.2010 Annex №5” which is about “Hygienic requirements for the use of wastewater and its sludge for irrigation and fertilizer in terms of parasitological parameters”. According to this Regulation, Helminth eggs should not be more than 1 per cubic meter for these uses.

4.1.1 Balykchy Wastewater Stabilization Ponds

79 The heavy metal content of the sludge accumulated in the ponds in Balykchy, pH, dry matter, and organic matter contents are given in Table 4-2. The metal levels are well below the limits for the use of sewage sludge on agricultural land. The metal content of the sludge was highest in Pond I and lowest in Pond IV. The highest metal concentration in all ponds was found for zinc which is usual for sewage sludges. The TCLP (Toxicity Characteristic Leaching Procedure) results also demonstrated that the metals present in the sludge can leach in low amounts (below the allowable limits) and cannot pollute the land when spread.

80 The sludge accumulated in the ponds of Balykchy WWTP was found to be highly biologically stable, with low organic contents. The lowest organic matter content was found in Pond II (6.75 %), and the range was 6.75-21.7% in all ponds. The dry matter content was high in the ponds, which was between 60.21-30.8%, where Pond I, with 30.8% avg., was lower than other ponds. The pH values were close to neutrality (6.64-7.66) in all ponds showing a stabilized sludge characteristic (Table 4.2).

81 Total coliforms in 100 mL were between 200-370 MPN at the ponds in Balykchy. Thermal tolerant coliforms were not present in any of the Pond sludges as well as *Salmonella sp.* was not detected in any ponds. No helminth eggs and protozoan cysts were detected in the Ponds No. II, III, V, VI of Balykchy WWTP where ponds I and IV contained more than 1 Helminth eggs in their sludge. On the other hand, more than 1 Acaridae eggs per cubic meter were detected in the Sludge of Ponds I and IV (Table 4-3).

Table 4-2. Total heavy metal concentrations for Balykchy Ponds

Parameter	Units	Limit Value	Balykchy Pond I			Balykchy Pond II			Balykchy Pond III			Balykchy Pond IV			Balykchy Pond V			Balykchy Pond VI		
			Original	Replicate	Average Value	Original	Replicate	Average Value	Original	Replicate	Average Value	Original	Replicate	Average Value	Original	Replicate	Average Value	Original	Replicate	Average Value
pH (25oC)	-	**-**	7.67	7.66	7.67	7.65	7.69	7.67	6.59	6.64	6.62	7.88	7.91	7.90	7.78	7.76	7.77	7.63	7.69	7.66
Dry matter	%	**-**	29.44	32.25	30.85	53.27	57.84	55.56	43.71	45.63	44.67	61.08	59.33	59.33	59.33	59.33	59.33	44.06	49.64	46.85
Organic matter	%	**-**	18.54	17	17.77	7.45	6.05	6.75	19.09	19.01	19.05	10.68	12.11	11.40	14.7	14.02	14.36	24.42	18.99	21.71
Arsenic (As)	mg/kg	**≤10**	8.7	10.6	9.65	4.66	4.75	4.71	4.8	4.88	4.84	4.42	5.34	4.88	3.11	5.05	4.08	2.57	3.9	3.24
Copper (Cu)	mg/kg	**≤750**	92.4	88.26	90.33	32.13	26.43	29.28	60.94	50.16	55.55	23.65	22.9	23.28	47.21	43.45	45.33	41.95	36.19	39.07
Mercury (Hg)	mg/kg	**≤7.5**	0.3	0.23	0.27	0.1	0.1	0.10	0.16	0.11	0.14	0.1	0.1	0.10	0.1	0.1	0.10	0.1	0.1	0.10
Zinc (Zn)	mg/kg	**≤1750**	452.3	446.2	449.25	117.4	111.6	114.50	294	277.9	285.95	74.3	80.4	77.35	169	239.5	204.25	161.1	213.7	187.40
Cadmium (Cd)	mg/kg	**≤10**	0.94	0,96	0.95	0.9	0.9	0.90	0.9	0.9	0.90	0.9	0.9	0.90	0.9	0.9	0.90	0.9	0.9	0.90
Chromium (Cr)	mg/kg	**≤500**	94.03	86.96	90.50	27	31.2	29.10	40.51	46.65	43.58	27.6	43.32	35.46	35.14	44.78	39.96	28.92	34.64	31.78
Lead (Pb)	mg/kg	**≤250**	65.02	48.99	57.01	23.72	17.37	20.55	31.2	26.94	29.07	16.19	13.89	15.04	23.2	22.42	22.81	19.35	17.57	18.46
Nickel (Ni)	mg/kg	**≤200**	41.97	37.44	39.71	12.67	15.13	13.90	18.21	15.86	17.04	21.2	25.97	23.59	18.27	24.31	21.29	14.82	13.31	14.07
Selenium (Se)	mg/kg	**≤36**	4.7	5.6	5.15	1.46	2.06	1.76	2.27	3.39	2.83	1.64	2.53	2.09	1.93	2.93	2.43	1.85	2.56	2.21

Table 4-3. MPN Results for total coliforms and viable helminth eggs/protozoan cysts in Balykchy

BALYKCHY	**MPN CFU Total coliforms in 100,0 mL**	**MPN CFU Thermal tolerant coliforms in 100 mL**	***Salmonella sp.* Pathogenic microbial**	Viable Helminth Eggs/Protozoan cysts (per m3)
Pond I	200	N.D:	N.D:	>1
Pond II	280	N.D:	N.D:	N.D:
Pond III	210	N.D:	N.D:	N.D:
Pond IV	210	N.D:	N.D:	>1
Pond V	230	N.D:	N.D:	N.D:
Pond VI	230	N.D:	N.D:	N.D:

4.1.2 Karakol Wastewater Stabilization Ponds

82 The heavy metal content of the sludge accumulated in Karakol ponds and pH, dry matter and organic matter contents, are given in Table 4-4. The metal levels are well below the limits for the use of sewage sludge on agricultural land. The highest metal concentration in all ponds was found for Zinc which is usual for sewage sludge. In Ponds II and III, Co and Cr were higher than the other ponds. The TCLP results also show that the metals in the sludge can leach in very low amounts (below the allowable limits) and have no potential to pollute the land when spread.

83 The sludge accumulated in Karakol WWTP's sludge ponds is highly biologically stable, with low organic contents. The percent organic matter content shows that, as expected, the sludge deposited in Karakol WWTP ponds is entirely stabilized, with the lowest O.M. content of 17.03 % in Pond I and around 40 % in Pond II and III of Karakol. The dry matter content was high in the ponds (28.7-44.6%), except in Pond IV, which was 9.4% on average. The pH value that affects the metals' mobility was between neutrality in all ponds.

84 Total coliforms in 100 mL were between 200-290 MPN at the sludge ponds in Karakol. Thermal tolerant coliforms were not present in any of the Pond sludges, and *Salmonella sp.* was not detected in any ponds (Table 4.5). The Sludge in Ponds I, II, III, and IV contain helminth eggs "More than 1 per cubic meter" which is higher than the limits (Table 4.5).

Table 4-4. Total heavy metal concentrations for Karakol Ponds

Parameter	Units	Limit Value	Karakol Pond I			Karakol Pond II			Karakol Pond III			Karakol Pond IV		
			Original	Replicate	Average Value	Original	Replicate	Average Value	Original	Replicate	Average Value	Original	Replicate	Average Value
pH (25°C)	-	**-**	7.48	7.55	7.52	6.67	6.71	6.69	6.55	6.62	6.59	6.97	7.02	7.00
Dry matter	%	**-**	44.55	41.71	43.13	28.67	30.98	29.83	33.61	34.76	34.19	9.45	9.29	9.37
Organic matter	%	**-**	17.03	19.16	18.10	40.6	35.82	38.21	35.49	34.29	34.89	39.43	39.9	39.67
Arsenic (As)	mg/kg	**≤10**	3.72	4.56	4.14	4.85	5.35	5.10	2.92	3.69	3.31	9.4	9.5	9.45
Copper (Cu)	mg/kg	**≤750**	48.75	58.22	53.49	156.17	177.47	166.82	121.78	147.72	134.75	106.7	91.49	99.10
Mercury (Hg)	mg/kg	**≤7.5**	0.2	0.16	0.18	0.89	0.68	0.79	0.71	0.57	0.64	0.26	0.24	0.25
Zinc (Zn)	mg/kg	**≤1750**	116.6	119	117.80	268.3	334.7	301.50	182.5	231.7	207.10	569.3	530.9	550.10
Cadmium (Cd)	mg/kg	**≤10**	<0.9	<0.9	<0.9	1.7	1.66	1.68	1.6	1.41	1.51	<0.9	<0.9	<0.9
Chromium (Cr)	mg/kg	**≤500**	53.79	58	55.90	141.65	186.2	163.93	114.58	141.22	127.90	59.53	67.08	63.31
Lead (Pb)	mg/kg	**≤250**	25.53	30.27	27.90	64.13	72.25	68.19	46.51	55.87	51.19	40.2	46.25	43.23
Nickel (Ni)	mg/kg	**≤200**	18.67	19.4	19.04	29.01	35.41	32.21	21.16	25.7	23.43	27.09	24.13	25.61
Selenium (Se)	mg/kg	**≤36**	1.4	1.78	1.59	2.53	2.62	2.58	1.44	1.6	1.52	2.27	3.24	2.76

Table 4-5. MPN Results for total coliforms and viable helminth eggs/protozoan cysts in Karakol

KARAKOL	MPN CFU Total coliforms in 100,0 mL	MPN CFU Thermal tolerant coliforms in 100 mL	Salmonella sp. Pathogenic microbial	Viable Helminth Eggs/Protozoan cysts (per m3)
Pond I	200	N.D:	N.D:	>1
Pond II	200	N.D:	N.D:	>1
Pond III	210	N.D:	N.D:	>1
Pond IV	290	N.D:	N.D:	>1

*N.D.: Not Detected

4.1.3 Irrigation pond (or BSR as a Russian acronym for Basin of Seasonal Runoff) of Ak-Suu District Department of Water resources (Aksu DDWR)

85 The heavy metal content of the sludge accumulated in the BSR of Aksu DDWR, along with pH, dry matter, and organic matter contents, are given in Table 4.6. The metal levels are well below the limits for the use of sewage sludge on agricultural land. The lowest metal content in all Karakol ponds was found in the irrigation pond. The TCLP results also show that the metals present in the sludge can leach in very low amounts (below the allowable limits) and cannot pollute the land when spread.

86 The sludge accumulated in the ponds of BSR of Aksu DDWR has the lowest O.M. content at 12.6% and is highly stabilized. The dry matter content was 28.85%. The pH value was close to neutrality, showing stabilized sludge characteristics.

87 Total coliform in 100 mL was 1300 MPN at the BSR of Aksu DDWR. Thermal tolerant coliforms were not present, and *Salmonella sp.* was not detected (Table 4.6). The sludge quality in the upper part and bottom of the irrigation pond of the Aksu DDWR wastewater treatment plant does not meet the standard for helminth eggs, with more than 1 Toxocarid eggs and Acaridae eggs per cubic meter detected in the sludge samples. (Table 4-6).

Table 4-6. Total heavy metal concentrations, total coliforms and viable helminth eggs/ protozoan cysts for BSR of Aksu DDWR

Parameter	Units	Limit Value	BSR of Aksu DDWR		
			Original	Replicate	Average Value
pH (25°C)	-	**-**	7.55	7.61	7.58
Dry matter	%	**-**	28.85	31.09	29.97
Organic matter	%	**-**	13.5	12.62	13.06
Arsenic (As)	mg/kg	**≤10**	1.36	1.35	1.36
Copper (Cu)	mg/kg	**≤750**	10.53	10.75	10.64
Mercury (Hg)	mg/kg	**≤7.5**	<0.1	<0.1	<0.1
Zinc (Zn)	mg/kg	**≤1750**	36.9	38.9	37.90
Cadmium (Cd)	mg/kg	**≤10**	<0.9	<0.9	<0.9
Chromium (Cr)	mg/kg	**≤500**	11.86	9.7	10.78
Lead (Pb)	mg/kg	**≤250**	6.8	6.13	6.47
Nickel (Ni)	mg/kg	**≤200**	6.24	4.46	5.35
Selenium (Se)	mg/kg	**≤36**	0.49	0.43	0.46

Seasonal Irrigation Pond of Aksu DDWR	**MPN CFU Total coliforms in 100,0 mL**	**MPN CFU Thermal tolerant coliforms in 100 mL**	**Salmonella sp. Pathogenic microbial**	**Viable Helminth Eggs/Protozoan cysts (per m^3)**
	1300	N.D:	N.D:	>1

*N.D.: Not Detected

4.2 Topographical Survey

4.2.1 The volume of Sludge in Existing Ponds

88 Sludge volume determination is crucial for managing sludge operations in extraction, transport, treatment, and application steps. In order to provide a better assessment of sludge management options, further characterization of the sludges may be required, since sludge characteristics may vary temporally and spatially.

89 During the topographical surveys, only the top elevations of the sludges of existing ponds could be measured. In order to increase measurement accuracy within the available conditions, measurement points are defined by splitting the ponds into grids. For both Balykchy and Karakol WWTP ponds a total of 83 points with 25 m grid distances; for the irrigation pond a total of 55 points with 100 m grid distances were selected. Since the sludge is silted at the bottom of ponds for a long time, it became solidified, and since there is no modern equipment available in the region to measure the thicknesses of solidified sludges, the thickness of the sludge couldn't be measured precisely. Therefore, sludge depths are determined by conducting sample excavations in dry ponds to determine the original bottom elevations of ponds. After these excavations are completed and approximate original bottom elevations are obtained. Top elevations of sludge levels were also gathered. With all this information collected during topographical studies; approximate volumes of sludge are calculated for each pond. The approximate volumes of the sludges for each location are listed below (Table 4-7, Table 4-8, and Table 4-9).

Table 4-7. Approximate Sludge Volumes in Balykchy WWTP Ponds

Pond No	Condition of Sludge	Average sludge Depth (m)	Pond Area (m^2)	Pond Volume (m^3)	Volume of Sludge (m^3)
1	Pathogenic	0.55	10,983	16,475	6 050
2	Uncontaminated	0.35	11,210	16,815	3,924
3	Uncontaminated	0.49	12,834	19,251	6,260
4	Pathogenic/ Dry Pond	0.46	12,963	32,408	5,962
5	Uncontaminated	0.50	10,065	25,163	5,010
6	Uncontaminated	0.41	8 720	21,800	3,595
General".				**131,911**	**30,801**

Table 4-8. Approximate Sludge Volumes in Karakol WWTP Ponds

Pond No	Condition of Sludge	Average sludge Depth (m)	Pond Area (m^2)	Pond Volume (m^3)	Volume of Sludge (m^3)
1	Pathogenic	0.59	8 720	13,080	5,145
2	Pathogenic	0.37	10,983	16,475	4 064
3	Pathogenic/ Dry Pond	0.55	10,065	15,098	5,536
4	Pathogenic	0.59	11,210	16,815	6,614
General".				**61,468**	**21,358**

Table 4-9. Approximate Sludge Volumes in BSR of Aksu DDWR

Pond No	Condition of Sludge	Aver. Sludge thickness (m)	Pond Area (m^2)	Volume of Sludge (m^3)
1	Pathogenic	0.30	**390,000**	**117,000**

4.2.2 Evaluation of Disposal Areas Storage Volume Capacities

90 **In Balykchy**: the total volume of sludge is 30,801 m^3. The ponds are still in use and are subject to climate conditions therefore, the sludge that is stored in these ponds should be treated as pathogenic in all cases. However, as observed from the Sampling Evaluation Report, in the time that the sampling event was conducted, sludges from some of the ponds were evaluated as non-pathogenic. If these conditions are verified by another sampling campaign these sludges and pathogenic sludges can be managed in different lots and with different depths in the aforementioned area in order to accelerate the stabilization of pathogenic sludges. The area of the landfill site in Balykchy is also sufficient if the contaminated sludge is to be disposed of in the landfill. During site visit of DSC local authorities verbally indicated that landfill site can be used for sludge disposal. The distance from Balykchy ponds to landfill area is 9.9 km.

91 **In Karakol:** the volume of sludge is 21,358 m^3. The storage area can only be sufficient if the average sludge thickness in the sludge storage areas is around 1.6 m. The size of the landfill in Karakol is insufficient if the contaminated sludge is to be placed in the landfill. The landfill is currently closed and not operational.

92 **In Irrigation Pond:** the volume of sludge is 117,000 m^3. The first proposed storage area by local authorities is next to the Irrigation Pond, and it is approximately 3.5 hectares. The storage area can only be sufficient if the average sludge thickness in the sludge storage areas is around 3.5 m. The topographical structure of the land proposed for sludges storage from irrigation pond is different from the others due to the valley-shaped steep-sloped characteristics. The valley is toward the irrigation pond so the leachates and waters that may be contaminated can affect the water quality of the irrigation pond if the rainwater drainage is not adequate. The operation to be conducted here will be harder to execute and may cost more.

93 The second proposed area is around 3 ha in size which is also located nearby the irrigation pond.. Some part of this site was used as a municipal solid waste landfill (according to the local authorities, the landfill area is 0.12 ha), which was operated in an uncontrolled manner. The landfill was reported to have closed in 2003, and there is a 1-1.5 m thick soil layer over the landfilled waste, as the authorities reported. Based on the usable area of 2.88 ha, sludge thickness of 4.2 m will be necessary to manage the sludge.

4.2.3 Evaluation of Safety of Disposal Areas in Terms of Flood Plains

94 Balykchy WWTP ponds are located on a flat terrain. There is no rainfall basin to create a risk of flood. The only risk of flooding can be due to the Chu River. Since the discharge in Chu River is regulated by the Orto-tokoy reservoir, which is approximately 17 km upstream, there is no risk of flood for the disposal ponds.

95 Karakol WWTP ponds are also located on a flat terrain. There is no rainfall basin to create a risk of flood. The only risk of the flood could be due to the Karakol river. Since the elevation difference between the Karakol WWTP disposal area and the Karakol river is around 10 m, there is no risk of flood for the disposal ponds.

96 BSR of Aksu DDWR disposal area Alternative-I has a valley-shaped topography. However, the rainfall basin size is small due to the flat topography around, which is covered with cultivated fields. During the site visit, no trace of flood plain was inspected which was also verified by local authorities. Topography of Alternative-2 is in general flat and sloping down smoothly to irrigation pond. Since the disposal area is not in a flood plain, there is no risk of flood.

4.3 Seismicity Conditions and Impact on Safety of Disposal Areas

97 Information is requested from the Seismology Institute of Kyrgyz Republic to evaluate seismic conditions for disposal sites in Balykchy an Karakol. In their correspondence, it is indicated that:

- The site near Balykchy City is located in a zone where a seismic shock force of up to 9 is possible, according to seismic zoning map of the Kyrgyz Republic (2018). Active faults in the area of the proposed area are not observed.
- Karakol City is located in the zone where seismic shock force up to 9 is possible. Near the proposed area, there is an active fault situated northward of Borubash upland which is not directly in the possible sludge management area.

98 Overall, there is no risk in terms of seismicity in the proposed sludge management areas.

5 ACTION PLANS FOR SLUDGE MANAGEMENT

99 This section has been revised by PMO using the DSC's original section following the recommendations of the ADB's Review Mission and will be included in the SMP. This section lists the final options for sludge management use practice for the biological ponds of the Balykchy and Karakol WWTPs, as well as the irrigation pond of the Ak-Suu DWMD, which were reached as a result of consideration and discussion of the materials submitted and decisions given in the meetings held on 20.02.2023 and 06.06.2023 by the DSC, PIU, ME "Vodokanal" and Ak-Suu DWMD (summarized in MoMs given in Appendix-1) and identified Action Plans for phased and sequential work.

5.1 Sludge Management Plan for Balykchy

5.1.1 Wastewater discharge, sludge treatment from the ponds of Balykchy WWTP and sludge stabilization

100 According to the sludge samples and analysis executed in 2021, ponds II, III, V and VI of the Balykchy WWTP were not found to be contaminated with heavy metals and pathogenic microorganisms, including helminth eggs and Ponds I and IV contain pathogens that need to be stabilized for soil application (agriculture and other uses). The dry matter content is high - more than 40%. The sludge in the ponds contains a low (<20%) content of organic matter, with the exception of Pond VI (>20%).

101 Considering that since 2021 there is a continuous wastewater inflow to these ponds there is a big probability of infection of these ponds by pathogens. Therefore, it is logical to accept that all ponds are pathogenically contaminated.

102 Currently the wastewater from the ponds of the Balykchy WWTP is diverted to the "Bereke" pumping station and, after mixing with water from the Chu River, it is used for irrigation. However, before diversion of waters from the ponds to Chu river supernatant waters should be evaluated for contamination in order to definite the discharge rate. The maximum discharge rate is determined via calculating the flow rates in Chu river during discharge period and the concentrations of pollutants in the supernatant waters. After dilution of supernatant water with river water contaminants should be lower than the legal limits.

103 It is preferable to carry out water diversion and dehydration of ponds II, III and V (IVth pond is dry) by shutting off the flow of wastewater from the WWTP into these ponds through the flume channel, stable operation of locks and valves between the ponds and shutting off the discharge pipeline between V and VI ponds. At the same time, ponds I and VI will be used during the operation of the existing Balykchy WWTP until the new WWTP facility is put into operation.

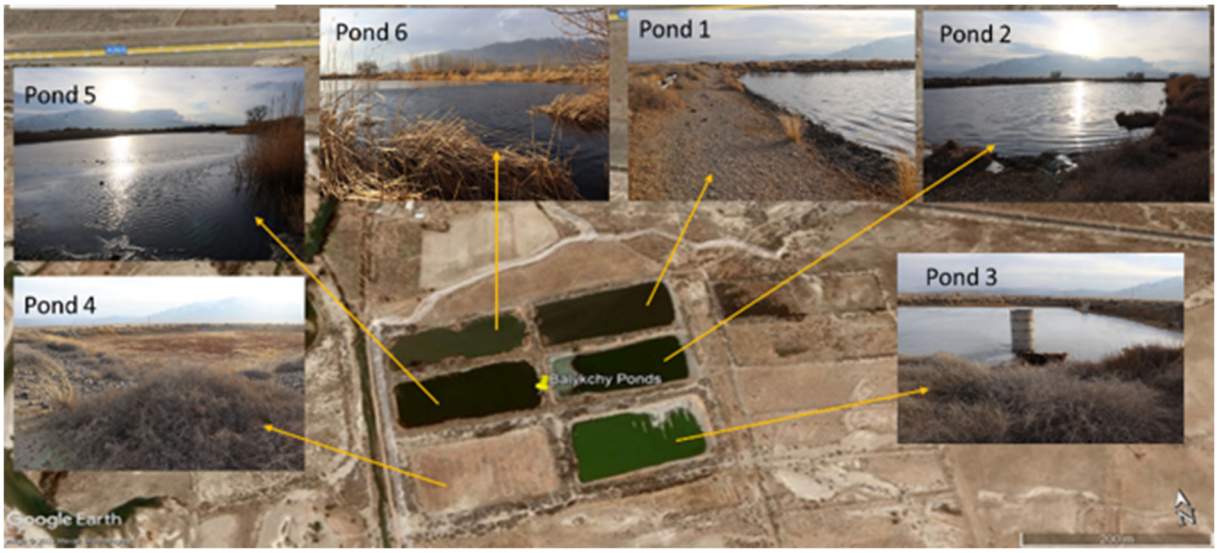

Figure 5-1. Location of Balykchy WWTP Ponds

104 As described in section 4.2, the **total volume of sludge in the ponds of the Balykchy WWTP is 30,801 m^3.**

Table 5-1. Approximate volumes of sludge in the ponds of the Balykchy WWTP

Ponds	Condition of Sludge	Aver. Sludge thickness (m)	Pond Area (m^2)	Pond Volume (m^3)	Volume of Sludge (m^3)
I	Pathogenic	0.55	10,983	16,475	6 050
II	Pathogenic	0.35	11,210	16,815	3,924
III	Pathogenic	0.49	12,834	19,251	6,260
IV	Pathogenic/ Dry Pond	0.46	12,963	32,408	5,962
V	Pathogenic	0.50	10,065	25,163	5,010
VI	Pathogenic	0.41	8 720	21,800	3,595

105 Taking into account that all ponds are contaminated pathogenically and the overall high content of solids in the ponds of the Balykchy WWTP, the sludge will be transferred by ME “Vodokanal” from Ponds II and V to Pond III (after dehydration of Pond III) by a caterpillar excavator and dump trucks (it is necessary to ensure the safe placement of special equipment on ponds). After cleaning of both ponds, pond II will be dried and then properly lined (in order to form an impermeable layer to prevent groundwater contamination) and will be used as emergency storage during operation of new WWTP, in case of failure.

