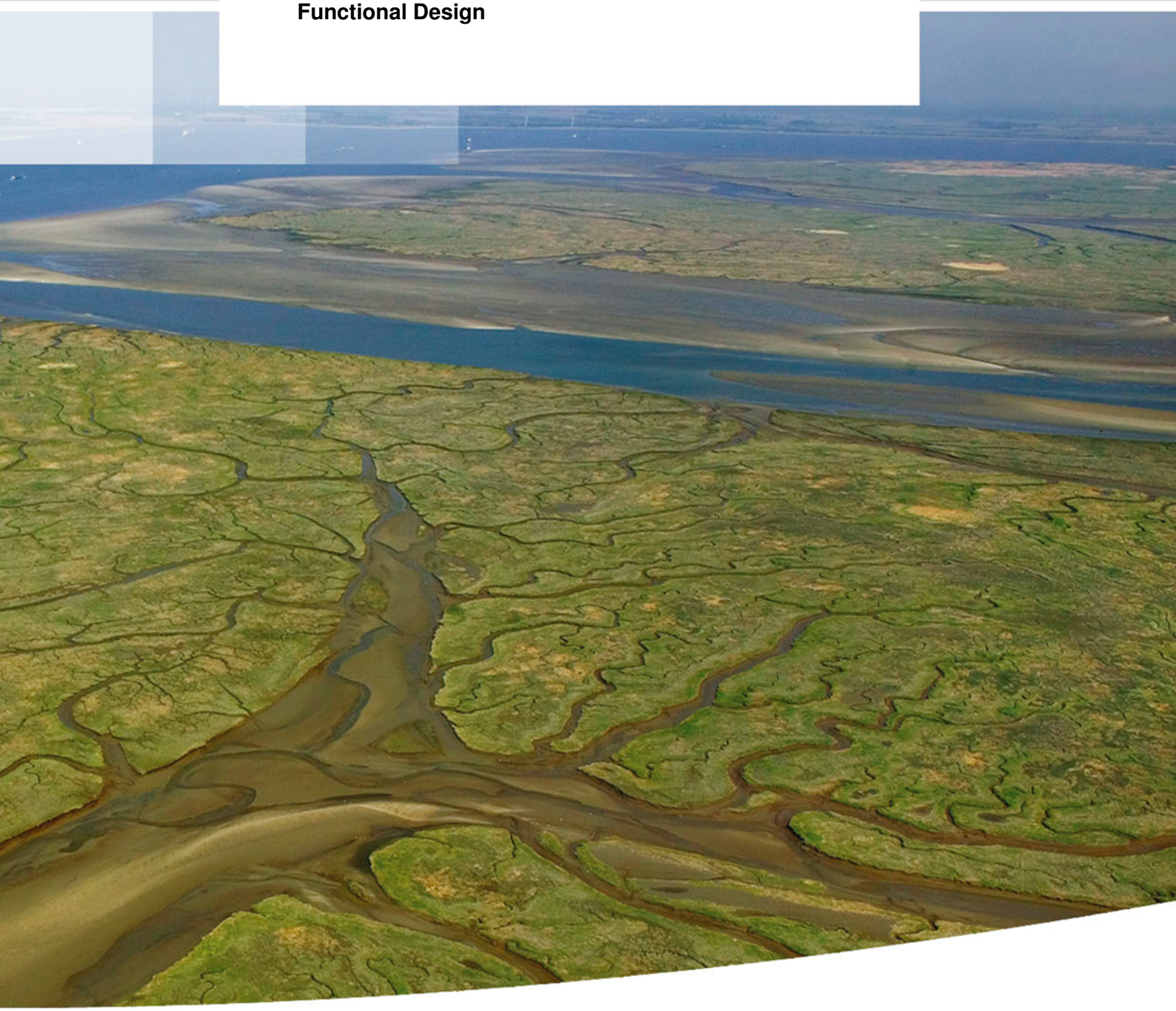
Deltares

Enabling Delta Life

DAM Engine

Functional Design



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Functional Design

1210702-000

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Title
DAM Engine

Client	Project	Reference	Pages
Deltares - Geo engineering DKS	1210702-000	1210702-000-GEO-0003	7

Classification
-

Keywords
Dike, safety assessment, design, software, macro stability, piping

Summary
This document contains the functional design for DAM Engine, a software module that computes the strength of a complete dikering with respect to several failure mechanisms, such as macro stability and piping.

