TALLINN UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING

CONSTRUCTION OF ENVIRONMENTALLY FRIENDLY AND SUSTAINABLE RAIL BALTICA RAILWAY INFRASTRUCTURE THROUGH RÄÄMA BOG

KESKKONNASÕBRALIKU JA TURVALISE RAIL BALTICA RAUDTEETARISTU RAJAMINE LÄBI RÄÄMA RABA

MASTER THESIS

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11 SUMMARY

This thesis provides an overview of different approaches and alternatives how to cross the Rääma bog and what are the main impacts of the chosen alternatives. Also, whether it is possible to realize technically complex structures in the way that impact to natural environment is minimal and bearable. Therefore, four technical alternatives to cross Rääma bog area were selected and assessed. The assessment determines different indicators that describe and evaluate the effects of technical alternatives on the environment, on the cost of the solution, on the duration of the solution and other less important parameters.

The main goal of this thesis is to provide the assessment and recommendation which technical solution is most feasible to cross Rääma bog. It is assumed that, technically all four alternatives comply with the requirements and conditions set by Rail Baltica project to build railway line across the bog.

Most important criteria are selected and set by author of thesis and focus areas are: Environmental impacts, Cost (CAPEX) and duration of the works and future maintenance cost (OPEX)

Considering the environmental aspect, as a one of the main criteria of the work, it is obvious that the first approach is to avoid the environmentally sensitive or technically complicated areas. It has been already described in the previous parts of theses, that setting the railway corridor is complicated process with limited flexibility. Mainly since many stakeholders are involved with different preferences and therefore to find the most optimal solution for implementation might be difficult. Unfortunately, sometimes most environmentally friendly solution, like to avoid bog area is not possible and outcome is the combination of many compromises.

Data of comparison is presented in Appendix 4, which shows that the bridge alternative 2 and bridge alternative 3 have scored the best result by significant margin over other alternatives (alternative 1 embankment solution and alternative 4 pile-slab solution).

Therefore, it is possible to concluded, that the concrete bridge option either prefabricated concrete bridge or cast-in situ concrete bridge are the most feasible solution in long term.

The main arguments which are supporting this approach are listed below:

Bridge options have the lower environmental impact to the bog, mainly because of the solution of foundations. There are only limited number of piles entering the

bog area and therefore the whole bog area is less disturbed. Also, bridge construction methodology is using pontoons instead of temporary service roads and areas what must build and afterwards removed.

Main advantages in terms of lower environmental impacts:

Rääma bog hydrology balance is less disturbed.

Animal passage is possible under the bridge, less barrier effect, less distribution.

Less impact to the overall Estonian mineral materials (natural resources) stock, as usage of mineral materials is minor.

Cost and duration wise, the Bridge options are not most economical solutions, but considering the full lifespan it will be most feasible solution.

Main advantages in construction process:

Construction process is better controlled (cost could be predicted) no need to wait for settlements.

Temporary arrangements during the construction period are efficient, no need to build temporary embankments for construction.

Maintenance and future cost wise, the bridge options have advantages as in long term operations it is most economical solution.

The main advantages in terms of lower maintenance and future costs:

Reliable and safe solution for entire lifespan with the lower maintenance costs comparing to Alternative 1.

Solution is more resistant to possible future climate changes for instance floods.

Solution maximises the operational availability due to the less maintenance intervals are needed.

Both bridge alternatives (alternative 2 and 3) will provide the best value for the money and are recommended technical solution to cross Rääma bog.

To finalize the assessment there a few important points to underline:

During the assessment of different solutions, it became apparent that every solution has the pros and cons, especially considering the technical complexity, funding availability and time pressure of Rail Baltica project.

One of the outcomes of assessment is that even the solution with highest positive score have also disadvantages to consider and therefore no solution or alternative could be determined as ideal. Therefore, this thesis should provide only the input for next project stages to continue with the development and improvement of technical solutions.

Rail Baltica project is going on with the full speed and construction works of railway line are started in all Baltic states. In Estonia DS1 and DS2 sections are under construction, in DS3 section the design phase is still on going and EIA 7 has not yet been approved by Authorities. Therefore, the results of this thesis could be utilized in further development of the design and in construction process.

To summarize, the best technical solution to cross the Rääma bog is the combination of technically advanced, environmentally sustainable, and for state affordable solution.

From presented four alternatives, the alternative 2 bridge option 1 and alternative 3 bridge option 2 will meet the required parameters and therefore could be considered as best technical solutions to cross Rääma bog.