106 After commissioning of the new WWTP facility and dehydration of the pond I and VI, sludge in pond I will be transferred to Pond IV and pond VI sludge to pond III of ME “Vodokanal”

assuming that previous analysis results are still applicable. Contamination can be verified after in disposal pond III by executing new analysis. In case, analysis results shows that the sludge is still uncontaminated they can be used without stabilization for one of the land applications indicated in section 3.4 depending on the criteria satisfied.

Figure 5-2. Piping Details of Balykchy WWTP Ponds

107 Special equipment (excavator, bulldozer and machines) involved in the work on cleaning the ponds from sludge and their transportation between the ponds will be located on the territory of the existing Balykchy WWTP.

108 During the period of stabilization and drying of sludge under the sun, three times a month, ME “Vodokanal” will need to periodically loosen the sludge in ponds III and IV using special equipment (excavator and bulldozer) in order to speed up stabilization.

109 According to the literature, in cold climates, sludge stabilization can take about 2-4 years. This period may increase depending on humidity, precipitation, evaporation. The

temperature in the region stays above 10°C only for about 5 months, which also creates inconvenience for the stabilization of pathogens in the sludge. Temperatures below 10°C are not very effective in removing helminth eggs when using natural drying. In addition, precipitation falls in the Issyk-Kul region for almost half of the year, which also makes it difficult to dry the sludge. Sludge can be susceptible to re-growth of pathogens when exposed to moisture during air drying if rainwater is not properly managed. During the discussion, ME "Vodokanal" noted that the climatic conditions of the city of Balykchy with prevailing wind, dry weather conditions will ensure the drying of sludge in ponds for 2-3 years without covering with special material.

110 As part of the IEE, a biological study was carried out at the WWTP and Balykchy ponds. It was found that Crake (Crex crex) lives northwest of the ponds along the right bank of the Chu River and in the Balykchy Bay in meadow biotopes, where these places meet the requirements of the species. In this regards, it is necessary to carry out works on fencing and cleaning of ponds from sludge in the ponds of the WWTP under the Action Plan for the protection of habitats of the Corncrake (Crex crex) brought to the attention of ME "Vodokanal" and the DB WWTP Balykchy Contractor. The fencing of ponds made of light materials (metal mesh) will be carried out by the DB WWTP Balykchy Contractor.

5.1.2 Further use of stabilized sludge from ponds of Balykchy WWTP

111 The legislation that is followed by Kyrgyzstan for sludge use and disposal consists of Russian GOST R 17.4.3.07-2001 “Requirements for sewage sludge use for fertilization” and SanPiN 2.1.7.573-96 “Hygienic requirements for the use of wastewater and its sludge for irrigation and fertilization”. These limits are used as reference values for heavy metals, pathogens, nutrients, dry matter and organic matter.

112 If the sludge meets all conditions but contains pathogenic organisms, it should be treated to remove the pathogenic organisms. Pathogenic microorganisms can also be removed by other methods, as described in Section 3.3. of the SMP. These methods may differ from each other in terms of cost, efficiency, duration of pathogen stabilization.

113 ME “Vodokanal” of Balykchy will control the distribution of sludge for application to the soil (use in agriculture as fertilizer, reforestation and parkland, recreation areas, land reclamation and restoration), which will be carried out in accordance with national regulations adopted in Kyrgyzstan after research and analysis.

114 Depending on the final use of the sludge, additional analysis for the presence of pathogenic microorganisms may be required as indicated in section 3.4 if necessary.

Action Plan for Sludge Management of Biological Ponds at Balykchy WWTP *

№	Objectives	Progress of sequential/phased works	Implementation timelines	Исполнитель
1	2	3	4	5
1.	Drainage and dewatering of ponds II, III and V	Since ponds I and VI will be involved in the operation of the existing WWTP, it is necessary to carry out the following sequential works: - blocking the flow of wastewater from the sewage treatment plant to pond II through the flume channel; - ensuring the operation of locks between ponds II and V, V and the discharge pipeline, as well as valves between ponds II and III, III and IV, IV and V; - after the water is drained from the ponds, the discharge pipeline between ponds V and VI is closed.	March-May 2024	ME Vodokanal
2.	Fencing of WWTP Balykchy ponds	The following consecutive works will be carried out: - introduction of an Amendment to the Contract with the Contractor of the DB WWTP; - obtaining approval for the Amendment to the Contract from ADB and signing; - development of the draft design by the DB WWTP Contractor for the fencing of the ponds; - agreement, evaluation and approval of the PIU, DSC, Vodokanal, PMO and ADB for the procurement package; - procurement of equipment and installation by the DB WWTP Contractor of fencing of the WWTP ponds from light construction.	March-June 2024	Contractor
3.	Preparation of sites for the placement of special equipment for cleaning / transferring sludge from ponds for further drying	Special equipment will be located on the territory of the existing WWTP.	May-June 2024	ME Vodokanal
4.	Cleaning ponds II and V from sludge and transferring it to pond III	The depth of the ponds is 1.5 m-2.5 m. The total volume of pond III is 19.2 thousand m^3 with the volume of silt in it 6.2 thousand m^3. The total volume of sludge in pond II is 3.9 thousand m^3, and in pond V - 5.0 thousand m^3.	July – September 2024	ME Vodokanal

№	Objectives	Progress of sequential/phased works	Implementation timelines	Исполнитель
		Sludge in ponds with low organic content. The lowest content of organic matter in pond II (6.75%), and in the rest - in the range of 6.75-21.7%. Dry matter content within 60.21-30.8%. pH values are close to neutral (6.64-7.66) in all ponds.		
5.	Periodic loosening of sludge in pond III during drying	Loosening will be carried out using special equipment. The climatic conditions of the city of Balykchy with the prevailing wind, dry weather conditions will ensure the drying of sludge in the pond for 2-3 years without covering with special material.	3 times a month 2024-2026	ME Vodokanal
6.	Removal of treated wastewater to the pumping station "Bereke"	After the commissioning of the new facility of the Balykchy WWTP, the treated wastewater will be discharged to the Bereke pumping station through a separate pipeline	April 2024	Contractor, Vodokanal
7.	Drainage and dewatering of ponds I and VI:	The following consecutive works will be carried out: - blocking the flow of wastewater into pond I through the flume channel; - after draining water from ponds I and VI, blocking the lock between pond VI and the discharge pipeline.	May-June 2024	ME Vodokanal
8.	De-sludging Pond I and transfer of sludge into Pond IV (as contaminated with pathogens)	The depth of the ponds is 1.5 m-2.5 m. The total volume of pond IV is 32.4 thousand m^3 with a volume of silt in it of 5.9 thousand m^3. The volume of silt in pond I is 6.0 thousand m^3 and pond VI is 3,69 thousand m^3	July–October, 2024	ME Vodokanal
9.	De-sludging Pond VI and transfer of sludge into Pond III (assuming as still uncontaminated with pathogens)	Sludge with a low content of organic matter, in the range of 6.75-21.7%. The content of dry matter in the first pond is lower (30.8%) than in the others (60.21-30.8%).	August - October 2024	ME Vodokanal
10.	Drying and lining of pond I и II to be used as emergency storage	Ponds I and II that will be used for emergency storage during new WWTP operation should be properly emptied, dried and then properly lined in order to form an impermeable layer to prevent groundwater contamination.	September-October 2024	ME Vodokanal
11.	Periodic loosening of sludge in a dedicated area	Loosening will be carried out using special equipment	3 times a month 2024-2026	ME Vodokanal
12.	Evaluation of sludge in ponds 3 and 4 prior to application to the soil	Legislation of Kyrgyzstan in the field of use and disposal of sludge, includes Russian GOST R 17.4.3.07-2001 and SanPiN 2.1.7.573-96.	2026-2027	ME Vodokanal,

№	Objectives	Progress of sequential/phased works	Implementation timelines	Исполнитель
	as: fertilizer in agriculture, reclamation/restoration of disturbed lands, forestry	These rates are used as reference values for heavy metals, pathogens, nutrients, dry matter and organic matter. According to the legislation of Kyrgyzstan, sludges that can be used for land application purposes (including agriculture, forestry, parks, and recreation, and as such, end uses along with landfilling) should comply with several requirements: content of heavy metals in the sludge must be suitable for use and the sludge must not contain pathogens. They also must comply with several other requirements such as dry matter content, nutrient concentrations, and organic matter content limits. If sludges comply with all other conditions, but they contain pathogens, they should be treated for removal of pathogenic organisms. Pathogenic microorganisms can also be removed by several methods reflected in the SMP. These methods may differ from each other in terms of cost, effectiveness, duration of pathogen stabilization, and other aspects. Stabilized sludge from the ponds of the Balykchy WWTP will be used as fertilizer in agriculture after necessary analysis of sludge and the soil in plot areas (nearby farms) are executed and meet the required parameters as described in section 3.4.		City SES, ITA of MNRETS

* The work implementation schedule may be amended.

5.2 Sludge Management Plan for Karakol

5.2.1 Wastewater discharge, water disposal and sludge treatment from the ponds of the Karakol WWTP

115 According to the results of studies and analyzes, the habitat of the Central Asian frog (Rana asiatica) listed in the Red Book of the Kyrgyz Republic was found in the biological ponds of the Karakol WWTP. The species is reportedly poached for medicinal purposes (used to treat cancer). Central Asian Frogs in these ponds are relocated on April 5-20, 2023 from these ponds to the places corresponding to their natural habitats as indicated in action plan agreed on November 5, 2020 in order to protect this species.

Table 5-2. The maximum and minimum number of adults and juveniles of Central Asian frogs on the territory of the WWTP in Karakol

Ponds	Adult Numbers		Juvenile	
	Max.	Min.	Max.	Min.
I	5	-	80	70
II	-	-	60	50
III	-	-	-	-
IV	15	10	50	40

116 According to the Sludge Sampling and Analyzes Report, no heavy metal contamination was found in the ponds of the Karakol WWTP. Still, pathogenic organisms, including helminth eggs, were above the threshold limits. The dry matter content is high - more than 30%, except for pond IV. The sludge in Pond I contains little organic matter (13%), while the content of organic matter in other ponds was higher (34-40%).

117 As described in Section 4.2, **the total volume of sludge in the ponds of the Karakol WWTP is 21,358 m^3:**

Table 5-3. Approximate Sludge Volumes in Karakol WWTP Ponds

Ponds	Condition of Sludge	Aver. Sludge thickness (m)	Pond Area (m^2)	Pond volume (m^3)	Sludge volume (m^3)
I	Pathogenic	0.59	8 720	13 080	5,145
II	Pathogenic	0.37	10,983	16,475	4 064
III	Pathogenic/ Dry Pond	0.55	10,065	15,098	5,536
IV	Pathogenic	0.59	11,210	16,815	6,614

118 During the discussion ME “Vodokanal” has proposed the following : supernatant/surface water should be removed and pond IV should be dewatered before the commissioning of new WWTP, and ponds II and III will be used to divert wastewater from the existing WWTP to the irrigation pond.

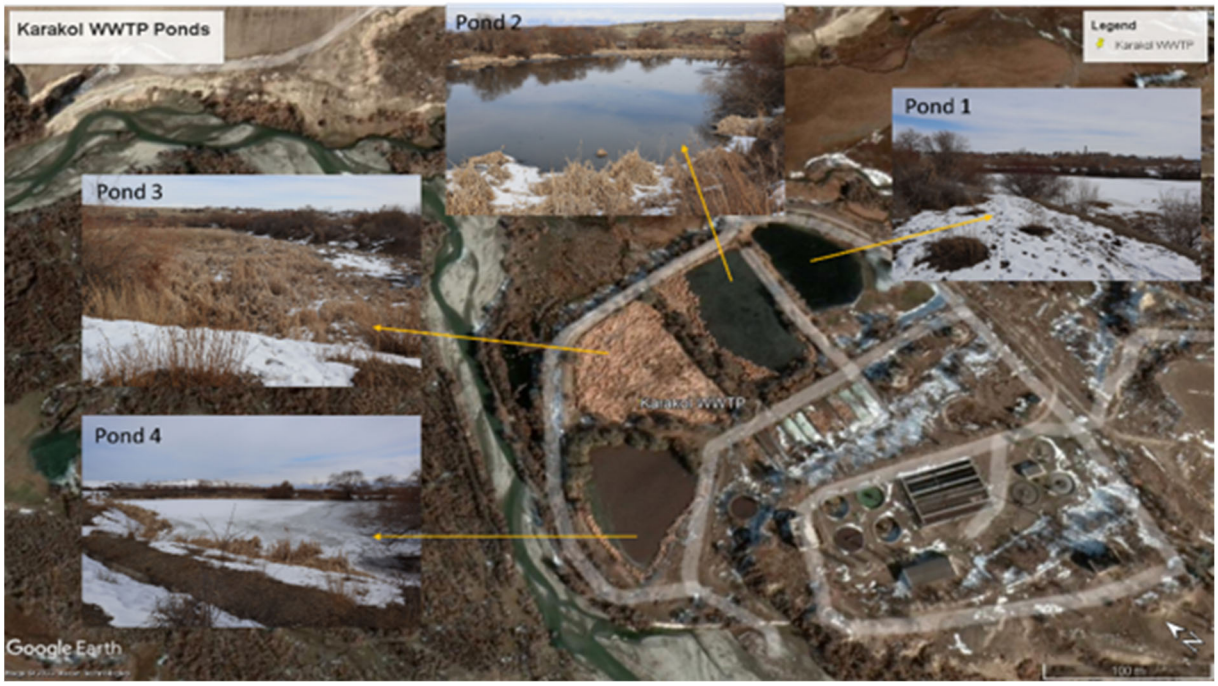

Figure 5-3. Location of Karakol WWTP Ponds

119 After the commissioning of a new WWTP, 6.6 thousand m3 sludge from pond IV will be transferred to the pond III which has a total storage capacity of 15.1 thousand m3 and contains accumulated sludge with a volume of 5.5 thousand m3 by special machinery of WWTP ME " Vodokanal". During this period the treated wastewater will be directed to the irrigation pond through an existing transmission line.

120 During the desludging of pond IV (two months), pond II will be used as an emergency pond. Cleaned and properly lined (to prevent seepage to groundwater) pond IV after will be used as an emergency pond after commissioning of the new WWTP.

121 At the same time, ponds I and II will not be cleaned from sludge due to infiltration water from the bottom of the ponds informed by Karakol Vodokanal.

122 During the period of stabilization and drying of the sludge in the sun, it is necessary to periodically loosen the sludge in Pond III using special equipment. However, given the impossibility of drying and stabilizing the sludge in the sun due to the infiltration water constantly seeping from the bottom of the pond, periodic loosening of the sludge in pond III will not be carried out.

123 According to the literature, in cold climates, sludge stabilization can take about 2-4 years. This period may increase depending on the humidity, precipitation, evaporation and seepage in the area. The temperature in the region stays above 10oC only for about 5 months, which also creates inconvenience for the stabilization of pathogens in the sludge.

124 Temperatures below 10oC are not very effective in removing helminth eggs when using natural drying. In addition, precipitation falls in the Issyk-Kul region for almost half of the year, which also makes it difficult to dry the sludge.

125 As noted by ME “Vodokanal” Karakol, infiltration water inflows into all ponds at the WWTP. Ponds I, II and III will not be de-sludged. In this regard, drying and stabilizing the sludge to remove pathogens is problematic and further use of the sludge, as well as cleaning of the ponds and disposal of sludge at a landfill (due to unavailability) will be solved upon allocation of an appropriate land plot by local authorities and for time being are not included in the Action Plan.

5.2.2 Further use of sludge from the Karakol WWTP

126 The legislation that is followed by Kyrgyzstan for sludge use and disposal consists of Russian GOST R 17.4.3.07-2001 “Requirements for sewage sludge use for fertilization” and SanPiN 2.1.7.573-96 “Hygienic requirements for the use of wastewater and its sludge for irrigation and fertilization”. These rates are used as reference values for heavy metals, pathogens, nutrients, dry matter and organic matter.

127 If sludges comply with all other conditions, but they contain pathogens, they should be treated for removal of pathogenic organisms. Pathogenic microorganisms can also be removed by several methods reflected in the SMP. These methods may differ from each other in terms of cost, effectiveness, duration of pathogen stabilization, and other aspects.

128 Because of the problem that infiltration water seeps into all ponds at the WWTP, the problem of stabilization of sludge from a pathogen cannot be solved. Ponds I, II and III will not be cleared from sludge and the sludge will not be used (introduced into the soil) and disposed of in a landfill (due to its absence).

Figure 5-4. Piping Details of Karakol WWTP Ponds

Discharge line
new pipeline
pipeline for draining water to an irrigation pond
fencing
gateways
emergency pipeline

Action Plan for the Sludge Management of Biological Ponds at the Karakol WWTP *

№	Objectives	Progress of sequential/phased works	Implementation timelines	Contractor
1	2	3	4	5
1.	Relocation of the CA frog from the WWTP ponds to a previously defined natural habitat	Cooperation and consultations with the MNRETS for approval and obtaining a permit as per the requirements of regulations in the Kyrgyz Republic; - carrying out work and consultations with the National Academy of Sciences of the Kyrgyz Republic on the procedures and methodology for the resettlement of the CA frog; - creation of a working commission from representatives of stakeholders to participate in the process of relocation of the CA frog from the ponds of the Karakol WWTP and the Ak-Suu DWMD (to be specified); - relocation of the CA frog; - carrying out information work on the conservation of the target audience of the frog by installing information boards and distributing brochures. - making proposals to the authorized state body on strengthening state control.	February – May 2023.	129 EA, PMO, DSC, IA, PIU, NAS KR, MNRET, “Karakol Balygy” LLC,
2.	Waste water disposal and dewatering of pond IV	Prior to the commissioning of new Karakol WWTP, water will be diverted and pond IV will be dewatered to ponds II and III. The following sequential/phased operations will be carried out: - blocking the inflow of wastewater into pond IV from the existing WWTP; - closure of the valves to prevent discharge of wastewater into the irrigation pond (BSR) after diverting of water from pond IV; - switching of wastewater discharge from the existing WWTP to the irrigation pond (BSR) through ponds II and III; - dewatering of pond IV.	August - September 2024	130 ME Vodokanal
3.	Fencing of the territory and ponds of WWTP	Work will be carried out in accordance with the requirements of the Contract	August - October 2024	131 DB WWTP Karakol Contractor,

№	Objectives	Progress of sequential/phased works	Implementation timelines	Contractor
4.	Desludging of Pond IV and transfer to Pond III	Upon commissioning of new Karakol WWTP and conveying of effluent through the existing transmission line, the following sequential operations will be carried out: - removal of supernatant/surface water from ponds II and III to the BSR and dewatering of the ponds; - Removal of 6.6 thousand m3 sludge from pond IV and transfer of sludge to pond III which has a total storage capacity of 15.1 thousand m3 and contains accumulated sludge with a volume of 5.5 thousand m3. - Sludge from Ponds I and II will not be removed due to infiltration water from the bottom of the ponds. - Cleaned and lined pond IV will be used as an emergency one during the operation of the new WWTP.	August - October 2024	Karakol VK, DB Contractor of Karakol WWTP

* The work implementation schedule may be amended.

5.3 Sludge Management Plan for BSR of Ak-Suu District Department of Water Resources

128 The irrigation pond is under the operational management and on the balance sheet of the Ak-Suu District Water Management Department, which is a subdivision of the Issyk-Kul Main Department of Water Resources (IKMDWR) under the Ministry of Agriculture of the Kyrgyz Republic as an independent legal entity with its own account.

129 IKMDWR indicated in its official letter to the PMO that the cleaning of the irrigation pond from sludge, transportation and disposal will be carried out by the forces and means of the Ak-Suu DWMD after the acquisition of special equipment under the project.

130 Decisions of the 11th session of the XXIX convocation of the aiyl kenesh of the Kara-Zhal aiyl aimag of the Issyk-Kul region of the Kyrgyz Republic dated September 11, 2022 No. 15 (Appendix-22) and the aiyl okmotu of the Kara-Zhal aiyl aimag of the Issyk-Kul region of the Kyrgyz Republic dated September 2, 2 No. 103 (Appendix-2) from agricultural land (pasture category), in contours Nos. 342 and 343 (site of the old landfill) a land plot was allocated to the Ak-Suu DWMD for temporary use (three years) for storing cleaned sludge from the irrigation pond.

131 Ak-Suu DWMD first of all needs to work with the Ak-Suu district state administration on the transfer of the allocated land plot from the category of pastures (there are restrictions on use) to another category of land, in accordance with the requirements and article 15 of the Land Code of the Kyrgyz Republic and the requirements and article 7 Law of the Kyrgyz Republic "On the transfer (transformation) of land plots" dated July 15, 2013 No. 145.

132 Ak-Suu DWMD needs to obtain the necessary positive conclusions and permits for the working project from the authorized state bodies in the field of environmental protection, health care and others for the placement / storage of treated sludge in the designated area, in accordance with the requirements of the Procedure for the management of production and consumption waste in the Kyrgyz Republic , approved by the Decree of the Government of the Kyrgyz Republic dated August 5, 2015 No. 559 and other national regulatory legal acts.

133 After receiving the necessary positive conclusions and permits for the working project from the authorized state bodies in the field of environmental protection, health care and others for the placement / storage of treated sludge in the allocated area, work is underway to prepare the allocated land plot and fence it for temporary storage of sludge from the irrigation pond. At the same time, according to the assurances of the Ak-Suu DWMD, out of 3.0 hectares of allocated land, 0.12 hectares fall under the location of the old dump of municipal solid waste, which will not be affected by the placement / storage of treated sludge from the irrigation pond.

134 The designated landfill was closed in 2003, according to local authorities. As the authorities reported, there is a 1-1.5 m thick soil layer over the landfilled waste. There is no information

about the presence of an impermeable layer at the base of the dump and about the depth of the waste that is stored inside.

135 Based on the allocated area, a depth of 4.2 m would be required to store all of the sludge from the irrigation pond. The site should be lined with an impermeable layer at the bottom end to prevent groundwater contamination.

136 In general, the allocated site is closer to the irrigation pond (600 m), already has an access road and is located on a more level area.

137 To the south of the allocated site at a distance of 250-300 meters there is a sheep barn, the user of which is informed by the Ak-Suu DWMD about the planned works in strict accordance with the requirements for ensuring safe storage of sludge with SSP and, during the development of soil on the allocated site.

Figure 5-5. General Layout of Alternative-2 Site for the storage area in BSR of AKSU DDWR

138 According to the Sludge Sampling and Analysis Report, heavy metal contamination was not found in the irrigation pond. Still, pathogenic organisms, including helminth eggs, were above the threshold limits. The dry matter content is high - more than 30%. The sludge in the irrigation pond contains a low level of organic matter (13.5%). Therefore, sludge application to the soil is possible after pathogen reduction and can be chosen as a management option for these ponds, in accordance with the GOST R standard.

139 Before starting work on cleaning and transporting silt from the irrigation pond, the Ak-Suu DWMD must ensure safe placement of special equipment to avoid heavy loads on access roads and embankments surrounding the irrigation pond.