Samenvatting
Dit document bevat het functioneel ontwerp voor DAM Engine, een software module die een gebruiker in staat stelt om voor een dijktraject berekeningen uit te voeren voor verschillende faalmechanismen, waaronder macrostabiliteit en piping.

References
Refer to chapter 4.

Version	Date	Author	Initials	Review	Initials	Approval	Initials
0.1	Jul 2017	Irene van der Zwan		Kin Sun Lam André Grijze		Maya Sule	

Status
draft
This is a draft report, intended for discussion purposes only. No part of this report may be relied upon by either principals or third parties.

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1 Introduction

1.1 Purpose and scope of this document

This document contains the functional design for the DAM Engine, a computational engine for the automated calculation of the strength of dikes. DAM was developed by Deltares with and for STOWA for all water authorities. This document describes requirements and functional design of DAM Engine. What will actually will be implemented depends on the requirements of the clients using this DAM Engine. If some functionality is not (yet) needed, then that part does not need to be implemented.

1.1.1 Future options

As mentioned above this document contains some options that will not be implemented in the first release, but are foreseen to be implemented in the near future. Therefore although sometimes a reference will be made to these options, these will not be described in detail yet.

That applies in particular to the following subjects:

- NWO module("Niet Waterkerende Objecten")
- WBI failure mechanisms (Piping, Macrostability)

1.2 Other system documents

The full documentation on the program comprises the following documents.

Title	Content
DAM Engine- Architecture Overall (The, 2017a)	Description of overall architecture of the DAM Engine and its components.
DAM Engine- Functional Design (this document) (Zwan, 2017)	Description of the requirements and functional design.
DAM Engine- Technical Design (The, 2017b)	Description of the implementation of the technical design of DAM Engine.
DAM Engine- Technical documentation (Doxygen, 2017)	Description of the arguments and usage of different software components, generated from in-line comment with Doxygen.
DAM Engine- Test Plan (Trompille, 2017a)	Description of the different regression and acceptation tests, including target values.
DAM Engine- Test Report (Trompille, 2017b)	Description of the test results (benchmarks and test scripts).
Architecture Guidelines (Kleijn *et al.*, 2017)	Architecture guidelines that are used by DSC-Deltares.

Table 1.1: *DAM Engine system documents.*

1.3 Document revisions

1.4 Document revisions

1.4.1 Revision 0.1

First concept of the document.

2 Non-functional requirements

3 Functional requirements

Main purpose of the DAM Engine The DAM Engine gets data from DAM Clients, combines this data to calculation input and make serially calculations with one ore more kernels and generates output.

3.1 REQ Data.Format

The DAM Engine has a defined format for the data input, so DAM Clients know how to arrange the input data.

3.2 REQ Data.Content

The DAM Engine has a defined content for the data input, so DAM Clients know how to arrange the input data.

3.3 REQ Data.Combination

The DAM Engine combines data per location. Locations are defined with RD-coordinates

3.4 REQ Calc.Type

The DAM Engine provides three types of calculations:

1 One-fold calculation: the input goes 'through' the kernel and generates one main calculation answer (assessment);
2 Goal-seeking calculation: the input contains one variable and a desired outcome, the answer is the variable sufficient for the goal (design);
3 Time-lapsed calculation; calculations are made as time serie (operational).

More specified; the DAM Engine provides the following calculation types, so the DAM Clients can provide this functionality.