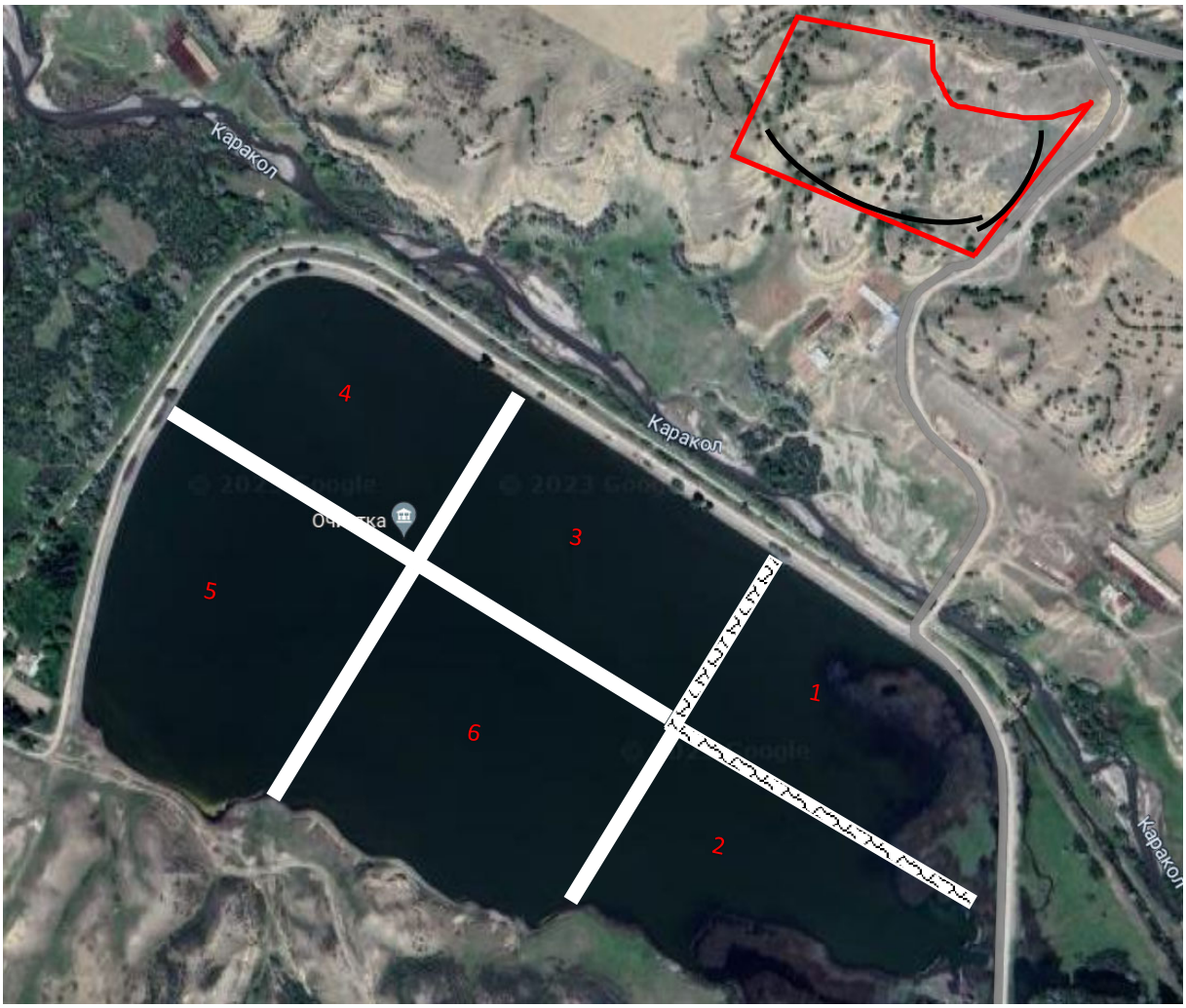

Figure 5-6. BSR of AKSU DDWR Storage area Working Sections

The Ak-Suu DWMD proposed to divide the irrigation pond into 6 sections for alternate annual work, where each section will have the following consecutive combinations:

- breakdown of irrigation pond into 6 sections for carrying out successive annual works;

- isolate in each area up to 6.5 hectares of area for sludge storage;

- Temporary, impervious walls will be built in each section to isolate the sludge storage area;

- sumps will be built in each area in the accumulation zone to pump out water seeping from the excavated silt and to keep the zone dry;

- with the help of special equipment (excavator and bulldozer), sludge will be excavated, moved to an isolated accumulation zone;

- as it dries up in the accumulation zone, the sludge will be loaded onto special equipment (dump trucks) and transported for disposal / storage on a dedicated site, which is located 600-800 meters north of the irrigation pond along the Karakol-Pristan-Przhevalsk highway.

Estimated cleaning time:

Sludge Volume in Karakol Irrigation Pond - 117.0 thou. m^3

- average distance to the sludge disposal area ≅ 1 km;
- time of one trip to the site for use: 2x1/30x60 ≅ 5 min;
- loading and unloading time: 30 min
- time of one flight: 5+20= 25 min

working hours per day: 7 hrs

- total number of flights per working day: 7x60/25 = 16 turn
- estimated daily volume of transported sludge: 52 m^3

estimated annual volume of sludge is about 17,0 thou. m^3

- the irrigation pond cleaning from sludge should be completed within six-seven years.

Sludge management plan for the irrigation pond at the Ak-Suu DWMD *

№	Objectives	Progress of sequential/phased works	Implementation timelines	Contractor
1	2	3	4	5
1.	Signing of the Cooperation Agreement/Contract (capacity building of the Ak-Suu DWMD) and transfer of special machinery and equipment	The following consecutive works will be carried out: - development and approval of the draft Agreement with EA, IA, PIU, Ak-Suu DWMD and ADB; - approval of EA and DWMD; - signing of the Agreement and transfer of special machinery and equipment to the Ak-Suu DWMD	April-June 2023	IA, PMO, EA, PIU, DWMD
2.	Carrying out the necessary work on the transfer of land for the disposal of sludge from the irrigation pond, in accordance with the legislation of the Kyrgyz Republic	Works will be carried out on the basis of the decisions of the 11th session of the XXIX aiyl kenesh of the Kara-Zhal aiyl aimag of the Issyk-Kul region of the Kyrgyz Republic dated September 15, 2022 No. 16 and the aiyl okmotu of the Kara-Zhal aiyl aimag of the Issyk-Kul region of the Kyrgyz Republic dated 09/20/2022 No. 103, in accordance with the requirements of the Land Code of the Kyrgyz Republic (Article 15), the Law of the Kyrgyz Republic "On the transfer (transformation) of land plots" (Article 7) and the Law of the Kyrgyz Republic	February – July 2024	DWMD, PIU, IA
3.	Obtaining the necessary conclusions and permits from authorized state bodies for the removal and disposal of sludge from the irrigation pond	Ak-Suu DWMD needs to obtain positive conclusions and permits for a working project from the authorized state bodies in the field of environmental protection, health and others for the placement / storage of treated sludge in a designated area, in accordance with the requirements of the Procedure for the management of production and consumption waste in the Kyrgyz Republic, approved Decree of the Government of the Kyrgyz Republic dated August 5, 2015 No. 559 and other normative legal acts of the Kyrgyz Republic	March- August 2024	DWMD, PIU, IA
4.	Preparation of an area for temporary sludge storage	The site should be excavated with a depth of 4.2 m to create the volume for the sludge to be disposed. In order to prevent seepage of pathogenically contaminated water in sludge, bottom of the disposal area should be lined according to the standards.	June-September, 2024	DWMD, PIU, Contractor
5.	Fencing of the area with light-weight structures	The following consecutive works will be carried out:	April-September 2024	EA, PMO, PIU,

№	Objectives	Progress of sequential/phased works	Implementation timelines	Contractor
		- development of a working draft and EMP by Ak-Suu DWMD, approval and receipt of all necessary positive conclusions and permits as in paragraph 2 of this Action Plan; - approval, evaluation and approval of the PIU, DSC, DWMD, PMO and ADB for the procurement package; - tender announcement; - procurement of equipment and production of fencing and preparation of the allocated area.		DWMD, Contractor
6.	Preparation of sites for the placement of special equipment for cleaning sludge from the irrigation pond for transportation and disposal to a designated area	Ak-Suu DWMD will determine the locations for placement of special equipment, taking into account safety and reducing the impact on the environment, the load on the road and the embankment along the irrigation pond.	July 2024	DWMD
7.	Cleaning of sludge from the irrigation pond and transportation for sludge to a dedicated site	The following consecutive works will be carried out to clean up sludge from the irrigation pond, transport and dispose of it to a designated area: Sludge from the irrigation pond can be removed as follows: - Division of the irrigation pond into 6 sections for sequential annual work; - isolate in each area up to 6.5 hectares of area for sludge storage; - Temporary, impervious walls will be built in each section to isolate the sludge storage area; - sumps will be built in each area in the accumulation zone to pump out water seeping from the excavated silt and to keep the zone dry; - with the help of special equipment, silt will be excavated and moved to an isolated accumulation zone; - as it dries up in the accumulation zone, the sludge will be loaded onto special equipment and transported for placement / storage to a designated area. Estimated duration of sludge treatment (Section 8.2 SMP):	October-November 2024-2031	DWMD, ~~PIU~~

№	Objectives	Progress of sequential/phased works	Implementation timelines	Contractor
		- Sludge Volume in Karakol Irrigation Pond - 117.0 thou. m^3 - average distance to the sludge disposal area ≅ 1 km; - duration of one trip to the sludge disposal area: 2x1/30x60 ≅ 5 min; - Time for loading and dumping: 30 min - time of one flight: 5+20= 25 min - working hours per day: 7 hrs - total number of flights per working day: 7x60/25 = 16 turn - approximate daily volume of transported sludge: 62 m^3 - estimated annual volume of sludge is 17.0 thou. m^3		
8.	Periodic loosening of sludge ~~in Pond IV~~ during drying	Ak-Suu DWMD will carry out work for loosening of disposed sludge with special equipment in compliance with safety measures.	3 times a month 2025-2032	DWMD
9.	If necessary, assess the sludge on the site before applying it as landfill,-for agricultural purposes, forestry and local farms.	Legislation of Kyrgyzstan in the field of use and disposal of sludge, includes Russian GOST R 17.4.3.07-2001 and SanPiN 2.1.7.573-96. These rates are used as reference values for heavy metals, pathogens, nutrients, dry matter and organic matter. Since with such a depth of sludge, stabilization cannot be obtained the only use of this sludge can be as landfill as described in section 3.4.5.	2032	DWMD, GorSes, MNRETS

* The work implementation schedule may be amended.

6 ENVIRONMENTAL IMPACT ASSESSMENT

140 The following environmental impacts are expected during sludge management operations:

- Human Health
- Land and Soil Environment
- Atmospheric Air
- Surface and Ground Water
- Flora and Fauna

6.1. Impacts of Pathogens on Human Health

141 Enterobacteriaceae includes, along with many harmless symbionts, many of the more familiar pathogens, such as Salmonella and Escherichia coli. Other disease-causing bacteria in this family have Enterobacter. Generally, these pathogens live in the intestines of animals or in the gut microbiota of human beings. In contrast, others are found in water or soil or are parasites on a variety of different animals and plants.

142 Some enterobacteria are essential pathogens, e.g., Salmonella or Shigella, because they produce endotoxins. Endotoxins reside in the cell wall and are released when the cell dies, and the cell wall disintegrates. Some members of the Enterobacteriaceae produce endotoxins that, when released into the bloodstream following cell lysis, cause a systemic inflammatory and vasodilatory response. The most severe form of this is known as endotoxic shock, which can be rapidly fatal. When these pathogens reach the parts of the human body out of their natural habitat, they can cause urinary system infections, digestive system diseases, meningitis, pneumonitis etc. Helminthiasis diseases have different manifestations, but in general, they cause intestinal wall damage, hemorrhages, deficient blood coagulation and undernourishment. Helminthiasis can degenerate into cancer tumors.

143 Helminth eggs are the infective agents for the types of worm diseases known globally as helminthiases. Although helminths are pluricellular animals, their eggs are microscopic and are contained in variable amounts in wastewater, sludge, and excreta. Helminth eggs infect the human body through the following: (1) the ingestion of food crops polluted with wastewater sludge or excreta, (2) direct contact with polluted sludge or fecal material, and (3) the ingestion of polluted meat or fish.

144 Eggs contained in wastewater, sludge, or excreta are not always infectious. To be infectious, they need to be viable, and larval development needs to occur. This occurs after nearly 10 days of incubation at the required temperature and moisture levels. These conditions frequently occur in soil or crops, where eggs are deposited when polluted wastewater, sludge, or excreta are used as fertilizer.

145 Helminth eggs remain viable for 1-2 months in crops and for many months in soil, freshwater, and sewage. They may remain viable for several years in feces, night soil, and sludge.

146 Sludges sampled from Karakol and Irrigation Pond contained helminth eggs, and sludges sampled from ponds I and IV in Balykchy also contained them. The sludge or waters containing helminth eggs and other pathogenic organisms should be stabilized with regard to pathogenic activity to be used or discharged. Otherwise, it can have a significant health impact on the people that interacts with these waters and soils.

6.2. Overall Impacts

6.2.1. Overall Impacts on Soil

147 As mentioned in the previous sections, there are four sludge management alternatives: agricultural fertilization, alternative landfill cover, disturbed land reclamation/rehabilitation and for fertilization/silviculture for Balykchy Ponds II, III, V, and VI. There are 6 sludge management alternatives: agricultural fertilization, alternative landfill cover, disturbed land reclamation/rehabilitation, forest fertilization/silviculture, chemical stabilization, landfill disposal, and dedicated landfill disposal for Karakol ponds, BSR of Aksu DDWR, and Balykchy Ponds I and IV.

148 According to the sludge analysis conducted by Çevre Endüstriyel Analiz Laboratory following the sampling conducted on 19-21.10.2021 in Kyrgyzstan, no negative environmental impact for any of the alternatives is foreseen for these sludges in most of the parameters measured. Samples were taken from 6 points for Balykchy pools and 4 points for Karakol pools, and 1 point for BSR of Aksu DDWR.

149 Because the results of all parameters analyzed, pH values are in the usual environmental ranges; Arsenic, Copper, Mercury, Zinc, Cadmium, Chromium, Lead, Nickel, and Selenium are all below the permissible limit values. The dry matter content of the sludges apart from Pond IV in Karakol are high enough to spread onto the land. The organic matter content of sludges in Karakol is suitable. The organic matter content of Irrigation Pond is low, and Balykchy Ponds are slightly below the legal lower limit when the legislate one of Kyrgyzstan is followed.

150 The sludges in Karakol Pond IV should be dried if it is not mixed with other sludges in the other ponds to balance the dry matter content. The sludges in the ponds can also be dried in summer to remove more moisture from them and decrease transport. During drying process, the layer onto which the sludge will be spread must be impermeable and waterproof to vent contact between sludge and soil and hence, soil contamination.

151 However, new access roads to storage ponds will be required during sludge handling. In the course of construction of the access road to the ponds, the following measures should be considered:

- Topsoil should be stripped and stored properly
- Land acquisition will be needed.
- Against possible leakage arising from trucks, drip trays should be used during transportation

6.2.2. Overall Impacts on Air

152 When incineration or solid fuel options are considered feasible, air quality is affected by these management options. In these cases, sewage sludge falls within the category of waste and thus falls under the scope of EU directive 2000/76/EC in 04.12.2000. This Directive sets several standards and technical requirements (air emissions, water discharge contamination, plant designs) that have to be respected by the operators of the plants which incinerate sewage sludge.

153 This Directive is partially transposed by the Regulation on Waste Management (OG 29314–02.04.2015) and by the Regulation on Air Pollution Control of Industrial Processes (OG No. 26236 – 22.07.2006). The latter sets specific conditions for facilities with air pollution potential, including the co-combustion of sewage sludge, for instance, in cement factories for which specific gas emission standards are set. A Circular on the Application of the Regulation (No. 2007/7 – 18 July 2007) describes the procedures of the permitting process.

154 Incineration or solid fuel is not feasible disposal option for the sludge accumulated in the ponds. Therefore, it is not foreseen that no negative environmental impact in terms of air quality would arise from these activities.

155 New access roads to temporary storage ponds will be needed during sludge handling needed. Air pollution from vehicles' exhaust gases will occur during this construction period. Vehicles release nitrogen oxides, carbon monoxide, hydrocarbons, soot, and sulfur dioxide. However, it is not foreseen that construction activity will cause a severe air pollution problem.

156 In this construction period, heavy vehicle operations may cause dust to arise. Depending on the need for spraying, the contractor should regularly operate water-spraying trucks to suppress rising dust.

157 During transportation and disposal of sludge, odor problems will occur. The following actions should be taken in order to prevent odor

- Disposal areas and access roads should be constructed away from settlement areas if possible.
- Sludge should be covered during transportation and at the storage/disposal area to minimize the odor.

6.2.3. Overall Impacts on Surface and Underground Water Resources

158 Supernatant waters (waters on the surface of the ponds) accumulated in ponds are not analyzed yet. After performing the necessary analysis, the degree of contamination will be determined, and depending on discharge criteria to nearby surface waters, necessary actions will be determined.

159 If the pond's surface waters are contaminated, a better solution might be diverting the waters to an additional pond, dewatering geotubes or another wastewater treatment method that can be utilized before discharge. Waters containing helminth eggs should not be discharged to the environment before removing these disease-causing agents. However, this will increase an area but better environmental performance since contaminated water will not reach natural streams. Further on-site dewatering can be achieved if the surface waters are diverted from the ponds before the dry season and sunshine are provided to the sludge in the ponds. This option should be optimized for operation in the selected site.

160 Depending on the geological and geotechnical surveys for disposal areas, necessary actions will be taken to prevent the contribution of seepage water to the ground water table under disposal areas. In both cases, the layer onto which the sludge will be spread must be impermeable and waterproof to prevent leakage to an underground water source. The groundwaters and nearby surface waters should be monitored regularly for an indication of contamination.

161 Another impact on surface water can be a change in topography and surface runoff due to the diversion of waters from their natural course around the ponds. However, there are no significant streams that need to be diverted in the areas that are proposed for sludge management operations.

6.2.4. Overall Impacts on Flora & Fauna and Natural Environment

162 The area of the work is not rich in vegetation. No significant impact on vegetation is foreseen in this regard.

163 The construction site at Balykchy WWTP is located in close proximity to the possible habitat of Corncrake (Crex crex), which is listed in the Red Book of the Kyrgyz Republic. The main type of negative impact is noise pollution.

164 On the other hand, the construction site in Karakol is close to the lagoons and is currently inhabited by Central Asian frogs listed in the Red Book of the Kyrgyz Republic. Central Asian frogs will be relocated before the commencement of works.

165 The selection of alternatives depends primarily on the solids content of lagoon water. Table 6-1 shows the main environmental impacts depending on the solids content.

Table 6-1. Main environmental Impacts Depending on the Solid Content.

Content of solids	7-10%,	10-25%	30-50% and more
Atmospheric Air, physical impacts	The minimum amount of harmful substances is emitted into the atmospheric air due to the use of pumps and pipelines. The main impact will take place directly during dewatering and drying of sludge, and possibly during the operation of pumps (depending on selection of power for pumps)	From the auger conveyor pollutants are emitted to the atmospheric air. Same happens during sludge drying.	Works related to the removal of sludge by machinery emit the greatest amount of harmful substances into the atmosphere. In addition, during drying, sludge also releases pollutants.
Surrounding soils	The impact on soils is land acquisition and temporary use of land, also possible leaks during the operation of vehicles and / or leaks from waterproofing layers of drying sludge sites.		
Surface water	If water should be discharged to another pond and appropriate analyses are performed, it is possible to remove it to the nearest watercourse. This will lead to pollution of the watercourse in any case. It is necessary to calculate MPD to normalize the time of discharge in consideration of dilution ratio in watercourse.		
Ground Water	Possible negative impact of the construction of sludge drying sites, namely leakage of geomembrane or other waterproofing material.		
Flora and Fauna	When carrying out all types of work, regardless of selected process, it is necessary to comply with measures for the conservation of Corncrake (Crex crex), which is listed in the Red Book of the Kyrgyz Republic. The construction site is poorly vegetated. Central Asian frogs listed in the Red Book of the Kyrgyz Republic will be relocated before the commencement of works. The area of the works to be carried out at irrigation pond should be transformed. OVOS Report will be developed for this. The report includes a biodiversity study. Based on this study, appropriate biodiversity conservation measures will be developed.		

6.3. Environmental Management Plan.

166 The EMP provides the basis for defining contractual obligations for contractors, as well as responsibilities and expectations for the vodokanals, municipal and national government entities, and Project staff.

167 During the construction phase, the overall responsibility for the implementation and monitoring of the EMP rests with authorized the Environmental Specialist ME Vodokanal (Balykchy) and CE Vodokanal, Ak-Suu District Department of Water Resource (Karakol City). This Specialist through assistance from the DSC Environmental staff, will supervise the implementation of the agreed mitigation measures and monitor the implementation progress in the field. The key

environmental parameters such as ambient air quality and noise levels etc. will be monitored at key receptor locations.

168 Indicators of EMP implementation performance are of two general types: (i) those that can be measured or observed in the environment; and (ii) those that are reported and can be measured with reference to compliance monitoring, reporting, and communication with people in the Project area.

6.3.1. Preparation Phase

169 Impacts arising in preparatory phase typically involve land acquisition and resettlement of people displaced as a result of infrastructure siting decisions. Although conventional land acquisition or resettlement will not be required for this project. Other components to be installed outside the boundaries of the existing sites will be installed either on land already owned by the relevant vodokanal or in existing public rights-of-way. The preconstruction section of the EMP also includes several line items for impacts for which mitigation measures are prescribed.

6.3.2. Sludge Management Works Implementation Phase

170 The general characteristics of works related to sludge management in Balykchy and Karakol impacts are related to the effects of specific construction practices works/actions on elements of the biophysical environment and on people. According to the adopted solutions, works/activities include:

Balykchy WWTP ponds: water diversion and pond dewatering; preparation of platforms for special machinery for sludge treatment and transport between the ponds for further drying; de-sludging of the ponds and its transportation; periodic loosening of sludge during its stabilization.

Karakol WWTP ponds: wastewater diversion and pond dewatering; fencing of WWTP and pond area; de-sludging of the ponds.

Irrigation pond of Ak-Suu DDWR: fencing of the allocated area using light-weight structures and preparation of the area for disposal of irrigation pond sludge; preparation of platforms for special machinery for sludge removal from the irrigation pond, transportation and ~~disposal~~ storage at the allocated area; cleaning of the irrigation pond to remove sludge and transportation for piling , periodic loosening of sludge at the allocated area.

171 Most impacts, impacts caused by works/activities such as noise, disruption of community life, and dust and emissions, are temporary, and can generally be addressed through such relatively simple interventions as good maintenance. Before the commencement of work/activities, there is a need to conduct public consultations~~,~~ information distribution to

inform the public about the upcoming works and possible impact on the social and environmental environment.

172 All impacts of works/activities to be carried out identified in the EMP are generally minimized through implementation of mitigation measures prescribed in the EMP as (good ~~site~~ section practices), and none are likely to be permanent or long-term, provided they are addressed as identified.

(i) Prior to the start works/activities:

- Ensure that all necessary clearances/permissions/licenses are in place prior to the start works/activities.
- Provide oversight on environmental management aspects of project and ensure EMPs are implemented.

(ii) Oversee and provide guidance to properly carry out the environmental monitoring as per the EMP

(ii) Oversee grievance redress mechanism to address any grievances brought about in a timely manner; ensure that records are properly maintained

(iii) Oversee site closures to ensure that all work / facility sites are restored properly prior to issuing work completion certificate to the contractor

6.3.3. Operation Period.

173 Potential impacts of the operation phase of the lagoons in Balykchy and Karakol, as well as the irrigation pond in Karakol are minimum.

174 The lagoons in Karakol are used as emergency ponds, the irrigation pond is used as a storage facility for treated wastewater. Balykchy WWTP lagoons will be used for storage of treated wastewater during non-irrigation season.

Table 6-2- Environmental Management Plan with Mitigation Measures for sludge management at Balykchy WWTP ponds

Project Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
Pre-Construction Phase				
Development of environmental management plan (EMP)/ SSEMP; EMP implementation and reporting	Unsatisfactory compliance to EMP	(i) Appoint Environmental, Health and Safety (EHS) Specialist to ensure EMP implementation (ii) Submission of updated EMP (ii) Timely submission of monthly reports, including documentary evidence of the implementation of the EMP, such as photographs	Balykchy VK, D&C Contractor for Balykchy WWTP	Contractor cost
Consents, permits, clearances, certificates etc.	Failure to obtain necessary consents, permits, etc. can result to design revisions and/or stoppage of works	(i) Obtain all necessary consents, permits, clearance, etc. prior to award of works. (ii) Ensure that all necessary approvals for works to be obtained by contractor are in place before start of works (iii) Acknowledge in writing and provide report on compliance all obtained consents, permits, clearance, etc.	Balykchy VK, DB WWTP Contractor	PMO costs for project approvals
Impacts on communities	Possible impacts associated with direct exposure during work (odor, noise, exhaust fumes)	- Ensure projected impacts and proposed measures have been discussed in advance with the affected community. PMO will ensure that EMP will be adequately included in bidding documents and all environmental mitigation measures will be included in construction contracts for works - Secure discussion of projected impacts and proposed measures with affected community in advance.	Balykchy VK, DB WWTP Contractor are responsible for public participation meetings (PPM) and consultations with relevant stakeholders.	Contractor cost
Works/activities				
Environmental Management Plan		Project manager and all key workers will be required to undergo training on EMP implementation including spoils/waste	Contractor	Project cost

Project Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
(EMP) Implementation and Safeguards	Irreversible impact to the environment, workers, and community	management, Standard operating procedures (SOP) for works; occupational health and safety (OHS), core labor laws, applicable environmental laws, etc.		
Social or Community Concerns	Impacts on health of pollutants, dust and noise emissions	- Avoid using older vehicles and machinery, with significant noise and air emissions. - Water unpaved site roads and large areas of exposed soil thrice daily in dry weather. - Ensure that no noise above 70 dB(A) is audible for significant periods within 50 m of any site and Cease activity producing significant noise at night (19:00 pm 07:00 am), Sundays & Public Holidays.	Supervision by DSC Implementation by Contractor	Included in overall project cost
Air Quality	Localised changes in ambient air quality due to operation of mobile and stationary equipment burning fossil fuels.	Contractor to maintain all fossil fuel burning equipment in accordance with manufacturers recommendations. Contractor to use good quality equipment with minimum emissions and avoid using old equipment and vehicles No equipment shall be left idling if not in use	Supervision by DSC Implementation by Contractor	Included in overall project cost
	Fugitive dust emissions from works, construction traffic causing dust soiling and increase in PM2.5 and PM10	Construction traffic speed limit when passing through populated areas Water of dusty-unpaved roads		
	Odor problem occur during sludge stabilizing and transporting	Coordinating work in windless weather to reduce odor spreading	Contractor with approval of DSC/PMO/PIU	Contractor cost
Noise and Vibration	Noise disturbance due to equipment and construction activities.	Awareness program for local residents prior to commencement of works Limitation of working hours for normal construction activities near to settlements Avoid using older vehicles and machinery, with significant noise and air emissions. No idling of equipment when not in use.	Supervision by DSC Implementation by Contractor	Included in overall project cost

Project Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
		Plan activities in consultation with PMO so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance, especially near schools and other sensitive receptors		
Occupational Health and Safety	Injury or fatality of workers due to insufficient controls on work activities and processes (including possibility of infection with helminth eggs and pathogens)	Contractor shall develop Method Statements for all major activities and include health and safety risk assessment for each of these activities Contractor shall provide health and safety induction training for all staff, and specific training for staff working on work sites. Contractor shall supply to site workers, free of charge all necessary Personal Protective Equipment (PPE) to include as protective footwear, high visibility vests, safety helmet and hearing protection. Particular attention should be paid to protection against odor, the mandatory use of respirators. Contractor will prepare and implement a Health & Safety (H&S) Plan for all work sites and activities. Contractor will train and assign a specialist as Health and Safety officer as responsible person for the duration of the project. Provision of health care and first aid - Contractor shall ensure that adequate first aid supplies, disinfectants, masks, gloves, etc. and trained first aiders are available. Preventive measures to prevent contamination by helminth eggs and pathogens. Conducting systematic monitoring (analysis) for helminth eggs and pathogens.	Supervision by DSC Implementation by Contractor	Included in overall project cost
Occupational Health and Safety	Establishment of construction camp sites (offices)	The camp sites will be located within WWTP area.	Supervision by DSC Contractor with approval of DSC	Contractor cost

Project Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
Cleaning upon completion of works/activities	Damage due to debris, spoils, excess construction materials	Remove all spoils wreckage, rubbish, or temporary structures which are no longer required. All excavated roads shall be reinstated to original condition. All disrupted utilities restored All affected structures rehabilitated/compensated The area that previously housed the construction camp is to be checked for spills of substances such as fuel and this shall be cleaned up. All hardened surfaces within the construction camp area shall be ripped, all imported materials removed, and the area shall be top soiled and re-grassed using the guidelines set out in the revegetation specification that forms part of this document. The contractor must arrange the cancellation of all temporary services. Request PIU/PMO to report in writing that worksites and camps have been vacated and restored to pre-project conditions before acceptance of work.	Contractor	Contractor costs
Waste Management	Inappropriate management and disposal of waste during construction	Include appropriate waste management protocols Location of appropriate waste storage facilities at all work sites Worker induction and regular toolbox talks to make all staff aware of zero waste discharge to environment Zero tolerance of waste entering water course or flood plain areas, this will include all materials (e.g welding rod stubs, wood, plastics and metals.	Supervision by DSC Implementation by Contractor	Included in overall project cost
	Poor waste management practices resulting in direct and indirect effects on project area environment	Contractor will establish a demarcated temporary waste storage area where waste is stored pending transport to final treatment/disposal location. Contractor will put in place measures to minimise waste, i.e. procure materials with less packaging,	Supervision by DSC Implementation by Contractor	Included in overall project cost

Project Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
		refrain from ordering excess materials, make arrangement with suppliers to return surplus, unused materials. Contractor will take measures to prevent the disposal, burying and burning of waste on-site, roadside dumping and illegal land filling. Contractor workforce will be trained in the requirements of the Waste Management Plan, particularly with regards to waste segregation, storage and handling. Implementation of recycling/recovery initiatives to reduce waste sent for disposal. Contractor will practice good housekeeping on site. Waste storage containers will be secure, undamaged and appropriately labelled. Waste to be segregated and containers clearly labelled specifying which type of waste is contained to assist with identifying appropriate disposal routes and in case of accidental spills or loss to the environment. Waste to be stored in appropriate containers or skips and removed for treatment/disposal at a frequency so as to avoid the build-up of waste on site. Waste will be collected and transported under cover of a Waste Collection Log and Waste Manifest.		
	Use of Sludges	According to the legislation of Kyrgyzstan, sludges that can be used for land application purposes (including agriculture, forestry, parks, and recreation, and as such, end uses along with landfilling) should comply with several requirements: content of heavy metals in the sludge must be suitable for use and the sludge must not contain pathogens. They also must comply with several other requirements such as	Supervision by DSC Contractor with approval of DSC	Contractor cost

Project Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
		dry matter content, nutrient concentrations, and organic matter content limits. If sludges comply with all other conditions, but they contain pathogens, they should be treated for removal of pathogenic organisms.		
Water resources	Pollution of surface water by supernatant wastewater and possible spillage from construction machinery.	Contractor to conduct risk assessment on all activities near to water courses and apply appropriate controls. No refuelling of vehicles or equipment to take place within river beds or within 25 metres of the edge of the water course. No work will be done in the water protection zones of the rivers. After performing the necessary analysis, the degree of contamination will be determined, and depending on discharge criteria to nearby surface waters, necessary actions will be determined. Waters containing helminth eggs should not be discharged to the environment before removing these disease-causing agents.	Supervision by DSC Implementation by Contractor	Included in overall project cost
	Filtration of wastewater into ground water.	The site onto which sludge will be spread must be impermeable and waterproof to prevent leakage to an underground water source. The groundwaters and nearby surface waters should be monitored regularly for an indication of contamination.		
Biodiversity	Preservation of Corncrake (Crex Crex)	Fencing of Balykchy WWTP lagoons as a part of the Action Plan to protect habitat of corncrake (Crex crex)	Supervision by DSC	DSC/Project costs

Project Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
Soil and Ground Water	Soil contamination by fuel and oil spills	Fuels should be stored in good quality above ground tanks placed on an impervious surface with a spill containment bund capable of containing 110% of the tank capacity No onsite refilling within or adjacent to water courses On site refuelling of equipment and vehicles shall utilise a drip tray to prevent hydrocarbons entering the ground	Supervision by DSC Implementation by Contractor	Included in overall project cost
	Soil contamination by helminth eggs and pathogens	Selection of alternative, depending on the analyses carried out at the designing stage.		
Reporting	Environmental monitoring and reporting to confirm compliance	Safeguards Monitoring: Contractor's monthly reports and DSC's quarterly progress reports should have a section on safeguard compliance. PMO will submit for disclosure on ADB and EA websites semi-annual environmental monitoring reports (SAEMR) in January and July each year. Final EMR will include post-construction environmental audit and will be submitted one month after the project physical completion.	Implementation by Contractor, DSC, PIU and PMO	Included within management costs
Operating Period				
Water resources	Filtration from lagoons	Wastewater Effluent Quality Criteria	Vodokanal and stakeholders	Included in maintenance budget of Vodokanal

Table6-3 Environmental Monitoring Plan for sludge management at Balykchy WWTP lagoons.

Pre-Construction Monitoring Requirements

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements:	Location	Frequency	Responsibility
Air Quality	To establish baseline air quality levels	NH3,H2S & PM10 (particulate matter smaller than 10 microns) concentration at receptor level	1-hr concentration levels	On site	Once (to determine a background concentration)	Contractor
Ambient Noise	To establish baseline noise levels	Ambient noise level near key noise sensitive receptors	A-weighted noise levels	On site	Twice in total (Once on a weekday and once on a weekend)	Contractor

Construction Phase Monitoring Requirements for sludge management at Balykchy WWTP lagoons

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements:	Location	Frequency	Responsibility
Noise Disturbance due to noise from construction activity	To determine the effectiveness of noise abatement measures on sound pressure levels	Ambient noise level near key noise sensitive receptors	A-weighted noise levels	At key receptor locations	On monthly basis	Contractor
Air Quality Dust emissions from construction vehicles and equipment, possible release of	To determine the effectiveness of dust control program on dust at receptor level	CO,NOx & PM10 (particulate matter smaller than 10 microns) at receptor level NH3,H2S (during sludge drying)	1-hr concentration levels	At key receptor locations	On monthly basis	Contractor

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements:	Location	Frequency	Responsibility
pollutants during drying of sludge		Visible dust	Visual observation of size of dust clouds, their dispersion, and the direction of dispersion	Construction sites	On daily basis	Contractor's EHS officer/DSC ES
Increase in traffic accidents	To minimize risk of traffic accidents	Number of accidents taking place	Visual monitoring	Construction vehicles traveling to/from construction sites	Once weekly	Contractor's EHS officer/DSC ES
Safety precautions by Safety workers	To prevent accidents for workers and general public	Number of near miss events and accidents taking place	Visual inspections	Construction sites	Once weekly	Contractor's EHS officer/DSC ES
Soil Pollution	To prevent contamination of soil from oil and toxic chemical spills and leakages	Incidents of oil and toxic chemical spills	Visual inspections	Construction sites	Once a month	Contractor's EHS officer/DSC ES
Solid Waste & Effluent disposal Insufficient procedures for waste collection, storage, transportation and disposal	To check the availability of waste management system and implementation	Inspection of solid and liquid effluent generation, collection, segregation, storage, recycling and disposal at construction sites	Visual inspections	Construction sites	On daily basis Liquid effluent to be tested on quarterly basis	Contractor's EHS officer/DSC ES

Table 6-4- Indicators for Assessing EMP Implementation

Indicator	Measure	Parameters to be Monitored	Method	Responsibility
Indicator has not been defined for pre-construction phase				
Works				
1. Occurrence of avoidable impacts	1.1 Violations of noise limits (construction period)	Ambient noise levels (day, night levels), dB(A)	1.1.1 Physical noise monitoring (though site observation by DSC is often more immediate and effective)	DSC/PIU/PMO
	1.2 Spills of fuels, lubricants, coolants or hazardous chemicals at work sites		1.21 Visual site inspections	DSC/PIU/PMO
	1.3 Exceedances of standards for dust and other gaseous substances at sensitive receptor sites	Ambient air quality (PM10, PM2.5, CO, SO2, NH3, H2S before the construction starts and once in a month)	1.3.1 Physical air quality monitoring (though site observation by DSC is often more immediate and effective)	DSC/PIU/PMO
2. Recurrence of impacts	2.1 Rate of recurring impact by site/contractor/impact		2.1.1 Review of inspection records	DSC/PIU/PMO
3. Compliance with EMP prescriptions	3.1 Number of findings of non-compliance as proportion of total compliance findings		3.1.1 Visual site inspections	DSC/PIU/PMO
	3.2 Number of repeat non-compliance findings		3.2.1 Review compliance findings	DSC/PIU/PMO
4. Effects of Project activities on public	4.1 Number of complaints received by PIO, PMO, and municipalities about impacts considered unacceptable by members of public		4.1.1 Gather and count complaint reports	DSC/PIU/PMO
	4.2 Number of grievances files under GRM about impacts		4.2.1 Review GRM records	DSC/PIU/PMO
Operating Period				
Indicator has not been defined for operating phase.				

Table 6-5- Environmental Management Plan with Mitigation Measures for sludge management at irrigation pond of Aksuu DDWM

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
Preparation Phase				
Development of environmental management plan EMP; EMP implementation and reporting	Unsatisfactory compliance to EMP	(i) Appoint Environmental, Health and Safety (EHS) Supervisor to ensure EMP implementation (ii) Submission of updated EMP (ii) Timely submission of monthly monitoring reports, including documentary evidence of the implementation of the EMP, such as photographs	Aksuu DDWM Contractor	Contractor costs
Consents, permits, clearances, certificates etc.	Failure to obtain necessary consents, permits, etc. can result to design revisions and/or stoppage of works	(i) Obtain all necessary consents, permits, clearance, etc. prior to award of civil works. (ii) Ensure that all necessary approvals for construction to be obtained by contractor are in place before start of construction (iii) Acknowledge in writing and provide report on compliance all obtained consents, permits, clearance, etc. (iv) transformation of the category of allocated land plot from the pasture and agricultural land category (there are restrictions on its use) to another land category in accordance with the requirements and Article 15 of the Land Code of the Kyrgyz Republic and the requirements and Article 7 of the Kyrgyz Republic Law	Aksuu DDWM Contractor	Contractor cost for construction approvals
Impacts on communities	Possible impacts associated with direct exposure during work (odor, noise, exhaust fumes)	- Ensure projected impacts and proposed measures have been discussed in advance with the affected community. - Secure discussion of projected impacts and proposed measures with affected community in advance.	Aksuu DWMD, Contractor undertake ultimate responsibility for conducting of consultations with	

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
			relevant stakeholders and public.	
Work Implementation Phase				
Environmental Management Plan (EMP) Implementation and Safeguards	Irreversible impact to the environment, workers, and community	All key workers will be required to undergo training on EMP implementation including spoils/waste management, Standard operating procedures (SOP) for construction works; occupational health and safety (OHS), core labor laws, applicable environmental laws, etc.	Aksuu DWMD, Contractor	Project cost
Social or Community Concerns	Impacts on health of pollutants, dust and noise emissions	- Avoid using older vehicles and machinery, with significant noise and air emissions. - Water unpaved site roads and large areas of exposed soil thrice daily in dry weather. - Ensure that no noise above 70 dB(A) is audible for significant periods within 50 m of any construction site and Cease activity producing significant noise at night (19:00 pm 07:00 am), Sundays & Public Holidays.	Supervision by DSC Implementation by Aksuu DDWM, Contractor	Included in Contractor's overall costs
Air Quality	Localised changes in ambient air quality due to operation of mobile and stationary equipment burning fossil fuels.	Contractor to maintain all fossil fuel burning equipment in accordance with manufacturers recommendations. Contractor to use good quality equipment with minimum emissions and avoid using old equipment and vehicles No equipment shall be left idling if not in use Dry materials to be covered to avoid dust blow.	Aksuu DWMD, Contractor	No additional cost associated.
Air Quality Noise and Vibration	Fugitive dust emissions from works, construction traffic causing dust soiling and increase in PM2.5 and PM10	Limiting vehicle speed Water of dusty-unpaved roads	Supervision by DSC Implementation by Aksuu DDWM, Contractor	Included in Contractor's overall costs

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
	Odor problem occur during sludge stabilizing and transporting	Coordinating work in windless weather to reduce odor spreading		
	Noise disturbance due to equipment and construction activities.	Awareness program for local residents prior to commencement of works Limitation of working hours for normal construction activities near to settlements times to be set out in the SEMP Avoid using older vehicles and machinery, with significant noise No idling of equipment when not in use Plan activities in consultation with PMO so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance, especially near schools and other sensitive receptors	Aksuu DDWM, Contractor with approval of DSC/PMO/PIU	Contractor cost
Occupational Health and Safety	Injury or fatality of workers due to insufficient controls on work activities and processes (including possibility of infection with helminth eggs and pathogens)	Contractor shall develop Method Statements for all major activities and include health and safety risk assessment for each of these activities Contractor shall provide health and safety induction training for all staff, and specific training for staff working on work sites. Contractor shall supply to site workers, free of charge all necessary Personal Protective Equipment (PPE) to include as protective footwear, high visibility vests, safety helmet and hearing protection. Particular attention should be paid to protection against odor, the mandatory use of respirators. Contractor will prepare and implement a Health & Safety (H&S) Plan for all work sites and activities. Contractor will train and assign a specialist as Health and Safety officer as responsible person for the duration of the project.	Supervision by DSC Implementation by Aksuu DDWM, Contractor	Included in Contractor's overall costs

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
		Provision of health care and first aid - Contractor shall ensure that adequate first aid supplies, disinfectants, masks, gloves, etc. and trained first aiders are available. Preventive measures to prevent contamination by helminth eggs and pathogens. Conducting systematic monitoring (analysis) for helminth eggs and pathogens.		
Post-construction clean-up	Damage due to debris, spoils, excess construction materials	Remove all spoils wreckage, rubbish, or temporary structures which are no longer required. All excavated roads shall be reinstated to original condition. All disrupted utilities restored All affected structures rehabilitated/compensated The area that previously housed the construction camp is to be checked for spills of substances such as fuel and this shall be cleaned up. All hardened surfaces within the construction camp area shall be ripped, all imported materials removed, and the area shall be top soiled and re-grassed using the guidelines set out in the revegetation specification that forms part of this document. The contractor must arrange the cancellation of all temporary services. Request PIU/PMO to report in writing that worksites and camps have been vacated and restored to pre-project conditions before acceptance of work.	Supervision by DSC Aksuu DWMD, Contractor with approval of DSC	Contractor cost
Waste Management	Inappropriate management and disposal of waste during construction	Include appropriate waste management protocols Location of appropriate waste storage facilities at all work sites	Aksuu DWMD, Contractor	Contractor costs

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
		Worker induction and regular toolbox talks to make all staff aware of zero waste discharge to environment Zero tolerance of waste entering water course or flood plain areas, this will include all materials (e.g welding rod stubs, wood, plastics and metals.		
Waste Management Water resources	Poor waste management practices resulting in direct and indirect effects on project area environment	Contractor will establish a demarcated temporary waste storage area where waste is stored pending transport to final treatment/disposal location. Contractor will put in place measures to minimise waste, i.e. procure materials with less packaging, refrain from ordering excess materials, make arrangement with suppliers to return surplus, unused materials. Contractor will take measures to prevent the disposal, burying and burning of waste on-site, roadside dumping and illegal land filling. Contractor workforce will be trained in the requirements of the Waste Management Plan, particularly with regards to waste segregation, storage and handling. Implementation of recycling/recovery initiatives to reduce waste sent for disposal. Contractor will practice good housekeeping on site. Waste storage containers will be secure, undamaged and appropriately labelled. Waste to be segregated and containers clearly labelled specifying which type of waste is contained to assist with identifying appropriate disposal routes and in case of accidental spills or loss to the environment.	Supervision by DSC Implementation by Aksuu DDWM, Contractor	Included in Contractor's overall costs

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
		Waste to be stored in appropriate containers or skips and removed for treatment/disposal at a frequency so as to avoid the build-up of waste on site. Waste will be collected and transported under cover of a Waste Collection Log and Waste Manifest.		
	Use of Sludges	According to the legislation of Kyrgyzstan, sludges that can be used for land application purposes (including agriculture, forestry, parks, and recreation, and as such, end uses along with landfilling) should comply with several requirements: content of heavy metals in the sludge must be suitable for use and the sludge must not contain pathogens. They also must comply with several other requirements such as dry matter content, nutrient concentrations, and organic matter content limits. If sludges comply with all other conditions, but they contain pathogens, they should be treated for removal of pathogenic organisms.	Supervision by DSC Implementation by Aksuu DDWM, Contractor	Included in Contractor's overall costs
	Pollution of surface water by supernatant wastewater and possible spillage from construction machinery.	Contractor to conduct risk assessment on all activities near to water courses and apply appropriate controls. No refuelling of vehicles or equipment to take place within river beds or within 25 metres of the edge of the water course. No work will be done in the water protection zones of the rivers. Lining with an impermeable layer at the bottom end to prevent groundwater contamination. Waters containing helminth eggs should not be discharged to the environment before removing these disease-causing agents.	Supervision by DSC Contractor with approval of DSC	Contractor cost

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
	Filtration of wastewater into ground water.	The site onto which sludge will be spread must be impermeable and waterproof to prevent leakage to an underground water source. The groundwaters and nearby surface waters should be monitored regularly for an indication of contamination.	Supervision by DSC Implementation by Aksuu DDWM, Contractor	Included in Contractor's overall costs
Biodiversity	Cutting of trees/shrubs during arrangement of sludge drying area	Approval and permits for involuntary cutting of trees/shrubs, followed by coordination with self-governance bodies	Supervision by DSC	Contractor cost
Soil and Ground Water	Soil contamination by fuel and oil spills	Fuels should be stored in good quality above ground tanks placed on an impervious surface with a spill containment bund capable of containing 110% of the tank capacity No onsite refilling within or adjacent to water courses On site refuelling of equipment and vehicles shall utilise a drip tray to prevent hydrocarbons entering the ground	Supervision by DSC Implementation by Aksuu DDWM, Contractor	Included in Contractor's overall costs
	Soil contamination by helminth eggs and pathogens	Selection of alternative, depending on the analyses carried out at the designing stage.	Supervision by DSC Implementation by Aksuu DDWM, Contractor	Included in Contractor's overall costs
Reporting	Environmental monitoring and reporting to confirm compliance	Safeguards Monitoring: Contractor's monthly reports and DSC's quarterly progress reports should have a section on safeguard compliance. PMO will submit for disclosure on ADB and EA websites semi-annual environmental monitoring reports (SAEMR) in January and July each year. Final EMR will include post-construction environmental audit and will be submitted one month after the project physical completion.	Implementation by Aksuu DWMD, Contractor, DSC, PIU and PMO	Included into the Contractor's cost

Table 6-6- Plan of Environmental Monitoring for sludge management at irrigation pond of Aksuu DDWM

Monitoring Requirements for the phase before work commencement

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements:	Location	Frequency	Responsibility
Air Quality	To establish baseline air quality levels	NH3,H2S & PM10 (particulate matter smaller than 10 microns) concentration at receptor level	1-hr concentration levels	At storage area near the irrigation pond	Twice in total (Once on a weekday and once on a weekend)	Aksuu DWMD, Contractor
Ambient Noise	To establish baseline noise levels	Ambient noise level near key noise sensitive receptors	A-weighted noise levels	At storage area near the irrigation pond	Twice in total (Once on a weekday and once on a weekend)	Aksuu DWMD, Contractor

Monitoring Requirements for the phase of work implementation

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements:	Location	Frequency	Responsibility
Noise Disturbance due to noise from construction activity	To determine the effectiveness of noise abatement measures on sound pressure levels	Ambient noise level near key noise sensitive receptors	A-weighted noise levels	At key receptor locations	On monthly basis	Aksuu DWMD, Contractor
Air Quality Dust emissions from construction vehicles and equipment, possible release of pollutants	To determine the effectiveness of dust control program on dust at receptor level	CO,NOx & PM10 (particulate matter smaller than 10 microns) concentration at receptor level NH3,H2S (during sludge stabilization)	1-hr concentration levels	At key receptor locations	On monthly basis	Aksuu DWMD, Contractor

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements:	Location	Frequency	Responsibility
during drying of sludge		Visible dust	Visual observation of size of dust clouds, their dispersion, and the direction of dispersion	Construction sites	On daily basis	Aksuu DDWM,
Increase in traffic accidents	To minimize risk of traffic accidents	Number of accidents taking place	Visual monitoring	Construction vehicles traveling to/from construction sites	Once weekly	Aksuu DDWM,
Safety precautions by Safety workers	To prevent accidents for workers and general public	Number of near miss events and accidents taking place	Visual inspections	Construction sites	Once weekly	Aksuu DDWM,
Soil Pollution	To prevent contamination of soil from oil and toxic chemical spills and leakages	Incidents of oil and toxic chemical spills	Visual inspections	Construction sites	Once a month	Aksuu DDWM,
Solid Waste & Effluent disposal Insufficient procedures for waste collection, storage, transportation and disposal	To check the availability of waste management system and implementation	Inspection of solid and liquid effluent generation, collection, segregation, storage, recycling and disposal at construction sites	Visual inspections	Construction sites	On daily basis Liquid effluent to be tested on quarterly basis	Aksuu DDWM,

Table 6-7 Indicators for Assessing EMP Implementation

Indicator	Measure	Parameters to be Monitored	Method	Responsibility
Preparation Phase				
Indicator has not been defined for pre-construction phase				
Work Implementation Phase				
1. Occurrence of avoidable impacts	1.1 Violations of noise limits (construction period)	Ambient noise levels (day, night levels), dB(A)	1.1.1 Physical noise monitoring (though site observation by DSC is often more immediate and effective)	DSC/PIU/PMO
	1.2 Spills of fuels, lubricants, coolants or hazardous chemicals at work sites		1.21 Visual site inspections	DSC/PIU/PMO
	1.3 Exceedances of standards for dust and other gaseous substances at sensitive receptor sites	Ambient air quality (SPM, RSPM, CO, SO2, NH3,H2S before the construction starts and once in a month)	1.3.1 Physical air quality monitoring (though site observation by DSC is often more immediate and effective)	DSC/PIU/PMO
2. Recurrence of impacts	2.1 Rate of recurring impact by site/contractor/impact		2.1.1 Review of inspection records	DSC/PIU/PMO
3. Compliance with EMP prescriptions	3.1 Number of findings of non-compliance as proportion of total compliance findings		3.1.1 Visual site inspections	DSC/PIU/PMO
	3.2 Number of repeat non-compliance findings		3.2.1 Review compliance findings	DSC/PIU/PMO
4. Effects of Project activities on public	4.1 Number of complaints received by PIO, PMO, and municipalities about impacts considered unacceptable by members of public		4.1.1 Gather and count complaint reports	DSC/PIU/PMO
	4.2 Number of grievances files under GRM about impacts		4.2.1 Review GRM records	DSC/PIU/PMO

Table 6-8 Environmental Management Plan with Mitigation Measures for sludge management at Karakol WWTP ponds

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
Pre-Construction Phase				
Development of environmental management plan (EMP); EMP implementation and reporting	Unsatisfactory compliance to EMP	(i) Appoint Environmental, Health and Safety (EHS) Specialist to ensure EMP implementation (ii) Submission of updated EMP (ii) Timely submission of monthly monitoring reports, including documentary evidence of the implementation of the EMP, such as photographs	Karakol VK, DB Contractor of Karakol WWTP	Contractor costs
Consents, permits, clearances, certificates etc.	Failure to obtain necessary consents, permits, etc. can result to design revisions and/or stoppage of works	(i) Obtain all necessary consents, permits, clearance, etc. prior to award of works. (ii) Ensure that all necessary approvals to be obtained by contractor are in place before start of works; (iii) Acknowledge in writing and provide report on compliance all obtained consents, permits, clearance, etc.	Karakol VK, DB Contractor of Karakol WWTP	PMO costs for project approvals Contractor cost
Impacts on communities	Possible impacts associated with direct exposure during work (odor, noise, exhaust fumes)	- Ensure projected impacts and proposed measures have been discussed in advance with the affected community. - PMO will ensure that EMP will be adequately included in bidding documents and all environmental mitigation measures will be included in construction contracts. - Secure discussion of projected impacts and proposed measures with affected community in advance.	VK of Karakol, DB Contractor of Karakol WWTP will take ultimate responsibility for impacts on property. Public participation meetings (PPM) and consult with relevant stakeholders. Complete detailed surveys. PMO will be responsible for inclusion of EMP into bidding documents	

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
			and its implementation.	
Works				
Environmental Management Plan (EMP) Implementation and Safeguards	Irreversible impact to the environment, workers, and community	All key workers will be required to undergo training on EMP implementation including spoils/waste management, Standard operating procedures (SOP) for construction works; occupational health and safety (OHS), core labor laws, applicable environmental laws, etc.	Contractor	Project cost
Social or Community Concerns	Impacts on health of pollutants, dust and noise emissions	- Avoid using older vehicles and machinery, with significant noise and air emissions. - Water unpaved site roads and large areas of exposed soil thrice daily in dry weather. - Ensure that no noise above 70 dB(A) is audible for significant periods within 50 m of any site and Cease activity producing significant noise at night (19:00 pm 07:00 am), Sundays & Public Holidays.	Supervision by DSC Implementation by construction company.	Included in overall project cost
Air Quality	Localised changes in ambient air quality due to operation of mobile and stationary equipment burning fossil fuels.	Contractor to maintain all fossil fuel burning equipment in accordance with manufacturers recommendations. Contractor to use good quality equipment with minimum emissions and avoid using old equipment and vehicles No equipment shall be left idling if not in use	Contractor	No additional cost associated.
Air Quality Noise and Vibration	Fugitive dust emissions from works, construction traffic causing dust soiling and increase in PM2.5 and PM10	Construction traffic speed limit when passing through populated areas Water of dusty-unpaved roads	Supervision by DSC Implementation by Contractor	Included in overall project cost
	Odor problem occur during sludge stabilizing and transporting	Coordinating work in windless weather to reduce odor spreading		
	Noise disturbance due to equipment and construction activities.	Awareness program for local residents prior to commencement of works Limitation of working hours for normal construction activities near to settlements	Contractor with approval of DSC/PMO/PIU	Contractor cost

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
		Avoid using older vehicles and machinery, with significant noise and air emissions. No idling of equipment when not in use Plan activities in consultation with PMO so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance, especially near schools and other sensitive receptors		
Occupational Health and Safety	Injury or fatality of workers due to insufficient controls on work activities and processes (including possibility of infection with helminth eggs and pathogens)	Contractor shall develop Method Statements for all major activities and include health and safety risk assessment for each of these activities Contractor shall provide health and safety induction training for all staff, and specific training for staff working on work sites. Contractor shall supply to site workers, free of charge all necessary Personal Protective Equipment (PPE) to include as protective footwear, high visibility vests, safety helmet and hearing protection. Particular attention should be paid to protection against odor, the mandatory use of respirators. Contractor will prepare and implement a Health & Safety (H&S) Plan for all work sites and activities. Contractor will train and assign a specialist as Health and Safety officer as responsible person for the duration of the project. Provision of health care and first aid - Contractor shall ensure that adequate first aid supplies, disinfectants, masks, gloves, etc. and trained first aiders are available. Preventive measures to prevent contamination by helminth eggs and pathogens. Conducting systematic monitoring (analysis) for helminth eggs and pathogens.	Supervision by DSC Implementation by Contractor	Included in overall project cost
Occupational Health and Safety	Establishment of construction camp sites (offices)	The camp sites will be located within WWTP area.	Supervision by DSC Implementation by Contractor	Included in overall project cost

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
Cleaning after work implementation	Damage due to debris, spoils, excess construction materials	Remove all spoils wreckage, rubbish, or temporary structures which are no longer required. All excavated roads shall be reinstated to original condition. All disrupted utilities restored All affected structures rehabilitated/compensated The area that previously housed the construction camp is to be checked for spills of substances such as fuel and this shall be cleaned up. All hardened surfaces within the construction camp area shall be ripped, all imported materials removed, and the area shall be top soiled and re-grassed using the guidelines set out in the revegetation specification that forms part of this document. The contractor must arrange the cancellation of all temporary services. Request PIU/PMO to report in writing that worksites and camps have been vacated and restored to pre-project conditions before acceptance of work.	Supervision by DSC Contractor with approval of DSC	Contractor cost
Waste Management	Inappropriate management and disposal of waste during work	Include appropriate waste management protocols Location of appropriate waste storage facilities at all work sites Worker induction and regular toolbox talks to make all staff aware of zero waste discharge to environment Zero tolerance of waste entering water course or flood plain areas, this will include all materials (e.g welding rod stubs, wood, plastics and metals.	Contractor	Contractor costs
Waste Management Water resources	Poor waste management practices resulting in direct and indirect effects on project area environment	Contractor will establish a demarcated temporary waste storage area where waste is stored pending transport to final treatment/disposal location. Contractor will put in place measures to minimise waste, i.e. procure materials with less packaging, refrain from ordering excess materials, make arrangement with suppliers to return surplus, unused materials.	Supervision by DSC Implementation by Contractor	Included in overall project cost

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
		Contractor will take measures to prevent the disposal, burying and burning of waste on-site, roadside dumping and illegal land filling. Contractor workforce will be trained in the requirements of the Waste Management Plan, particularly with regards to waste segregation, storage and handling. Implementation of recycling/recovery initiatives to reduce waste sent for disposal. Contractor will practice good housekeeping on site. Waste storage containers will be secure, undamaged and appropriately labelled. Waste to be segregated and containers clearly labelled specifying which type of waste is contained to assist with identifying appropriate disposal routes and in case of accidental spills or loss to the environment. Waste to be stored in appropriate containers or skips and removed for treatment/disposal at a frequency so as to avoid the build-up of waste on site. Waste will be collected and transported under cover of a Waste Collection Log and Waste Manifest.		
	Use of Sludges	According to the legislation of Kyrgyzstan, sludges that can be used for land application purposes (including agriculture, forestry, parks, and recreation, and as such, end uses along with landfilling) should comply with several requirements: content of heavy metals in the sludge must be suitable for use and the sludge must not contain pathogens. They also must comply with several other requirements such as dry matter content, nutrient concentrations, and organic matter content limits. If sludges comply with all other conditions, but they contain pathogens, they should be treated for removal of pathogenic organisms.	Supervision by DSC Implementation by Contractor	Included in overall project cost
	Pollution of surface water by supernatant wastewater and possible spillage from construction machinery.	Contractor to conduct risk assessment on all activities near to water courses and apply appropriate controls.	Supervision by DSC Contractor with approval of DSC	Contractor cost

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
		No refuelling of vehicles or equipment to take place within river beds or within 25 metres of the edge of the water course. No work will be done in the water protection zones of the rivers. After performing the necessary analysis, the degree of contamination will be determined, and depending on discharge criteria to nearby surface waters, necessary actions will be determined. Waters containing helminth eggs should not be discharged to the environment before removing these disease-causing agents.		
	Filtration of wastewater into ground water.	The site onto which sludge will be spread must be impermeable and waterproof to prevent leakage to an underground water source. The groundwaters and nearby surface waters should be monitored regularly for an indication of contamination.	Supervision by DSC Implementation by Contractor	Included in overall project cost
Biodiversity	CA Frog rehosting	Cooperation and consultations with the MNRETS for approval and obtaining a permit as per the requirements of regulations in the Kyrgyz Republic; Cooperation and consultations with the National Academy of Sciences of the Kyrgyz Republic on the procedures and methodology for the relocation of CA frogs; CA Frog relocation;	Supervision by DSC	DSC/Project costs
Soil and Ground Water	Soil contamination by fuel and oil spills	Fuels should be stored in good quality above ground tanks placed on an impervious surface with a spill containment bund capable of containing 110% of the tank capacity No onsite refilling within or adjacent to water courses On site refuelling of equipment and vehicles shall utilise a drip tray to prevent hydrocarbons entering the ground	Supervision by DSC Implementation by Contractor	Included in overall project cost

Draft Activity/Issue	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibility	Action/Cost
	Soil contamination by helminth eggs and pathogens	Selection of alternative, depending on the analyses carried out	Supervision by DSC Implementation by Contractor	Included in overall project cost
Reporting	Environmental monitoring and reporting to confirm compliance	Safeguards Monitoring: Contractor's monthly reports and DSC's quarterly progress reports should have a section on safeguard compliance. PMO will submit for disclosure on ADB and EA websites semi-annual environmental monitoring reports (SAEMR) in January and July each year. Final EMR will include post-construction environmental audit and will be submitted one month after the project physical completion.	Implementation by Contractor, DSC, PIU and PMO	Included within management costs
Operating Period				
Water resources	Filtration from lagoons	Wastewater Effluent Quality Criteria	Vodokanal and stakeholders	Included in maintenance budget of Vodokanal

Table 6-9 Environmental Monitoring Plan for sludge management at Karakol WWTP lagoons.

Pre-Construction Phase

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements:	Location	Frequency	Responsibility
Air Quality	To establish baseline air quality levels	NH3,H2S & PM10 (particulate matter smaller than 10 microns) concentration at receptor level	1-hr concentration levels	receptor locations TBD by DSC	Twice in total (Once on a weekday and once on a weekend)	Contractor
Ambient Noise	To establish baseline noise levels	Ambient noise level near key noise sensitive receptors	A-weighted noise levels	receptor locations TBD by DSC	Twice in total (Once on a weekday and once on a weekend)	Contractor

Table 6-10- Monitoring Requirements for the phase of work implementation

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements:	Location	Frequency	Responsibility
Noise Disturbance due to noise from construction activity	To determine the effectiveness of noise abatement measures on sound pressure levels	Ambient noise level near key noise sensitive receptors	A-weighted noise levels	At key receptor locations	On monthly basis	Contractor
Air Quality Dust emissions from construction vehicles and equipment, possible release of pollutants during drying of sludge	To determine the effectiveness of dust control program on dust at receptor level	CO,NOx & PM10 (particulate matter smaller than 10 microns) concentration at receptor level NH3,H2S (during sludge stabilization)	1-hr concentration levels	At key receptor locations	On monthly basis	Contractor
		Visible dust	Visual observation of size of dust clouds, their dispersion, and the direction of dispersion	Construction sites	On daily basis	Contractor's EHS officer/DSC ES
Increase in traffic accidents	To minimize risk of traffic accidents	Number of accidents taking place	Visual monitoring	Construction vehicles traveling to/from construction sites	Once weekly	Contractor's EHS officer/DSC ES
Safety precautions by Safety workers	To prevent accidents for workers and general public	Number of near miss events and accidents taking place	Visual inspections	Sites	Once weekly	Contractor's EHS officer/DSC ES
Soil Pollution	To prevent contamination of soil from oil and toxic chemical	Incidents of oil and toxic chemical spills	Visual inspections	Sites	Once a month	Contractor's EHS officer/DSC ES

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements:	Location	Frequency	Responsibility
	spills and leakages					
Solid Waste & Effluent disposal Insufficient procedures for waste collection, storage, transportation and disposal	To check the availability of waste management system and implementation	Inspection of solid and liquid effluent generation, collection, segregation, storage, recycling and disposal at construction sites	Visual inspections	Sites	On daily basis Liquid effluent to be tested on quarterly basis	Contractor's EHS officer/DSC ES

Table 6-11- EMP implementation assessment indicators for sludge management of Karakol WWTP lagoons

Indicator	Measure	Parameters to be Monitored	Method	Responsibility
Preparation Phase				
Indicator has not been defined for pre-construction phase				
Work Implementation Phase				
1. Occurrence of avoidable impacts	1.1 Violations of noise limits	Ambient noise levels (day, night levels), dB(A)	1.1.1 Physical noise monitoring (though site observation by DSC is often more immediate and effective)	DSC/PIU/PMO
	1.2 Spills of fuels, lubricants, coolants or hazardous chemicals at work sites		1.21 Visual site inspections	DSC/PIU/PMO
	1.3 Exceedances of standards for dust and other gaseous substances at sensitive receptor sites	Ambient air quality (SPM, RSPM, CO, SO2, NH3,H2S before the construction starts and once in a month)	1.3.1 Physical air quality monitoring (though site observation by DSC is often more immediate and effective)	DSC/PIU/PMO
2. Recurrence of impacts	2.1 Rate of recurring impact by site/contractor/impact		2.1.1 Review of inspection records	DSC/PIU/PMO

Indicator	Measure	Parameters to be Monitored	Method	Responsibility
3. Compliance with EMP prescriptions	3.1 Number of findings of non-compliance as proportion of total compliance findings		3.1.1 Visual site inspections	DSC/PIU/PMO
	3.2 Number of repeat non-compliance findings		3.2.1 Review compliance findings	DSC/PIU/PMO
4. Effects of Project activities on public	4.1 Number of complaints received by PIO, PMO, and municipalities about impacts considered unacceptable by members of public		4.1.1 Gather and count complaint reports	DSC/PIU/PMO
	4.2 Number of grievances files under GRM about impacts		4.2.1 Review GRM records	DSC/PIU/PMO
Operating Period				
Indicator has not been defined for operating phase.				

6.3.4. *Environmental Management Budget*

175 Most of the mitigation measures require the contractors to adopt good site practice, which should be part of their normal construction contract, so there are additional costs, such as instrumental monitoring, cost of mitigation measures, tree replanting etc.to be included in the EMP. Costs of design-related mitigation measures are included in the budgets for the civil works.

Table 6-12 Costs of Contractor for EMP implementation for sludge management of Balykchy WWTP lagoons

	Item	Units	Quantity	Rate US $	Total
A	**Environmental Management Plan (EMP) Implementation and Safeguards**				
	Safety signage boards, caution tapes during construction works in sites. Street lighting and safety fences Pavement Markings, Channelizing Devices(cones), Arrow Panels and Warning Lights. Night lights, solid barricades, and reflectorized signages.	Lump sum	1	200	200
	Guardrails or barriers, metal planks as walkways or cover for vehicles over open excavation/trenches	Lump sum	1	500	500
	Water sprinkling to reduce dusts	Per truck	25	100	2500
	Air quality monitoring -Instrumental air quality monitoring (parameters CO, NO2, SO2, NH3,H2S and PM10)	per set	12	100	1200
	Noise levels monitoring -Instrumental noise levels monitoring (dB)	Per monitoring	12	20	240
	Vibration level monitoring - Instrumental vibration level monitoring (dB)	Per monitoring	12	15	180
	Sludge Quality Monitoring	Per monitoring	12	50	600
	Reinstatement of disturbed sites/roads/properties	Lump sum	1		
	Collection, transport, and disposal of wastes	Lump sum	3		
	Total				**5420**

Table 6-13 Costs of Contractor for EMP implementation for sludge management of irrigation pond of Aksuu DDWM

	Item	Units	Quantity	Rate US $	Total
B	**Environmental Management Plan (EMP) Implementation and Safeguards**				
	Safety signage boards, caution tapes during construction works in sites. Street lighting and safety fences Pavement Markings, Channelizing Devices(cones), Arrow Panels and Warning Lights. Night lights, solid barricades, and reflectorized signages.	Lump sum	1	200	200
	Water sprinkling to reduce dusts	Per truck	50	50	2500

	Item	Units	Quantity	Rate US $	Total
	Air quality monitoring -Instrumental air quality monitoring (parameters CO, NO2, SO2, NH3,H2S and PM10)	per set	20	100	2000
	Noise levels monitoring -Instrumental noise levels monitoring (dB)	Per monitoring	20	20	285
	Vibration level monitoring - Instrumental vibration level monitoring (dB)	Per monitoring	20	15	342
	Sludge Quality Monitoring	Per monitoring	12	50	600
	Reinstatement of disturbed sites/roads/properties	Lump sum	1		
	Collection, transport, and disposal of wastes	Lump sum	5		
	Total				5 927

Table 6-14 Costs of Contractor for EMP implementation for sludge management of Karakol WWTP lagoons

	Item	Units	Quantity	Rate US $	Total
B	**Environmental Management Plan (EMP) Implementation and Safeguards**				
	Safety signage boards, caution tapes during construction works in sites. Street lighting and safety fences Pavement Markings, Channelizing Devices(cones), Arrow Panels and Warning Lights. Night lights, solid barricades, and reflectorized signages.	Lump sum	1	200	200
	Guardrails or barriers, metal planks as walkways or cover for vehicles over open excavation/trenches	Lump sum	1	500	500
	Water sprinkling to reduce dusts	Per truck	25	100	25 00
	Air quality monitoring -Instrumental air quality monitoring (parameters CO, NO2, SO2, NH3,H2S and PM10)	per set	5	50	950
	Noise levels monitoring -Instrumental noise levels monitoring (dB)	Per monitoring	5	20	285
	Vibration level monitoring - Instrumental vibration level monitoring (dB)	Per monitoring	5	15	342
	Sludge Quality Monitoring	Per monitoring	5	50	250
	Reinstatement of disturbed sites/roads/properties	Lump sum	1		
	Collection, transport, and disposal of wastes	Lump sum	1		
	Total				**5027**

Note: Contractors' costs are estimated based on the units applied in the similar calculations for the networks of Karakol and Balykchy (average market prices) as well as the sludge management period determined in this report and frequency of instrumental measurements once a quarter

6.4. Sanitary Protection Zone

176 A Sanitary protection zone is the territory that separates enterprises, their buildings, and facilities with processes, which are the sources of impact on the environment and human health, from the residential area, landscape, and recreational areas, rest areas, and resorts. Sanitary protection zone is an obligatory element of any object that is a source of impact on the environment and human health.

177 According to SANITARY-EPIDEMIOLOGICAL RULES AND REGULATIONS, Sanitary and Epidemiological rules and regulations "Sanitary protection zones and sanitary classification of enterprises, facilities and other objects" approved by the Regulation of the Government of the Kyrgyz Republic dated April 11, 2016, № 201.

Table 6-15. Sanitary protection zones for sewage treatment facilities.

Wastewater treatment plants	Distance (m) at the designed capacity of WWTP (thou.m^3/day)			
	less than 0.2	more than 0.2 less than 5.0	more than 5.0 less than 50.0	more than 50.0 less than 280
Facilities for mechanical and biological treatment with sludge areas for digested sludge, as well as sludge areas	150	200	400	500
Fields: a) filtration b) irrigation	 200 150	 300 200	 500 400	 1000 1000
Biological Ponds	200	200	300	300

178 After evaluation of the design for Balykchy WWTP, SPZ extent was calculated. Based on the results of calculations, it is concluded that:

- The sound pressure level at the border of the residential area for the existing conditions is not a sources of noise pollution.
- Calculations of the dispersion of harmful substances in the ground atmosphere layer showed that the concentration of pollutants is less than 1 MPC in the residential area for all substances.
- The calculated sanitary protection zone of Balykchy WWTP does not cover the residential area and coincides with the normative SPZ. To adjust the normative SPZ, it is proposed to conduct systematic measurements at the site.
- The Contractor will take measures to reduce the harmful impact on the environment through:
    - Landscaping of the SPZ area, industrial areas of the enterprise at the part which is closer to residential buildings,
    - Implementation of measures planned for 2024-2027.
    - Control the level of environmental impact using monthly measurements of the level of pollution for the first year of operation to confirm the estimated SPZ, and then quarterly.

6.5. Comparison of Sludge Use Alternatives

179 It is not foreseen that any of the below-mentioned alternatives will have a major environmental effect. Besides, their advantages and disadvantage are variable. Please see Table 6.6 for comparative advantages and disadvantages of sludge use alternatives.

Table 6-16. Comparison Table of Sludge Use Alternatives.

Alternative	Possible environmental impacts	Advantage	Disadvantage
Agricultural Fertilization	Low	It can be sold and becomes revenue	Need pathogen stabilization
Alternative landfill cover	Low	Low cost	Need pathogen stabilization, gas emission
Disturbed land reclamation/rehabilitation	Low	Nutrients	Need pathogen stabilization
Forest Fertilization/Silviculture	Low	Organic matter	Need pathogen stabilization
Chemical stabilization / acidic soil amendment	Low	-	Need pathogen stabilization
Landfill Disposal	Low	Low cost, No need pathogen stabilization	Gas emission
Dedicated Land Disposal	Low	Low cost, No need pathogen stabilization	Need a large dispose area

7. PROPOSED SURVEYS AND ANALYSIS

7.1. Geological Surveys

180 The decision to use on site storage ponds and the transfer of the available sludge to these ponds should be evaluated by considering the data for soil type/texture analysis, bearing capacity, and hydrogeology with groundwater conditions.

181 Depending on the geological and geotechnical surveys for storage or disposal areas, necessary actions should be taken to prevent the contribution of seepage water to ground water table under these storage or disposal areas. In both cases, the analysis should be conducted regularly and carefully so that the layer onto which the sludge will be spread must be impermeable and waterproof to prevent leakage to groundwater sources.

182 Design parameters of disposal areas depend on the groundwater table elevation (GWT). In order to evaluate the suitability of the volume of the storage or disposal areas, groundwater levels should be determined for the volume of the sludge from the ponds that is going to be stored. The maximum depth of the excavation cannot be lower than 1 m. above the GWL, and thereby volume calculations should consider this requirement. In the case of excavation, depth is not enough to create the required storage volume; then it is necessary to elevate the surrounding barriers and extend the storage area above the ground. Deeper excavations will result in the contamination of groundwater in the surrounding area.

183 Boreholes will provide information about soil types according to depths, and the presence of bedrock, which will provide the foundation's bearing capacity for storage or disposal areas. After the design of storage or disposal area the height of the sludge, thus, the load over the foundation will be defined and, depending on the bearing capacity of the foundation, will be assessed. Subsequently, it will be decided if there is a risk of settlement in the foundation and necessary improvements in the foundation should be decided accordingly. The necessity of foundation improvement and, if required, its details will be planned according to the results from these surveys. Lack of impermeable surface or a deformation in the foundation of the areas will result in contamination of the groundwaters in the surrounding area.

184 Similarly, for the access roads and platforms around existing ponds and disposal areas, search wells need to be opened in order to determine the bearing capacity of the soils so that these soils can resist the dynamic loads from the machinery and trucks.

185 Depending on permeability test results, if an impervious waterproof layer is present below the foundation of the storage or disposal areas, the foundation will only be covered with a geomembrane layer. If permeability is high and GWL is close to the foundation, in this case, a clay layer will be laid first, and a geomembrane layer will be spread on these clay layers to ensure an impermeable surface.

186 In order to obtain hydrogeological and geological information required for final evaluation and design of the storage areas and access roads, search wells and boreholes should be opened at sites during the design steps of these structures.

Search Wells:

187 The search wells for access roads and platforms around existing ponds and disposal areas should be opened with 3 m. depth, and disturbed samples will be taken. Detailed soil investigations shall be undertaken with the purpose of identifying; types of sub-grade soils, ground water existence (depth of GWL will be recorded) and permeability values (only for the wells in ponds). Moreover, in-situ CBR (bearing ratio) tests should be carried to assess the strength of the sub-grade. Search wells on access roads will be opened approximately at each 500m.

Boreholes:

188 Boreholes at disposal areas with 10 m. depth will be opened, and undisturbed samples will be taken to definite soil structure and their layers. Types of sub-grade soils, bearing capacity of sludge area foundation, presence of bedrock, groundwater level, and permeability of soils (till groundwater level) will be identified.

189 All pits and boreholes shall be properly logged and drawn in A1 size plans showing the thickness of each layer, the color, the type and visual description of each layer, depth below the surface, and depth of water level (if encountered), etc.

7.2. Laboratory Analysis and Information Required for Dewatering

190 Wastewater accumulated in the ponds should be analyzed. After performing the necessary analysis, the degree of contamination will be determined, and depending on the results and the discharge limits set established within Surface Water Protection Rules and approved by the Kyrgyz Government's Regulation № 128 as of 14 March 2016, the discharge of these waters to nearby surface waters are going to be conducted. Necessary actions of treatment - if required- will be determined, and requirements for dilution and the discharge rates are to be calculated according to these regulatory standards to be met downstream of the discharge.

191 If water causes contamination in those streams, these waters should be discharged to another pond for further settlement of contaminants. Appropriate analyses should then be performed to assess the possibility of discharging them to the nearest watercourse. The discharge would lead to pollution of the waterway in any case. Therefore, it is necessary to calculate a discharge rate to normalize the time of discharge considering the dilution ratio in the watercourse. Supernatant pond waters should be evaluated for contamination before discharging to the nearby surface waters since they may contain pathogens and other polluting substances.

Sample Gathering from Surface Waters:

192 The samples from the existing ponds of both Karakol and Balykchy WWTPs and form the Chu and Karakol rivers before the discharge points of WWTPs will be taken for one day (24h) with 6 hours intervals and 4 samples collected for each pond will be mixed and a composite sample will be formed. In this case;

- 5 Composite samples will be formed from the 5 wet ponds of Balykchy and a composite sample will be formed before the discharge point of Chu River to be analyzed.

- 3 Composite samples will be formed from the 3 wet ponds of Balykchy and a composite sample will be formed from the discharge point of Karakol river to be analyzed.

193 Depending on the reported numbers for defined parameters both in the supernatant and river water, along with the flow rates of nearby rivers, allowable amount of discharge will be calculated to be within the limits of Effluent Discharge Standards in the mixing point and the downstream.

194 Parameters to be analyzed, corresponding standards and sampling requirements are given in Table 7-1 below.

Table 7-1. Parameters to be analyzed in water samples for discharge purposes

Parameter	Standards	Required Volume	Sample Holder	Preservation	Storage Time
Electrical conductivity	SM 2510 B	100 mL	Field Analysis	N.A.	N.A.
Temperature	SM 2550 B	50 mL	Field Analysis	N.A.	N.A.
Dissolved oxygen	EN ISO 5814	300 mL	Field Analysis	N.A.	N.A.
pH	SM 4500-H+:B	100 mL	Field Analysis	N.A.	N.A.
Total Suspended Solids	SM 2540 D	500 mL	Plastic or Glass	2-8 C	2 days
Total Nitrogen	SM 4500 Norg:B; SM 4500 NH3:B,C; SM 4500 NO3-:E	1 L	Plastic or Glass	pH 1-2 with H2SO4; 2-8 C	1 month
Total Phosphorus	SM 4500-P B.C; SM 4500-P:B,E; SM 4500-P:F	300 mL	Plastic or Glass	pH 1-2 with H2SO4 or HNO3; 2-8 C	1 month
Nitrate	SM 4500-NO3:B; SM 4500 NO3:E	250 mL	Plastic or Glass	Should be filtered at site; 2-8 C	4 days
Ammonia	SM 4500-NH3:B,C; SM 4500-NH3:F;	500 mL	Plastic or Glass	Should be filtered at site and pH 1-2; 2-8 C	14 days
BOD	SM 5210 B; EN 1889-1; TS EN ISO 5815-1	1 L	Amber Borosilicate Glass	2-8 C at dark	1 day
COD	SM 5220 B; TS 2789	100 mL	Amber Borosilicate Glass	pH 1-2 with H2SO4; 2-8 C	6 months
E. coli	ISO 9308-1	200 mL	Sterile locked bag with sodium thiosulfate; sterile jar; single use gama ray sterilized sampling vessels	4 C	1 hr

195 Ideally, measurements should be conducted from about 10 cm below the water surface (and then about 10 cm above the sediment surface); however, this is not always possible in shallow water bodies. A mid-water column reading will be sufficient in these cases.

196 ASTM D3370-18 standard or equivalent standard should be used to sample the stream's waters. Samples should be taken according to the preservation methods to be applied to the samples. Composite sampling should account for the minimum volumes required for analysis. The pieces should be conducted to form larger volumes of composite samples and then the analysis can be performed from subsamples taken from the large composite samples. At least 5 L of samples should be uniformly mixed before taking a subsample for analysis requires 1 L of sample and the same ratio can be followed for other analyses.

7.3. River Flow Rates of Chu and Karakol River at Discharge Points of WWTPs

197 In order to calculate the maximum permissible supernatant water discharges to Chu River from Balykchy WWTP ponds, it is also necessary to have the latest available data of long-term observations of monthly flows (for last 10 years) measured at hydro posts close to Chu River (nearest to Balykchy City). The discharge rates will be calculated using these data together with the results of the parameters obtained for both supernatant and river water. Depending on the calculated rate, mobile pump specifications will be determined and ponds will be dewatering.

8. MANAGEMENT PLAN

8.1. Machinery Requirements for Sludge Removal

198 As it was indicated before, sludge removal can be conducted with mechanical removal by earth removal machinery and tractors/suitable trucks, which is the most economical solution. The types of machinery and their use for sludge removal in the irrigation pond of Ak-Suu DDWR irrigation pond can be summarized as below:

199 **Excavators** - are the most proper machinery in order to load cumulated sludge from the ponds to dump trucks. Their long booms and 360o rotating ability will ease the removal of sludge and the operation of loading. Due to their power and dependability, excavators are one of the most common pieces of equipment found at sludge storage sites. Also, these mighty machines can utilize various attachments to perform multiple tasks. They cannot only help carry off the debris and level out the soil, but they also can help carry off the sludge from the ponds. Depending on the total volume of sludge to be removed and pond size, bucket capacity can be determined.

200 **Dump Trucks**- are necessary to carry the removed sludge to the disposal or landfill areas. As the number of dump trucks to be used increases, the total transportation time will decrease. The number of dump trucks also depends on the time period proposed to complete the sludge removal procedure. It is crucial to select the right size of trucks for your project. While the expansive sites will call for the larger versions of these machines, this size of the truck will not work for the smaller areas.

201 **Trailer-** for transportation of the excavator to the site is required. The loading Capacity of trailer should be enough to carry the excavator and dump truck selected.

202 The specifications and amount of excavator and dump truck for sludge removal depend on,

a. The volume of sludge to be removed, sizes of ponds to be cleaned,
b. The time period proposed to complete sludge removal works,
c. Budget allocated for procurement of machinery.

203 Considering the approximate sludge volumes calculated, time proposed to complete sludge removal procedure, and the machinery to procure for Issyk-Kul Main Water Management Department specifications are listed in Table 8.1.

Table 8-1 Machinery Specifications to be used for Sludge Removal of Irrigation Pond of DDWR

Machinery Type	Photos	Specifications	Intended Use
Excavator		1 x Crawler type, 21,5 tons with 0,9-1,0 m^3 bucket capacity Digging depth 6,6 m	Desludging and Construction of Disposal Ponds-to load the sludge to trucks
Dump truck		1 x 16m^3 dumper trucks	Desludging and Construction of Disposal Ponds- to transport sludge to the disposal area
Trailer		1 x 25-30 ton loading capacity lowbed trailer with 2 axle	Transporting machinery to the site

8.2. Operation Plan for Desludging of Ak-suu Irrigation Pond

The following consecutive works will be carried out to clean up sludge from the irrigation pond, transport and dispose of it to a designated area:

- sludge from the irrigation pond can be removed as follows:
- breakdown of the irrigation pond into 6 sections for sequential annual work;
- isolate in each area up to 6.5 hectares of area for sludge storage;
- Temporary, impervious walls will be built in each section to isolate the sludge storage area;
- sumps will be built in each area in the accumulation zone to pump out water seeping from the excavated silt and to keep the zone dry;
- with the help of special equipment, silt will be excavated and moved to an isolated accumulation zone;
- as it dries up in the accumulation zone, the sludge will be loaded onto special equipment and transported for placement / storage to a designated area.

Estimated duration of sludge treatment:

The total volume of the irrigation pond is 117.0 thou. m^3

- average distance to the sludge disposal area ≅ 1 km;
- duration of one trip to the sludge disposal area: 2x1/30x60 ≅ 5 min;
- time for loading and unloading: 30 min
- time of one flight: 5+20= 25 min

working hours per day: 7 hrs

- total number of flights per working day: 7x60/25 = 16 turn

approximate daily volume of transported sludge: 52 m^3

estimated annual volume of sludge is 17.0 thou. m3

204 Calculated durations of sludge removal are under ideal conditions. Depending on failure of machinery and weather conditions, these durations can be longer.

205 Considering the minimum water level in pond will be at the end of irrigation period i.e November-December, sludge removal should be initiated from the lower elevations of pond so that when water level increases with rain it will be still possible to work at higher elevations

8.3. Monitoring

206 **Soil Quality** - The quality of the receiving soils should be monitored when sludge is applied to the soils in order to maintain soil structure. The soil analysis results should be carried out with representative composite samples and should be recorded and approved by local environmental agencies before land application may proceed. It is advised to monitor and re-analyze the soils every 5 biosolids application is completed. The composite soil sample(s) collected must be representative of the application site, collected following a consistent and acceptable sampling procedure, and shall be analyzed by an accredited laboratory with the parameters of concern being listed on the laboratory's scope of accreditation.

207 **Groundwater Quality** - Groundwater samples from domestic wells located within 500 meters of the land application and/or storage sites, with the consent of the homeowner in land application, endues options for private lands, and local authorities should open observation wells near storage area sites. Each well must be analyzed quarterly for total and fecal coliform and annually for the parameters listed in Section 3.4. Local legislation concerning groundwater quality and monitoring should be followed. Samples should be collected before the initial application of municipal biosolids and analyzed for the parameters identified in Section 3.4 to establish baseline data. Following receipt of the sample results, a copy of the analysis shall be provided to the well owner. In addition, monitoring frequency can be increased, if necessary, such as in conditions where it is suspected that groundwater is contaminated. All groundwater samples must be collected following a consistent and acceptable sampling procedure and shall be analyzed accredited laboratory with the parameters of concern being listed on the laboratory's scope of accreditation.

208 **Surface Water Quality** – Surface water samples from the streams where the supernatant surface waters are discharged should be checked quarterly for contamination by pathogenic organisms and the parameters listed in Section 7.2. Local legislation concerning surface water quality and monitoring should be followed. When calculating the discharge ratios and through the first discharges, waters should also be checked for verification. Surface flow should also be measured in order to determine the mixing ratios. Local authorities can increase monitoring frequencies.

209 **Extraction and Transportation** – During extraction and transportation, unwanted contamination from sludge spills on the land, where pathogenic organisms are present in the sludge, should be avoided. Especially the dumper trucks that transport the sludge should be sealed as much as it can. Routes that are shortest and possibly not passed from residential areas and main roads should be taken to avoid people's contact with sludge.

9. SUMMARY AND RECOMMENDATIONS

210 Sludge removal operations as well as extended storage areas design and construction, should be conducted according to required surveys and analysis, which are mandatory for environmental protection and public health.

211 Helminth eggs are particularly resistant to sludge treatment, including thermal and chemical treatment. Therefore, in regions where helminths are endemic, sludge reuse should be conducted with extreme caution, especially given that few laboratories in these regions are able to monitor helminth eggs in sludge on a routine basis.

212 The removal of pathogens during sludge management depends on several environmental factors as well as engineering design and operation and maintenance practices. The following four factors were found to have the most significant impact on pathogen removal: 1) retention time, 2) temperature, 3) pH, and 4) moisture content. Sunlight exposure is expected to result in better removal of pathogens.

213 The least expensive and most advanced options were provided and evaluated for different locations investigated. The beneficial use of sludges as biosolids was considered with Balykchy WWTP and Karakol WWTP sludges. In Ak-Suu Irrigation Pond, the volume was too large to consider this option.

214 For Balykchy, sludges that do not contain pathogenic organisms can be used in land application practices, after verification of sludge as uncontaminated with a new analysis, their suitability for application to land and the status of the land that these sludges are going to be applied to be investigated. These requirements and detailed information on agricultural use of the sludge were described in Section 3.4. After evaluation of all sludge stabilization alternatives for the sludges that contain pathogens, the most economical alternative is air drying of sludges in existing ponds. In this alternative there is no need to construct a new disposal site and to transport the sludge. After extracting the supernatant waters from the ponds, the sludge will be left to dry and stabilize in-situ. Dewatering of the ponds should consider for local legislations of discharge to the nearby Chui River. This operation should be conducted in the warmest and driest periods. The period of stabilization depends on the sunlight, temperature, and precipitation and should be controlled carefully. During extended storage, sludge should be regularly plowed to maximize sunlight exposure. The sludge that is stabilized then can be used as agricultural fertilizer, after investigation and monitoring of parameters such as heavy metal, organic matter content, and nutrient content of sludge as well as the soils to that these sludges will be applied. The emptied ponds (1 of 6) can then be used for treated water storage or emergency storage for raw wastewater in WWTP failure conditions after required protection measures are applied for soil and groundwater preservation. The sludge stabilization can take up to 2-5 years or more with different scenarios, which were explained in the respective section for Balykchy WWTP Sludge Management Plan. With this alternative decommissioning of the existing ponds can be started when the existing WWTP is in use. Moreover, construction of new ponds will be avoided in this scenario which will decrease the cost of the operation.

215 After receiving the final information from Karakol Vodokanal that Pond I and II have water inflow to these ponds and considering the cold climate conditions the stabilization of contaminated sludge will not be possible. Moreover, since there is no proper disposal area proposed by local authorities, it is not possible to transfer the sludge to another site for extended storage stabilization. Therefore, PMO and Karakol Vodokanal have decided to keep the sludge in the ponds. Pond IV sludge will be removed to Pond 3 to be used as emergency pond for new WWTP after proper lining to prevent contamination of groundwater. Ponds I, II, III will be dewatered to irrigation pond through existing transmission line and sludge will be kept in-situ. In case, local authorities will definite a proper disposal area the sludges in these ponds will be transported to new disposal area for extended storage stabilization.

216 For BSR of Ak-Suu, The disposal area (3 ha) will be utilized for sludge storage purposes after excluding the part used for landfilling purposes (0,12 ha). However, the surveys for the suitability of the land to carry the sludge and the waters to be held in it, excavation, or embankment requirements, as well as the presence of groundwaters and location of the aquifers (if any) should be carried out. The site should be lined and rainwater management structures along with platforms have to be built and the site should be properly lined.

References

- Andreadakis, A.D. (1999). Treatment and disinfection of sludge using quicklime. DGE/JRCEC European Commission Workshop Around Sludge, Italy, Stresa. pp. 18–19.
- Andreoli, C.V., von Sperling, M., Fernandes, F. and Ronteltap, M. (2007). Sludge treatment and disposal. IWA Publishing. London, United Kingdom:
- Arthurson, V. (2008). Proper sanitization of sewage sludge: a critical issue for a sustainable society. Applied and Environmental Microbiology. 74, pp. 5267–5275.
- Burton, F.L., Stensel, H.D. and Tchobanoglous, G. (2014). Wastewater engineering: treatment and resource recovery. 5th ed. McGraw-Hill.
- Bresters, A.R., Coulomb, I., Deak, B., Matter, B., Saabye, A., Spinosa, L., Utvik, A.O., Uhre, L. and Meozzi, P. (1997). Sludge Treatment and Disposal Management Approaches and Experiences, Environmental Issues Series No.7, ISWA and European Environment Agency
- Carre, J., Laigre, M.P. and Legeas, M. (1990). Sludge removal from some wastewater stabilization ponds. Water Science & Technology, 51 (12), 227–234. 22, pp. 247–252.
- Darimani, H.S., Ito, R., Sou, M., Dakoure, N.F., Yacouba, H. and Maiga, A.H. (2015). Design of Post-Treatment Unit for Compost from a Composting Toilet with Microbial Risk Assessment. Journal of Residuals Science and Technology.
- Dodane, P.H., Mbéguéré, M., Sow, O. and Strande, L. (2012). Capital and operating costs of full-scale fecal sludge management and wastewater treatment systems in Dakar, Senegal. Environmental Science and Technology. 46, pp. 3705–3711.
- Dortmans, B.M., Diener, S., Verstappen, B. and Zurbrügg, C. (2017). Black Soldier Fly Biowaste Processing-A Step-by-Step Guide [online]. Dübendorf, Switzerland: Eawag-Swiss Federal Institute of Aquatic Science and Technology.
- Drechsel, P., Scott, C., Raschid-Sally, L., Redwood, M. and Bahri, A. 2010 Wastewater Irrigation and Health: assessing and mitigating risk in low-income countries. Earthscan.
- Dumontet, S., Dinel, H. and Baloda, S.B. (1999). Pathogen reduction in sewage sludge by composting and other biological treatments: A review. Biological Agriculture and Horticulture. 16, Taylor and Francis. pp. 409–430.
- Eastman, B.R., Kane, P.N., Edwards, C.A., Trytek, L., Gunadi, B., Stermer, A.L. et al. (2001). The effectiveness of vermiculture in human pathogen reduction for USEPA biosolids stabilization. Compost Science and Utilization. 9, pp. 38–49.
- Espinoza, L.M.C., Yeh, D., Vinneras, B., Rajaram, L., Whiteford, L., Corvin, J. et al. (2012). Inactivation of Ascaris suum by ammonia in feces simulating the parameters of the solar toilet. Journal of Applied Sciences in Environmental Sanitation.
- Farzadkia, M. and Bazrafshan, E. (2014). Lime stabilization of waste activated sludge. Health Scope. 3, Kowsar.
- Feachem, R.G., Bradley, D.J., Garelick, H. and Mara, D.D. 1981 Appropriate Technology for Water Supply and Sanitation: Health Aspects of Excreta and Sullage Management- A State-of-the-Art Review. World Bank.
- Feachem, R.G., Mara, D.D. and Bradley, D.J. 1983 Sanitation and disease. John Wiley and Sons Washington DC, USA.
- Franceys, R., Pickford, J. and Reed, R. 1992 A guide to the development of on-site sanitation. World Health Organization (WHO), Geneva, Switzerland.
- Gabler, F. and Vinnerås, B. (2014). Using Black Soldier Fly for waste recycling and effective Salmonella spp. reduction. Energy and Technology. Swedish University of Agricultural Sciences.

- Gantzer, C., Gaspard, P., Galvez, L., Huyard, A., Dumouthier, N. and Schwartzbrod, J. (2001). Monitoring of bacterial and parasitological contamination during various treatment of sludge. Water Research. 35, pp. 3763–3770.
- Gaspard, P.G., Wiart, J. and Schwartzbrod, J. 1995 Urban sludge reuse in agriculture: waste treatment and parasitological risk. Bioresource Technology, 230, 143-151. 52, pp. 1–37-40.
- Goncalves, R.F. (1999). Gerenciamento do lodos de lagoas de estabilizaçâo nâo mecanizadas. Gerenciamento do lodos de lagoas de estabilizaçâo nâo mecanizadas. PROSAB.
- Horan, N.J., Fletcher, L., Betmal, S.M., Wilks, S.A. and Keevil, C.W. 2004 Die-off of enteric bacterial pathogens during mesophilic anaerobic digestion. Water Research. 38, pp. 1113–1120.
- Humphrey, N. (1999). E. Coli in UK Mesophilic Anaerobically Digested Sludges. UK Water Industry Research Limited.
- Imhoff, K. and Hess, M.L. (1966). Manual de tratamento de águas residuais. Edgard Blucher.
- Jiménez, B. (2007). Helminth ova control in sludge: A review. Water Science & Technology, 51 (12), 227–234. 56, pp. 147–155.
- Kabrick, R.M. and Jewell, W.J. 1982 Fate of pathogens in thermophilic aerobic sludge digestion.
- Manser, N.D., Cunningham, J.A., Ergas, S.J. and Mihelcic, J.R. 2016 Modeling inactivation of highly persistent pathogens in household-scale semi-continuous anaerobic digesters. Environmental Engineering Science. 33, pp. 851–860.
- Manser, N.D., Wald, I., Ergas, S.J., Izurieta, R. and Mihelcic, J.R. (2015). Assessing the fate of Ascaris suum ova during mesophilic anaerobic digestion. Environmental Science and Technology. 49, pp. 3128–3135.
- Mehl, J., Kaiser, J., Hurtado, D., Gibson, D.A., Izurieta, R. and Mihelcic, J.R. 2011 Pathogen destruction and solids decomposition in composting latrines: study of fundamental mechanisms and user operation in rural Panama. Journal of Water and Health. 9, pp. 187–199.
- Mihelcic, J.R., Myre, E.A., Fry, L.M., Phillips, L.D. and Barkdoll, B.D. 2009 Field Guide in Environmental Engineering for Development Workers: Water, Sanitation, Indoor Air.
- Mihelcic, J.R. and Zimmerman, J.B. (2014). Environmental engineering: Fundamentals, sustainability, design. Wiley Global Education.
- Monpoeho, S., Maul, A., Bonnin, C., Patria, L., Ranarijaona, S., Billaudel, S. et al. 2004 Clearance of human-pathogenic viruses from sludge: study of four stabilization processes by real-time reverse transcription-PCR and cell culture. Applied and Environmental Microbiology. 70, pp. 5434–5440.
- Monteleone, M.C., Furness, D., Jefferson, B. and Cartmell, E. 2004 Fate of E. coli across mechanical dewatering processes. Environmental Technology. 25, pp. 825–831.treatment
- National Research Council (2002). Biosolids applied to land: advancing standards and practices. National Academies Press.
- Oakley, S.M., Mendonça, L.C. and Mendonça, S.R. (2012). Sludge removal from primary wastewater stabilization ponds with excessive accumulation: a sustainable method for developing regions. Journal of Water Sanitation and Hygiene for Development. 2, pp. 68–78.

- Pecson, B.M., Barrios, J.A., Jimenez, B.E. and Nelson, K.L. (2007). The effects of temperature, pH, and ammonia concentration on the inactivation of Ascaris eggs in sewage sludge. Water Research. 41, pp. 2893–902. doi: 10.1016/j.watres.2007.03.040.
- Picot, B., Sambuco, J.P., Brouillet, J.L. and Riviere, Y. 2005 Wastewater stabilisation ponds: sludge accumulation, technical and financial study on desludging and sludge disposal case studies in France. Water Science & Technology, 51 (12), 227–234.
- Pepper, I.L., Brooks, J.P., Sinclair, R.G., Gurian, P.L. and Gerba, C.P. 2010 Pathogens and indicators in United States Class B biosolids: National and historic distributions. Journal of Environmental Quality. 39, pp. 2185–2190.
- Sahlström, L. 2003 A review of survival of pathogenic bacteria in organic waste used in biogas plants. Bioresource Technology, 230, 143-151. 87, pp. 161–166.
- Sanders, D.A., Malina, J.F., Moore, B.E., Sagik, B.P. and Sorber, C.A. 1979 Fate of poliovirus during anaerobic digestion. Journal Water Pollution Control Federation. 51(2), pp. 333–343.
- Sanguinetti, G.S., Tortul, C., Garcia, M.C., Ferrer, V., Montangero, A. and Strauss, M. 2005 Investigating helminth eggs and Salmonella sp. in stabilization ponds treating septage. Water Science & Technology, 51 (12), 227–234. 51, pp. 239–247.
- Semiyaga, S., Okure, M.A.E., Niwagaba, C.B., Katukiza, A.Y. and Kansiime, F. (2015). Decentralized options for faecal sludge management in urban slum areas of Sub-Saharan Africa: A review of technologies, practices and end-uses. Resources, Conservation and Recycling. 104, pp. 109–119.
- Sidhu, J.P.S. and Toze, S.G. 2009 Human pathogens and their indicators in biosolids: a literature review. Environment International. 35, pp. 187–201.
- Sinton, L.W., Hall, C.H., Lynch, P.A. and Davies-Colley, R.J. 2002 Sunlight inactivation of fecal indicator bacteria and bacteriophages from waste stabilization pond effluent in fresh and saline waters. Applied and Environmental Microbiology. 68, pp. 1122–1131.
- Strande, L., Ronteltap, M. and Brdjanovic, D. (2014). Faecal Sludge Management (FSM) Book-Systems Approach for Implementation and Operation. London, United Kingdom: IWA Publishing.
- Tayler, K. (2018) Faecal Sludge and Septage Treatment: A guide for low- and
- middle-income countries, Rugby, UK, Practical Action Publishing
- USEPA (2003). Environmental Regulations and Technology Control of Pathogens and Vector Attraction in Sewage Sludge. USEPA Office of Research Development.
- USEPA (1994). A plain english guide to the EPA part 503 biosolids rule. USEPA Office of Wastewater Management, Washington, DC. USEPA Office of Wastewater Management, Washington, DC.
- Viau, E. and Peccia, J. 2009 Survey of wastewater indicators and human pathogen genomes in biosolids produced by class A and class B stabilization treatments. Applied and Environmental Microbiology. 75, pp. 164–174.
- von Sperling, M. (2007). Waste stabilisation ponds. Biological Wastewater Treatment Series. 3, IWA publishing. London, United Kingdom:
- Water Sanitation Program (2014). The missing link in sanitation service delivery: A review of fecal sludge management in 12 cities. World Bank.
- WHO (2006). Guidelines for the safe use of wastewater, excreta and greywater. Volume 4: Excreta and greywater use in agriculture. 3rd ed.4, World Health Organization. Geneva, Switzerland.
- WHO (2006). Guidelines for the safe use of wastewater, excreta and greywater. Volumes I-IV. World Health Organization
- World Bank (2016). Fecal Sludge Management Tools.

APPENDICES

APPENDIX - 1

Minutes of Meetings

Проект «Управление сточными водами Иссык-Куля»
Кредит № L3742-KGZ/Грант № G0628 KGZ

ПРОТОКОЛ
он лайн заседания/совещания

«20» Окт 2023-года № 046/23 **г.Бишкек, офис Отдела управления проектов (ОУП)**

Председательствовал: - Омурканов С.А. – директор ОУП.

Участники:

От ОУП:	-	Жундубаев К.Ш. – специалист по охране окружающей среды;
	-	Жумабеков М.К. – специалист по защитным мерам и переселению.
От МП «Водоканал» города Балыкчы	-	Акматов Б.Т. – менеджер очистного сооружения.
От МП «Водоканал» города Каракол	-	Омуралиев Ж.К. – главный инженер;
	-	Завьялова О.И. – директор ОРП проекта ЕБРР.
От Ак-Суйского РУВХ	-	Жакупов Т.У. – начальник.
От ОРП Балыкчы	-	Карасартов К.З. – менеджер.
От ОРП Каракол	-	Джаныбеков А.К. – менеджер.

Повестка дня он лайн заседания/совещания:

1. Предложения ОУП к обновлению Раздела 5 Программы управления илом (ПУИ).
2. Планы действий по реализации ПУИ для биологических прудов КОС Балыкчы и Каракол, а также ирригационного пруда (БСР) Ак-Суйского районного управления водного хозяйства (РУВХ).

ОУП выразил особую признательность ОРП, МП «Водоканал» и Ак-Суйскому РУВХ за оперативную совместную работу по обновлению Раздела 5 ПУИ и своевременное предоставленные необходимых схем и материалов.

ОУП подготовил свои предложения к обновлению Раздела 5 ПУИ на основании рекомендаций Обзорной миссии АБР (23 января – 3 февраля 2023 года).

Участники совещания отметили, что со стороны Консультанта по проектированию и надзору (КПН) не были проведены консультации и работы с ОРП, МП «Водоканал» и Ак-Суйским РУВХ по обновлению ПУИ, помимо проведения ранее совместных работ по отбору проб ила для анализов и определения объема ила в прудах.

Директор ОУП Омурканов С.А. проинформировал участников о бюджете проекта в целом, в т.ч. о приобретении специальной техники для МП «Водоканал» городов Кыркол и Балыкчы, Ак-Суйскому РУВХ, о намечаемых работах в рамках

проекта по огораживанию прудов КОС и выделенного участка для размещения и складирования ила с БСР в период реализации проекта, согласно требованиям национального НПА и процедурам АБР.

Решение

(Омурканов, Жундубаев, Карасартов, Акматов, Джаныбеков, Омургалиев, Завьялова, Жакупов, Жумабеков)

Заслушав и обсудив презентацию специалиста по окружающей среды ОУП Жундубаева К.Ш. и обменявшись мнениями, участники он лайн совещания приняли решение:

1. Одобрить Предложения ОУП к обновлению Раздела 5 ПУИ и Планов действий по реализации ПУИ для прудов КОС и БСР с учетом внесенных предложений (срокам, размещениям специальной техники, предварительному обезвоживанию пруда 4 на КОС Каракол до ввода в эксплуатацию нового сооружения КОС, задействовав при этом 2 и 3 пруды для отвода сточной воды от действующего КОС, огораживаний прудов, разработок рабочих проектов и другие).
2. По обращениям МП «Водоканал» города Каракол от 14 февраля 2023 года № 01-5/94 и Ак-Суйского РУВХ от 16 февраля 2023 года № 0007/24 ОУП даны исчерпывающие разъяснения и ответы.
3. Ак-Суйское РУВХ за счет собственных средств разработает рабочий проект и проведет работы по получению положительных заключений и разрешений от уполномоченных государственных органов в сфере охраны окружающей среды, здравоохранения и других на размещение/складирование очищенного ила на выделенном участке, согласно требованиям Порядка обращения с отходами производства и потребления в Кыргызской Республике, утвержденного постановлением Правительства Кыргызской Республики от 5 августа 2015 года № 559 и других национальных нормативных правовых актов до начала работ по перемещению и складированию ила с БСР.
4. Направить Предложения ОУП к обновлению Раздела 5 Программы управления илом и Планы действий по реализации ПУИ на рассмотрение в АБР.

Подписи:

Омурканов С.А.

Жундубаев К.Ш.

Issyk-Kul Wastewater Management Project
Loan № L3742-KGZ/Grant № G0628 KGZ

MINUTES
of the online meeting

_20_ _02_ 2023	**#_046/23_**	**Bishkek, Project Management Office (PMO)**

Chaired: - Mr. Omurkanov S.A.- PMO Director.

Participants:

From PMO:	-	Mr. Zhundubaev K.Sh. -Environmental Specialist;
	-	Mr. Dzhumabekov M.K. – Safeguard and Resettlement Specialist.
From ME "Vodokanal" of Balykchy	-	Mr. Akmatov B.T. – Manager on treatment facilities.
From ME "Vodokanal" of Karakol	-	Mr. Omurgaliev Zh.K. – Chief Engineer;
	-	Ms. Zaviyalova O.V. – PIU Director of EBRD project.
From Ak-Suu DWMD	-	Mr. Zhakupov T.U. – Head.
From Balykchy PIU	-	Mr. Karasartov K.Z. – Manager.
From Karakol PIU	-	Mr. Dzhanybekov A.K. – Manager.

Agenda of the Online Meeting:

1. PMO's proposals for updating Section 5 of the Sludge Management Program (SMP).
2. Action plans for the implementation of SMP for the oxidation ponds of the Balykchy and Karakol WWTPs, as well as the Seasonal Storage Pond (SSP) of the Ak-Suu District Water Management Department (DWMD).

The PMO expressed special gratitude to the PIU, ME "Vodokanal" and Ak-Suu DWMD for the prompt joint work on updating Section 5 of the SMP and the timely provision of the necessary schemes and materials.

The PMO has prepared its proposals for updating Section 5 of the SMP based on the recommendations of ADB Review Mission (January 23 – February 3, 2023).

The meeting participants noted that the Design and Supervision Consultant (DSC) had not carried out consultations and work with the PIU, ME "Vodokanal" and Ak-Suu DWMD on updating the SMP, in addition to carrying out earlier joint work on sampling sludge for analysis and determining the volume of sludge in ponds.

PMO Director Mr. Omurkanov S.A. informed the participants about the budget of the project as a whole, including the purchase of special equipment for ME "Vodokanal" in the cities of Karakol and Balykchy, Ak-Suu DWMD, about the planned works within the framework of the project on fencing ponds of WWTP and a dedicated

site for the placement and storage of sludge from SSP during the project implementation, in accordance with the requirements of the national RLA and ADB procedures.

Decision

(Omurkanov, Zhundubaev, Karasartov, Akmatov, Dzhanybekov, Omurgaliev, Zaviyalova, Zhakupov, Dzhumabekov)

After hearing and discussing the presentation of the Environmental Specialist of the PMO Mr.Zhundubaev K.Sh. and exchanging views, the participants of the online meeting made a decision:

1. To approve the PMO's proposals for updating Section 5 of the SMP and Action Plans for the implementation of SMP for the ponds of the WWTP and SSP, taking into account the proposals made (timing, placement of special equipment, preliminary dewatering of Pond 4 on the Karakol WWTP before commissioning of the new the WWTP facility, using 2 and 3 Ponds to divert wastewater from the existing WWTP, fencing ponds, development of detailed designs and others).
2. According to the appeals of ME "Vodokanal" of Karakol dated February 14, 2023 #01-5/94 and Ak-Suu DWMD dated February 16, 2023 #0007/24 by the PMO exhaustive explanations and answers were given.
3. Ak-Suu DWMD will develop a detailed design at its own expense and carry out work to obtain positive conclusions and permits from authorized state bodies in the field of environmental protection, health and others for the placement/storage of purified sludge on a designated site, in accordance with the requirements of the Procedure for Handling Production and Consumption Waste in the Kyrgyz Republic, approved by the Resolution of the Government of the Kyrgyz Republic # 559 of August 5, 2015 and other national regulatory legal acts prior to the start of work on the movement and storage of sludge from the SSP.
4. To send the PMO's Proposals for updating Section 5 of the Sludge Management Program and Action Plans for the implementation of SMP for consideration to ADB.

Signatures:

Omurkanov S.A. _____

Zhundubaev K.Sh. _____

Проект «Управление сточными водами Иссык-Куля»
Кредит № L3742-KGZ/Грант № G0628 KGZ

ПРОТОКОЛ
онлайн заседания/совещания

«_06_» ___06___2023-года № 148/23 **г.Бишкек, офис Отдела управления проектом (ОУП)**

Председательствовал: - Омурканов С.А. – директор ОУП.

Участники:

От Реализующего агентства:	-	Иванова И.Ю. – главный специалист Аппарата ППИКРИКО.
От МП «Водоканал» города Балыкчы	-	Ахматов Б.Т. – главный инженер-менеджер очистного сооружения.
От МП «Водоканал» города Каракол	-	Казакбаев К.М. – начальник КОС;
	-	Завьялова О.И. – консультант по проектам.
От Ак-Суйского РУВХ	-	Шергазиев С.Дж. – главный инженер.
От ОРП Балыкчы	-	Карасартов К.З. – менеджер.
От ОРП Каракол	-	Джаныбеков А.К. – менеджер.
От ОУП	-	Жундубаев К.Ш. – специалнет по охране окружающей среды;
От Консультанта по проектированию и надзору (КПН)	-	Коркут Аккорек – координатор проекта;
	-	Манченко Н. – переводчик/офис-менеджер.

Повестка дня онлайн заседания/совещания:

Обсуждение Планов действий по реализации Программы управления ила (ПУИ) и Планов управлений окружающей среды (ПУОС) для биологических прудов КОС Балыкчы и Каракол, а также ирригационного пруда (БСР) Ак-Суйского районного управления водного хозяйства (РУВХ), доработанного и внесенного Консультантом по проектированию и надзору (КПН).

(Омурканов, Жундубаев, Карасартов, Ахматов, Джаныбеков, Завьялова, Иванова, Шергазиев, Коркут Аккорек)

Краткая стенограмма обсуждений.

Жундубаев К.Ш. Уважаемые коллеги, проект ПУИ внесенный КПН с предварительными проработками ОУП был направлен на рассмотрение и согласование в ОРП, Водоканалам, Ак-Суйскому РУВХ и в РА 31 мая 2023 года. Давайте рассмотрим и уточним Планы действий по управлению илом (Раздел 5) и Планы управления окружающей среды (Раздел 6), которые были дополнены КПН на основании комментариев АБР. Это у нас с вами второе обсуждение ПУИ, первое было

20 февраля 2023 года. Я направил также свои предварительные комментарии по документу в КПН на почту Натальи Манченко.

По Плану действий управления илом прудов КОС Балыкчы:

Омурканов С.А. У нас в ОУП состоялась встреча с Подрядчиком КОС Балыкчы, где мы подняли вопрос о дополнительных работах для очистки и огораживания прудов. Водоканал может выполнить данные работы как суб-подрядчик? В ОУП обратился частный предприниматель, который имеет опыт и оборудование в переработке ила, обеззараживании, гранулировании и реализации в качестве удобрения. Это один из вариантов.

Акматов Б.Т. Необходимо определиться с рабочим проектом насчет огораживания или сметы. Мы имеем технику и возможность, обсудим с руководством и внесем вам предложение.

Коркут Акюрек. Если Водоканалу нужны будут топографические съемки биопрудов, то КПН предоставит их.

Жундубаев К.Ш. Давайте уточним сроки и исполнителей по каждому мероприятию Плана действий. КПН необходимо разделить п.п 9 и 10 Плана (перемещение ила с пруда 1 в пруд 4 и перемещение ила с пруда 6 в пруд 3).

Коркут Акюрек. Мы исходили из того, чтобы объемы прудов 3 и 4 должны соответствовать по объему и вмещать илы с прудов 1 и 6. Мы проведем дополнительные расчеты. ОУП дайте нам откорректированные данные и КПН обобщим.

С Водоканалом Балыкчы и ОРП уточнены мероприятия, обновлены сроки и исполнители для Плана действий управления илом прудов КОС Балыкчы.

По Плану действий управления илом прудов КОС Каракол:

Жундубаев К.Ш. Уважаемые коллеги, представители Водоканала, ОРП вами были рассмотрены ПУИ в части управления илом прудов КОС Каракол, какие есть у вас предложения и комментарии?

Завьялова О.И. По итогам первой встречи (20.02.2023 года) мы направляли свои предложения об очистке прудов КОС не силами Водоканала, а Подрядчиком. По Плану действий необходимо очистить пруд 4 и переместить ил в пруд 3, который сильно заилен и заросший, техника может утонуть при производстве работ, необходимо очистить этот пруд. У проекта есть КПН, который должен дать предложения по управлению илом прудов КОС Каракол. У нас назначен новый мэр, может он решит проблему с выделением земель. Надо обязать Подрядчика КОС Каракол об очистке прудов от ила.

Омурканов С.А. Водоканал дайте четкие и конкретные предложения и меры как очистить пруды КОС. Водоканал (Завьялова О.И.) вы когда-нибудь консультировались с КПН по данным вопросам? Было предложено сделать 4-й пруд аварийным, со всеми вытекающими обстоятельствами. Сегодня есть решение местных властей по участку для временного складирования ила с БСР и Ак-Суйское РУВХ ведет конкретные работы по подготовке проекта, получения необходимых документов и другим вопросам. Проблем с илом с прудов КОС Балыкчы решены со стороны Водоканала. А вопрос с участком для складирования или утилизации ила с прудов КОС Каракол до сих пор не решен со стороны Водоканала и РА. Тем более мы на последней встрече отметили о проблеме с инфильтрационной водой, просачивающиеся в пруды, что способствует росту патогенов и Водоканал отлично знает, что район вокруг КОС заболочен. В связи с этим, было предложено, что пруды КОС Каракол не будут очищены от ила. Об этих аспектах мы неоднократно отметили

еще в прошлом году при распределении средств проекта. ОУП что ли должен решить вопрос с участками для складирования или утилизации ила, когда эти вопросы находятся в компетенции местных органов власти и РА.

В рамках проекта были предусмотрены 1,490 млн.долл.США на очистку ила с прудов КОС Каракол и Балыкчы, а также БСР Ак-Суйского РУВХ. Мы же по согласованию с Водоканалами и РА согласованию решили о закупке спец.техники для Водоканалов и РУВХ, в т.ч. насосов для насосной станции из обозначенных средств. А теперь поднимаете вопрос, что необходимо чистить пруды, когда бюджет уже распределен.

Может Водоканал рассмотрит вариант, который мы предложили Водоканалу Балыкчы в начале нашего сегодняшнего обсуждения – Водоканалу выступить суб-подрядчиком, т.к. у Подрядчика есть непредвиденные расходы (необходимо уточнить у Хаятт Групп), которых можно направить на работы по очистке ила, на основании Дополнения к Контракту.

Мы проводим конструктивные работы с Водоканалом Балыкчы и Ак-Суйским РУВХ, когда с Водоканалом Каракол – постоянные недопонимания и проблемы для разрешения практически всех вопросов проекта.

Джанызбеков А.К. КПНу уже третий год поднимаем вопросы по ПУИ, каждый раз КПН вносит разные варианты ПУИ, конкретных предложений с их стороны не вносятся, КПН должен был приехать и неследовать, изучить все вопросы на месте, для этого они, то есть проектировщики выиграли тендер как специалисты. Надо чистить биопруды. Спецтехнику для Водоканала закуплены не для реализации ПУИ, а для Ак-Суйского РУВХ – спецтехника и насосы были закуплены согласно их запросу для очистки БСР собственными силами и средствами и подачи очищенной воды на ирригацию. Каракольское Предприятие «Водоканал» предлагал участок для размещения ила, находящийся на территории КОС. КПН считает, что этот участок маленький для размещения ила из биопрудов. В связи с этим я предлагаю излишки ила с биопрудов КОС г. Каракол разместить на участке складирования ила из БСР, который выделен для Ак-Суйского РУВХ.

Иванова И.Ю. Я поддерживаю ОРП, ведь было же решено, что ил будет вывозиться на выделенный участок, обсуждался как обезопасить от выбросов газа и другие работы, а в Плане указано, что мы не должны чистить ил в биопрудах КОС и КПН не дает конкретных предложений по участкам для складирования или утилизации ила. Ранее Миссией АБР было отмечено, что очистку БСР от ила будет проводить сам РУВХ, а проект закупает спецтехнику, пруды КОС будут очищены за счет проекта. Куда тогда ушли запланированные средства на эти цели?

Жундубаев К.Ш. По итогам оценки проб ил во всех прудах КОС загрязнен патогенными элементами, тем более во все пруды просачивается инфильтрационная вода, что способствует дальнейшему развитию патогенов. Тем более Водоканалом и РА не решены вопросы выделения участков, куда можно было складировать ил с прудов для его стабилизации (обеззараживания) и при необходимости дальнейшей реализации. Участок, который был предложен на территории КОС, он небольшой и будет мешать строительным работам, чтобы утилизировать ил в Караколе отсутствует мусорный полигон, а участок рядом с КОС принадлежит айыл окмоту и подпадает под категорию пастбище, которую необходимо трансформировать. Тем более рядом расположены сельхозкультуры местного населения и ил с патогеном может негативно повлиять на продукции и вызовет негодование местного населения, никакие органы не разрешат складировать ил там.

Давайте придем к разрешению ситуаций. Чтоб не задерживать работы по управлению илом с прудов КОС Балыкчы и Ак-Суйского РУВХ предлагаю в тексте ПУИ (подраздел 5.2.2) отметить, что *«…вопрос об очистке или утилизации ила из прудов КОС Каракол со стороны Подрядчика будут определены после решения местными органами власти вопросов о выделении участков для временного складирования с целью стабилизации (обезвреживания) или утилизации ила (предложенные Водоканалом и РА участки внутри и рядом с территорией КОС неприемлемы с точки зрения безопасности) с соответствующим изменением Плана действий до завершения периода реализации проекта.».*

По Плану действий управления илом БСР Ак-Суйского РУВХ:

Жундубаев К.Ш. ОУП очень тесно работает с РУВХ, они ведут слаженную работу с органами местного самоуправления и райгосадминистрацией, местным Кадастром и проектным учреждением по выделенному участку, правоустанавливающему документу, рабочему проекту, огораживанию территории и другим вопросам. Между НА и РУВХ подписан Договор на использование спец.техники для работ по очистке, транспортировке, складировании ила с БСР.

По итогам обсуждения внесены изменения по мероприятиям и срокам, ответственным за исполнение, а также уточнены калькуляция по годам (ежегодной очистки) Плана действий.

По Планам управления окружающей среды для прудов КОС Балыкчы и Каракол, а также БСР Ак-Суйского РУВХ:

Жундубаев К.Ш. Уважаемые коллеги, ОУП рассмотрев русскую версию представленного ПУИ внес некоторые корректировки по тексту (желтыми для включения и дополнения, синими – для исключения из текста).

КПН необходимо уточнить бюджет на охрану окружающей среды, непонятно откуда были взяты эти данные и предусмотрены ли они у Водоканалов, РУВХ и Подрядчиков, отразить в сомах.

Заслушав участников онлайн заседания/совещания, **принято решение:**

1. Принять к сведению все предложения и комментарии к обновленной русской версии ПУИ, внесенного КПН и проработанного ОУП.
2. ОУП провести доработку русской версии ПУИ с учетом высказанных предложений и комментариев участников и направить в КПН до конца рабочего дня 7 июня 2023 года.
3. КПН обновить и доработать проект ПУИ с учетом направленного ОУП русской версии, привести в соответствие английскую версию с русским и внести вордовскую версии до конца рабочего дня 9 июня 2023 года для дальнейшего направления в АБР.

Подписи:

Омурканов С.А.

Жундубаев К.Ш.

«Issyk-Kul Wastewater Management Project»
Loan № L3742-KGZ/Grant № G0628 KGZ

Minutes of online session/meeting

«_06_» ___06___2023 **№ 148/23** **Bishkek, Project Management Office (PMO)**

Chairman:	-	Omurkanov S.A. – PMO Director
Participants:		
On behalf of the IA:	-	Ivanova I.U. Chief specialist of the Office of Plenipotentiary Representation of the President of the Kyrgyz Republic of the IK region.
On behalf of the ME «Vodocanal» Of the Balykchy	-	Akmatov B.T. – chief engineer-manager of the treatment plant.
On behalf of the «Vodocanal» Of the Karakol	-	Kazakbaev K.M. – Chief of the WWTP;
	-	Zavyalova O.I. – Project Consultant.
On behalf of the Ak-Suu DDWR	-	Shergaziev S.Dzh. – Chief Engineer.
On behalf of the PIU Balykchy	-	Karasartov K.Z. – Manager.
On behalf of the PIU Karakol	-	Dzhanybekov A.K. – Manager.
On behalf of the PMO	-	Zhundubaev K.Sh. – Environmental Specialist;
On behalf of the Design and Supervision Consultant (DSC)	-	Korkut Akurek – Project Coordinator;
	-	Manchenko N. – Translator/Office-Manager.

Agenda of the online session/meeting:

Discussion of the Action Plans for the implementation of the Sladge Management Plan (SMP) and the Environmental Management Plans (EMP) for the biological ponds of the Balykchy and Karakol WWTP, as well as the bioponds (BP) of the Ak-Suu District Department of Water Resources (DDWR), finalized and submitted by the Design and Supervision Consultant (DSC).

(Omurkanov, Zhundubaev, Karasartov, Akmatov, Dzhanybekov, Zavyalova, Ivanova, Shergaziev, Korkut Akyurek)

Brief transcript of the discussions.

Zhundubaev K.Sh. Dear Colleagues, the Draft SMP submitted by the DSC with preliminary review by the PMO was sent for consideration and approval to the PIU, Vodokanals, Ak-Suu DDWR and the IA on May 31, 2023. Let's review and refine the Sludge Management Action Plans (Section 5) and Environmental Management Plans (Section 6) that have been updated by the DSC based on ADB comments. This is the second discussion of SMP with you, the first was on February 20, 2023. I have also sent my preliminary comments on this document to the DSC to Natalia Manchenko's email.

Action Plan for sludge management from the ponds of the Balykchy WWTP:

Omurkanov S.A. We had a meeting at the PMO with the Balykchy WWTP Contractor, where we raised the issue of additional work for cleaning and fencing the ponds. Can Vodokanal perform these works as a sub-contractor? PMO was contacted by a private entrepreneur who has experience and equipment in sludge processing, disinfection, granulation and sale as a fertilizer. This is one of the options.

Akmatov B.T. It is necessary to decide on a working project about fencing or estimates. We have the equipment and the opportunity; we will discuss with the management and make you an offer.

Korkut Akyurek. If Vodokanal needs topographic surveys of bioponds, the DSC will provide them.

Zhundubaev K.Sh. Let's clarify the timing and executors for each activity of the Action Plan. DSC has to devide items 9 and 10 of the Plan (sludge transfer from pond 1 to pond 4 and sludge transfer from pond 6 to pond 3).

Korkut Akyurek. We proceeded from the fact that the volumes of ponds 3 and 4 should correspond in volume and mix sludge from ponds 1 and 6. We will carry out additional calculations. PMO give us the corrected data and the DSC will summarize.

Activities are clarified with Vodokanal Balykchy and the PIU, deadlines and executors for the Action Plan for the sludge management from the ponds of the Balykchy WWTP are updated.

Action Plan for sludge management from the ponds of the Karakol WWTP:

Zhundubaev K.Sh. Dear colleagues, representatives of Vodokanal, PIU, you have reviewed the ISP regarding the sludge management from the ponds of Karakol WWTP, what suggestions and comments do you have?

Zavyalova O.I. Based on the results of the first meeting (02/20/2023), we have sent our proposals for cleaning the WWTP ponds not by Vodokanal, but by the Contractor. According to the Action Plan, it is necessary to clean up Pond 4 and move the sludge to Pond 3, which is heavily silted and overgrown, equipment can drown during the work, it is necessary to clean this pond. The project has a DSC, which should give proposals for the management of sludge from the ponds of the Karakol WWTP. We have a new mayor, maybe he will solve the problem with the allocation of land. It is necessary to oblige the Contractor of WWTP Karakol to clean the ponds from sludge.

Omurkanov S.A. Vodokanal please give clear and specific proposals and measures on how to clean up the WWTP ponds. Vodokanal (O.I. Zavyalova) have you ever consulted with the DSC on these issues? It was proposed to make the 4th pond emergency, with all the ensuing circumstances. Today there is a decision of local authorities on the site for temporary storage of Sludge from the bioponds and the Ak-Suu DDWR is carrying out specific work on preparing the project, obtaining the necessary documents and other issues. The problems with sludge from the ponds of the Balykchy WWTP have been resolved by Vodokanal. And the issue with the site for storage or disposal of sludge from the ponds of the Karakol WWTP has not yet been resolved by Vodokanal and the Implementing Agency. Moreover, at the last meeting we noted the problem with infiltration water seeping into the ponds, which contributes to the growth of pathogens, and Vodokanal is well aware that the area around the WWTP is swampy. In this regard, it was proposed that the ponds of the Karakol WWTP would not be desludged. We mentioned these aspects many times last year when distributing project funds. The PMO should decide on the issue of sites for storage or disposal of sludge, when these issues are within the competence of local authorities and the Implementing Agency.

Within the framework of the project, 1.490 million US dollars were provided for the sludge treatment from the ponds of the Karakol and Balykchy WWTP, as well as the bio ponds of the Ak-Suu DDWR. We, in agreement with Vodokanals and the Implementing Agency, agreed on the purchase of special equipment for Vodokanals and DDWR, including pumps for the pumping station from designated funds. And now you raise the issue that it is necessary to clean the ponds when the budget has already been allocated.

Maybe Vodokanal will consider the option that we proposed to Vodokanal Balykchy at the beginning of our discussion today - Vodokanal to act as a subcontractor, because the Contractor has contingencies (should be clarified with the Hayatt Group) that can be allocated to sludge treatment works, based on the Amendment to the Contract.

We are carrying out constructive works with Vodokanal Balykchy and Ak-Suu DDWR, when there are constant misunderstandings and problems with Vodokanal Karakol to resolve almost all issues of the project.

Dzhanybekov A.K. The DSC has been raising questions on the SMP for almost three years, and every time the DSC introduces different options for the SMP, no specific proposals are made from their side, the DSC was supposed to arrive and investigate, study all the issues at the site, for these purposes they (designers), won the tender as specialists. Bioponds need to be cleaned. Special equipment for Vodokanal was purchased not for the implementation of the SMP, but for the Ak-Suu DDWR - special equipment and pumps were purchased according to their request for cleaning the bio ponds with their own forces and means and supplying treated water for irrigation. The Karakol ME "Vodokanal" offered a site for sludge placement, located on the territory of the WWTP. The DSC considers that this area is too small for bioponds sludge storage. In this regard, I propose to place the excess sludge from the bioponds of the Karakol WWTP on the site for storing sludge from the BSR, which is allocated for the Ak-Suu DDWR.

Ivanova I.Yu. I support the PIU, because it was decided that the sludge would be removed to a designated area, how to protect it from gas emissions and other work was discussed, and the Plan states that we should not clean the sludge in the bioponds of the WWTP and DSC does not give specific proposals on sites for storage or disposal of sludge. Earlier, the ADB Mission noted that the DDWR itself will clean up the bioponds from sludge, and the project will purchase special equipment, the WWTP ponds will be cleaned at the expense of the project. Where did the planned funds for these purposes go then?

Zhundubaev K.Sh. Based on the results of the assessment of samples, the sludge in all ponds of the WWTP is contaminated with pathogenic elements, especially infiltration water seeps into all ponds, which contributes to the further development of pathogens. Moreover, Vodokanal and the Implementing Agency have not resolved the issues of allocating sludge where sludge from ponds could be stored for its stabilization (disinfection) and, if necessary, further sale. The site that was proposed on the territory of the WWTP is small and will interfere with construction works, in order to dispose of sludge there is no landfill in Karakol, and the site next to the WWTP belongs to the aiyl okmotu and falls under the category of pasture that needs to be transformed. Moreover, agricultural crops of the local population are located nearby and sludge with a pathogen can adversely affect products and cause resentment of the local population, no authorities will allow storing sludge there.

Let's resolve situation. In order not to delay the work on sludge management from the ponds of the Balykchy WWTP and the Ak-Suu DDWR, I propose to note in the text of the SMP (subsection 5.2.2) that "... the issue of cleaning or disposal of sludge from the ponds of the Karakol WWTP by the Contractor will be determined after the decision by local self-governments on the allocation of sites for temporary storage for the purpose of stabilization (decontamination) or disposal of sludge (sites proposed by Vodokanal and the IA are unacceptable from the point of view of safety) with a corresponding change in the Action Plan before the end of the project implementation period.

Action Plan for sludge management of the bio ponds of the Ak-Suu DDWR:

Zhundubaev K.Sh. The PMO works very closely with the DDWR, they work well with local self-governments and the district state administration, the local Cadastre and the design agency on the allocated site, title document, working draft, fencing of the territory and other issues. An Agreement was signed between the EA and DDWR for the use of special equipment for cleaning, transportation, and storage of sludge from the bio ponds.

As a result of the discussion, changes were made to the activities and deadlines responsible for execution, as well as the costing by year (annual cleaning) of the Action Plan was clarified.

Environmental Management Plans for the ponds of the Balykchy and Karakol WWTP, as well as the bio ponds of the Ak-Suu DDWR:

Zhundubaev K.Sh. Dear Colleagues, The PMO, having reviewed the Russian version of the submitted SMP, made some corrections to the text (yellow for inclusion and addition, blue for exclusion from the text).

DSC needs to clarify the budget for environmental protection, it is not clear where these data were taken from and whether they are provided for Vodokanals, DDWR and Contractors, reflect in soms.

After hearing the participants of the online session / meeting, **it was decided:**

1. To consider all suggestions and comments on the updated Russian version of the SMP submitted by the DSC and elaborated by the PMO.
2. The PMO has to finalize the Russian version of the SMP, taking into account the proposals and comments of the participants, and send it to the DSC by the end of the working day on June 7, 2023.
3. The DSC has to update and finalize the draft SMP taking into account the Russian version submitted by the PMO, bring the English version into line with the Russian one, and submit the Word version by the end of the working day on June 9, 2023 for further submission to ADB.

Signatures:

Omurkanov S.A. _____

Zhundubaev K.Sh. _____

APPENDIX - 2

Decisions of the Aiyl Kenesh and Okmotu of the Kara-Zhal Aiyl Aimag

КЫРГЫЗ РЕСПУБЛИКАСЫ
ЫСЫК-КӨЛ ОБЛАСТЫ
АК-СУУ РАЙОНУ

КАРА-ЖАЛ АЙЫЛ
АЙМАГЫНЫН
АЙЫЛДЫК КЕНЕШИ

КЫРГЫЗСКАЯ РЕСПУБЛИКА
ЫСЫК-КУЛЬСКАЯ ОБЛАСТЬ
АК-СУЙСКИЙ РАЙОН

АЙЫЛНЫЙ КЕНЕШ
КАРА-ЖАЛЬСКОГО
АЙЫЛНОГО АЙМАКА

Кара-Жал айылдык кеңешинин XXIX чакырылышынын кезектеги 11 - сессиясынын

ТОКТОМУ

15.09.2022 № 16 **Тегизчил айылы**

Жер тилкесин убактылуу бөлүү жөнүндө

Ак-Суу райондук суу чарба башкармалыгынын Азия өнүктүрүү банкынын (АБР) Ысык-Көлдүн саркынды сууларын башкаруу проектисинин (ПУСВИК) бассейнди сезондук тейлөө (БСР) боюнча БСРди тазалоо иштери жүргүзүлө тургандыгына байланыштуу Кара-Жал айыл аймагына тиешелүү кара жолдон төмөнкүрөөк эски свалканын айланасынан 3,0 га жерди убактылуу бөлүп берүү тууралуу берүү кайрылуусун карап чыгып, Кыргыз Республикасынын Жер Кодексинин 25 беренесинин 2-пунктуна, 32-беренесинин 4-пунктуна таянып, Кара-Жал айылдык кеңеши **токтом кылат:**

1. Айыл аймакка караштуу № 342, 343 - контурдагы пайдаланылбаган жерлерден убактылуу 3 (үч) жылга 3,0 га жер тилкеси бөлүнсүн.
2. Бөлүнгөн жер тилкедеги лабораториялык иштерди жүргүзүүдө территорияны курчап экологиялык талаптарды сактоо менен иштерди алып баруу Ак-Суу райондук суу чарба башкармалыгына милдеттендирисин.
3. Бөлүнгөн жер тилкенин тиешелүү иш-кагаздарын даярдап, мыйзам чегинде бүтүрүү, жер тилкенин пайдаланышын көзөмөлдөө айыл өкмөт башчыга милдеттендирилсин.
4. Бул токтомдун аткарылышын көзөмөлдөө айылдык кеңештин жер маселелери боюнча туруктуу комиссиясына жүктөлсүн.

Төрага **Жумашов Р.О.**

КЫРГЫЗ РЕСПУБЛИКАСЫ
ЫСЫК-КӨЛ ОБЛАСТЫ
АК-СУУ РАЙОНУ

КАРА-ЖАЛ АЙЫЛ
АЙМАГЫНЫН
АЙЫЛ ӨКМӨТҮ

КЫРГЫЗСКАЯ РЕСПУБЛИКА
ЫСЫК-КУЛЬСКАЯ ОБЛАСТЬ
АК-СУЙСКИЙ РАЙОН

АЙЫЛ ОКМОТУ
КАРА-ЖАЛЬСКОГО
АЙЫЛНОГО АЙМАКА

ТОКТОМ

20.09.2022 № 103

Тегизчил айылы

Жер тилкесин убактылуу бөлүү жөнүндө

Ак-Суу райондук суу чарба башкармалыгынын Азия өнүктүрүү банкынын (АБР) Ысык-Көлдүн саркынды сууларын башкаруу проектисинин (ПУСВИК) бассейнди сезондук тейлөө (БСР) боюнча БСРди тазалоо иштери жүргүзүлө тургандыгына байланыштуу Кара-Жал айыл аймагына тиешелүү Пристань-Пржевальск автожолунан төмөнкүрөөк эски свалканын айланасынан 3,0 га жерди убактылуу бөлүп берүү тууралуу берүү кайрылуусун карап чыгып, Кыргыз Республикасынын Жер Кодексинин 25 беренесинин 2-пунктуна, 32-беренесинин 4-пунктуна таянып, Кара-Жал айылдык кеңешинин 2022-жылдын 15-сентябырындагы токтомунун негизинде Кара-Жал айыл өкмөтү **токтом кылат:**

1. Айыл аймакка караштуу № 342, 343 - контурдагы пайдаланылбаган жерлерден 3,0 га жер тилкеси убактылуу пайдалануга 3 (үч) жылга бөлүнсүн.
2. Бөлүнгөн жер тилкедеги лабораториялык иштерди жүргүзүүдө территорияны курчап, бардык экологиялык талаптарды сактоо менен иштерди алып баруу Ак-Суу райондук суу чарба башкармалыгына милдеттендирисин.
3. Бөлүнгөн жер тикенин тиешелүү иш-кагаздарынын мыйзам чегинде даярдалышын карап, бүтүрүү боюнча иштерди алып баруу жерге жайгаштыруу боюнча жетектөөчү адис У.Бейшекеевге милдеттендирилсин.
4. Бул токтомдун аткарылышын көзөмөлдөө жагын өзүмө калтырам.

Башчы **Бараканов С.К.**

APPENDIX - 3

Agreement for transfer of special machinery to Aksuu DDWM

ДОГОВОР
ПЕРЕДАЧИ АКТИВОВ

«4» 04 20__ г. г. Бишкек

Департамент Строительства и Инженерной Инфраструктуры при Государственном агентстве архитектуры, строительства и жилищно-коммунального хозяйства при Кабинете Министров Кыргызской Республики, именуемый в дальнейшем «Передающая сторона», в лице заместителя директора Халова Ш.К, действующего на основании Положения с одной стороны и Ак-Суйское районное управление водного хозяйства (далее - РУВХ), именуемое в дальнейшем «Принимающая сторона», в лице начальника Жакупова Т.У., действующего на основании Положения о государственном учреждении «Ак-Суйское районное управление водного хозяйства» № 69 от 13 июля 2022 года, с другой стороны (далее – Стороны), заключили настоящий договор о нижеследующем:

1. ПРЕДМЕТ ДОГОВОРА

1.1. Передающая сторона безвозмездно передает в собственность Принимающей стороны, а Принимающая сторона принимает в свою собственность приобретенные и построенные активы в рамках проекта «Управление сточными водами Иссык-Куля», финансируемого Азиатским Банком Развития по мере их приобретения и завершения строительства.

1.2. Передающая сторона передает Принимающей стороне активы, свободные от любых прав третьих лиц.

1.3. Безвозмездная передача Активов осуществляется в соответствии с Кредитным соглашением (КРЕДИТ № KGZ 3742 (COL)) и Грантовым соглашением (ГРАНТ № KGZ 0628 (SF)) проекта «Управление сточными водами Иссык-Куля», заключенные между Кыргызской Республикой и Азиатским банком развития 28 декабря 2018 года для последующей передачи Ак-Суйскому РУВХ в целях выполнения работ по очистке оросительного пруда от ила и откачки очищенных сточных вод для полива сельскохозяйственных культур со следующими условиями безвозмездной передачи:

- оформление прав на активы в соответствии с законодательством Кыргызской Республики в установленном порядке;
- зачисление в реестр государственной собственности;
- принятие на баланс Ак-Суйского РУВХ;
- надлежащее содержание, своевременное техническое обслуживание и эксплуатация для целей Ак-Суйского РУВХ, обеспечение сохранности активов в надлежащем порядке Принимающей стороной;
- проведение внутреннего аудита ведения учета переданных активов со стороны Департамента Строительства и Инженерной Инфраструктуры при Государственном агентстве архитектуры, строительства и жилищно-коммунального хозяйства при Кабинете Министров Кыргызской Республики.

1.4. Стоимость активов указывается по каждой единице активов в акте приема-передачи, составленным Поставщиком или Подрядчиком, с которым заключен Контракт Передающей стороной.

2. ПРАВА И ОБЯЗАННОСТИ СТОРОН

2.1. Передающая сторона обязана:

2.1.1. организовать составление и предоставление на подписание Принимающей стороны актов приема-передачи активов по мере их поставки и завершения строительства;

2.1.2. организовать предоставление Принимающей стороне документов, которые относятся к активам.

2.2. Принимающая сторона обязуется:

2.2.1. Принять активы в соответствии с актом приема-передачи. Риск случайной потери и/или случайного повреждения актива переходит на Принимающую сторону с момента подписания сторонами и Поставщиком или Подрядчиком акта приема-передачи;

2.2.2. Обеспечить оформление прав на активы в соответствии с законодательством Кыргызской Республики в установленном порядке в срок не позднее 30 (тридцати) рабочих дней со дня подписания акта приема-передачи активов, по мере поставки и завершения строительства.

2.2.3. Принимающая сторона не вправе осуществлять сделки с активами, влекущие переход прав (предусматривающие возможность перехода прав) к иным лицам.

2.2.4. Использовать полученные активы в соответствии с настоящим договором.

3. ПЕРЕХОД ПРАВ НА АКТИВЫ

3.1. Право собственности у Принимающей стороны на принимаемые по настоящему договору активы возникает с момента оформления прав на активы в соответствии с законодательством Кыргызской Республики в установленном порядке.

3.2. До момента оформления прав на активы Принимающая сторона имеет право владения и пользования активами.

4. ПЕРЕДАЧА АКТИВОВ

4.1. Передача Передающей стороной активов, указанных в подпункте 1.1 пункта 1 настоящего договора, и их принятие Принимающей стороной осуществляются на основании акта приемки-передачи, подписанного сторонами и Поставщиком или Подрядчиком.

5. ОТВЕТСТВЕННОСТЬ ПО ДОГОВОРУ

5.1. В случае невыполнения условий безвозмездной передачи активов, указанных в настоящем договоре, стороны несут ответственность в соответствии с законодательством Кыргызской Республики.

6. СРОК ДЕЙСТВИЯ ДОГОВОРА

6.1. Срок действия договора устанавливается с даты подписания сторонами до даты закрытия Проекта «Управление сточными водами Иссык-Куля» и полного выполнения Сторонами взятых на себя обязательств по настоящему договору.

7. ЗАКЛЮЧИТЕЛЬНЫЕ ПОЛОЖЕНИЯ

7.1. Настоящий договор может быть изменен или расторгнут по письменному соглашению Сторон.

7.2. Изменения и дополнения к настоящему договору действительны только в случае, если они совершены в письменной форме, подписаны уполномоченными на то представителями обеих Сторон в установленном порядке.

7.4. Взаимоотношения Сторон, не урегулированные настоящим договором, регулируются законодательством Кыргызской Республики.

7.5. Споры, возникающие при исполнении настоящего договора, разрешаются в соответствии с законодательством Кыргызской Республики.

7.6. Настоящий договор составлен в 2-х экземплярах на официальном языке, имеющих одинаковую юридическую силу, по одному экземпляру для каждой из Сторон.

8. ЮРИДИЧЕСКИЕ АДРЕСА И РЕКВИЗИТЫ СТОРОН

Передающая сторона:

Наименование: Департамент строительства и инженерной инфраструктуры (ДСИИ) при ГААСЖКХ при Кабинете Министров Кыргызской Республики
Почтовый адрес: г. Бишкек ул. Манаса 28
Адрес банка: ОАО «РСК Банк» г. Бишкек
БИК 129001 ИНН 01409202210313 ОКПО 31568177
Тел. (факс)

(должность уполномоченного лица, Ф.И.О., его подпись)
Халов Шамшидин Карыевич, Заместитель директора ДСИИ
М.П.

Принимающая сторона:

Наименование: Ак-Суйское районное управление водного хозяйства
Почтовый адрес: с. Теплоключенка, ул. Кызыр Ажи 40
Название банка: Центральное Казначейство
Адрес банка: Ак-Суйский ТУМФ
ИНН 00807190610039
Тел. (факс) 03948 91-382

(должность уполномоченного лица, Ф.И.О., его подпись)
Жакупов Тимирбек Усенбаевич, Начальник Ак-Суйского РУВХ
М.П.

ASSET TRANSFER AGREEMENT

"4" April, 2023 Bishkek

Department of Construction and Engineering Infrastructure under the State Agency for Architecture, Construction, Housing and Communal Services under the Cabinet of Ministers of the Kyrgyz Republic, hereinafter referred to as the "Transferring Party", represented by Deputy Director Khalov Sh.K., acting on the basis of the Regulation on the one hand and Ak-Suu district division of water management (hereinafter - DDWM), hereinafter referred to as the "Receiving Party", represented by the head Zhakupov T.U., acting on the basis of the Regulations on the state institution "Ak-Suu district division of water management" No. 69 dated July 13, 2022 , collectively referred to as the "Parties," hereby enter into this agreement with the following provisions:

1. SCOPE OF AGREEMENT

1.1. The Transferring Party shall transfer ownership of acquired and constructed assets within the framework of the Issyk-Kul Wastewater Management project, funded by the Asian Development Bank, to the Receiving Party, free of charge. The Receiving Party shall accept these assets into its ownership as they are acquired and construction is completed.

1.2. The Transferring Party transfers assets to the Receiving Party, free from any rights of third parties.

1.3. The gratuitous transfer of Assets is carried out in accordance with the Loan Agreement (LOAN No. KGZ 3742 (COL)) and the Grant Agreement (GRANT No. KGZ 0628 (SF)) of the Issyk-Kul Wastewater Management Project, signed between the Kyrgyz Republic and the Asian Development Bank on December 28, 2018, for the subsequent transfer to the Ak-Suu DDWM to carry out the work on cleaning the irrigation pond from sludge and pumping treated wastewater for agricultural irrigation, under the following terms of gratuitous transfer:

- establishing ownership rights to assets in accordance with the legislation of the Kyrgyz Republic as prescribed by law;
- inclusion in the state property register;
- recognition by Ak-Suu DDWM;
- proper maintenance, timely technical servicing, and operation for the purposes of Ak-Suu DDWM, as well as ensuring the proper preservation of assets by the Receiving Party;
- conducting internal audits of the asset transfer accounting by the Department of Construction and Engineering Infrastructure under the State Agency for Architecture, Construction, Housing, and Communal Services under the Cabinet of Ministers of the Kyrgyz Republic.

1.4. The value of assets is indicated for each individual asset in the acceptance-transfer document, which is prepared by the Supplier or Contractor, as specified in the Contract by the Transferring Party.

2. RIGHTS AND RESPONSIBILITIES OF THE PARTIES

2.1. The Transferring Party is obliged to :

2.1.1. Organize the preparation and submission for signing by the Receiving Party of acceptance-transfer documents for assets as they are delivered and construction is completed.

2.1.2. Organize the presentation of documents related to the assets to the Receiving Party.

2.2. The Receiving Party is obliged to:

2.2.1. Accept the assets in accordance with the acceptance-transfer document. The risk of accidental loss and/or accidental damage of the asset transfers to the Receiving Party upon the signing of the acceptance-transfer document by the Parties and the Supplier or Contractor;

2.2.2. Ensure the formalization of rights to the assets in accordance with the legislation of the Kyrgyz Republic, in the established manner, within a period not exceeding 30 (thirty) working days from the date of signing the acceptance-transfer document for the assets, as they are delivered and construction is completed.

2.2.3. The Receiving Party is not entitled to carry out transactions involving assets that result in the transfer of rights (or provide the possibility of transferring rights) to other parties.

2.2.4. Utilize the acquired assets in accordance with this agreement.

3. TRANSFER OF RIGHTS TO ASSETS

3.1. The ownership right of the Receiving Party to the assets accepted under this agreement arises from the moment of formalizing rights to the assets in accordance with the legislation of the Kyrgyz Republic, in the established manner.

3.2. Until the rights to the assets are formalized, the Receiving Party has the right of possession and use of the assets.

4. TRANSFER OF ASSETS

4.1. The transfer of assets by the Transferring Party, as specified in subparagraph 1.1 of clause 1 of this agreement, and their acceptance by the Receiving Party shall be carried out based on an acceptance-transfer document signed by the Parties and the Supplier or Contractor.

5. LIABILITY UNDER THE AGREEMENT

5.1. In case of non-compliance with the conditions of gratuitous transfer of assets as specified in this agreement, the parties shall be liable in accordance with the legislation of the Kyrgyz Republic.

6. AGREEMENT TERM

6.1. The term of the agreement is established from the date of signing by the parties until the closure of the Issyk-Kul Wastewater Management Project and the complete fulfillment of the obligations assumed by the Parties under this agreement.

7. CONCLUDING PROVISIONS

7.1. This Agreement may be amended or terminated by mutual written consent of the Parties.

7.2. Changes and amendments to this Agreement are valid only if made in writing and signed by authorized representatives of both Parties in accordance with the established procedure.

7.4. Relationships between the Parties not covered by this Agreement are governed by the legislation of the Kyrgyz Republic.

7.5. Disputes arising from the execution of this Agreement shall be resolved in accordance with the legislation of the Kyrgyz Republic.

7.6. This Agreement is drawn up in 2 copies in the official language, both copies having equal legal force, with one copy for each Party.

8. LEGAL ADDRESSES AND PARTIES' DETAILS

Transferring Party:	Receiving Party:
Title: Department of Construction and Engineering Infrastructure (DCEI) under SAACHCS under the Cabinet of Ministers of the Kyrgyz Republic	Title: Ak-Suu District Division of Water Resources
Postal address: Bishkek, 28 Manas str.	Postal address: Teploklyuchenko village, 40 Kydyr Ake str.
Bank address: RSK Bank OJSC, Bishkek	Bank address: Central Treasury
BIK 129001 IN 01409202210313 OKPO 315681777	Bank address: Ak-Suu TUMF
Tel. (Fax)	IN 00807199610039
	Tel. (fax) 03948 91-392
_____signed_____	_____signed_____
(position, authorized person, full name, signature) Khalov Shamshydin Karimovich, DCEI Deputy Director	(position, authorized person, full name, signature) Zhakupov Talapker Usenbaevich, DDWM Head
stamp	stamp

APPENDIX – 4

SITE VISIT PHOTOS

BALYKCHY PONDS

BALYKCHY ALTERNATIVE DISPOSAL AREA

BALYKCHY LANDFILL SITE

KARAKOL PONDS

KARAKOL ALTERNATIVE DISPOSAL AREA

IRRIGATION POND OF BSR OF AKSU DDWR

Alternative Disposal Area for sludge of BSR of Aksu DDWR