- Assessment general
- Assessment regional dikes
- Operational calculation from sensor data
- Design of geometry, given required safety factor: Design-Geometry
- Design of normative NWO-location, given dimensions of NWO and required safety factor: Design-NWO

3.5 REQ Calc.Assess.General

3.6 REQ Calc.Assess.Regional

For the assessment of regional dikes, DAM Engine must calculate several assessment scenarios (RRD-scenario), depending on:

- the type embankment (peat/other); green block in **??** and

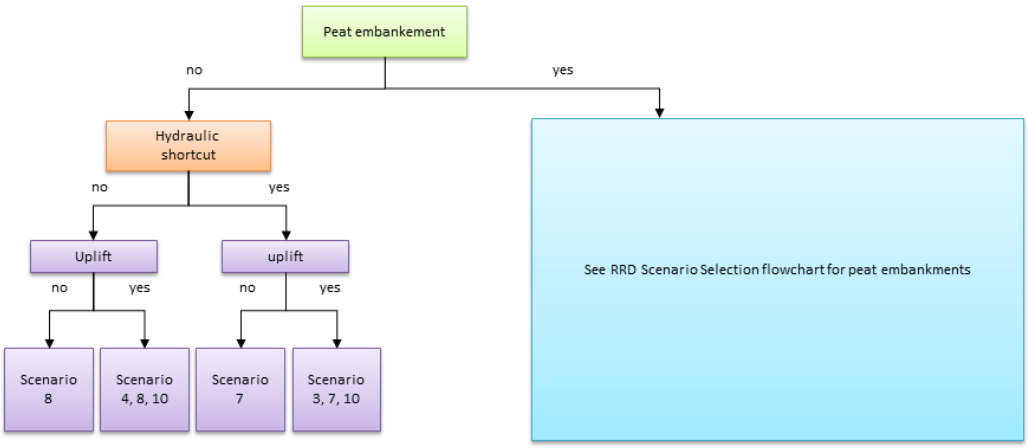

Figure 3.1: *Flowchart of embankements other than peat*

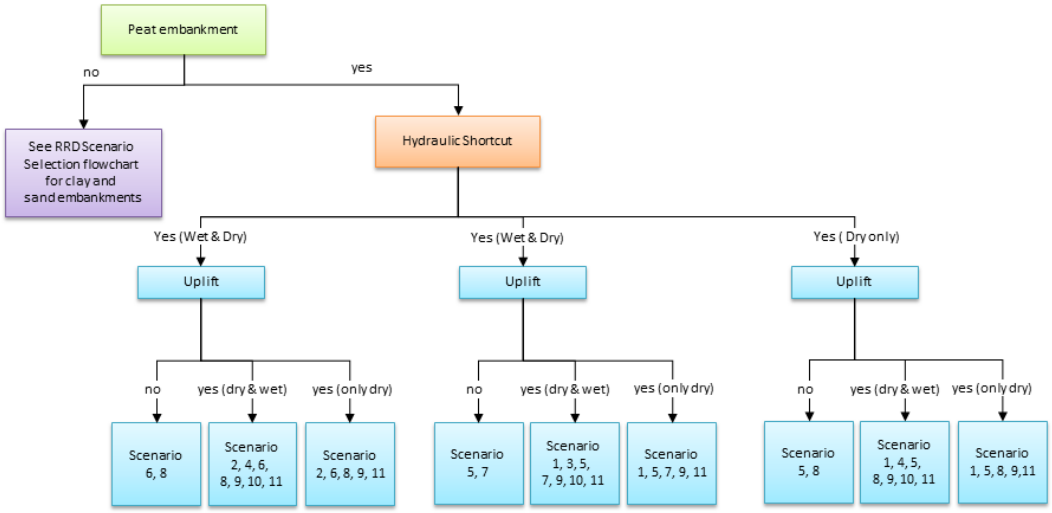

Figure 3.2: *Flowchart of embankements of peat*

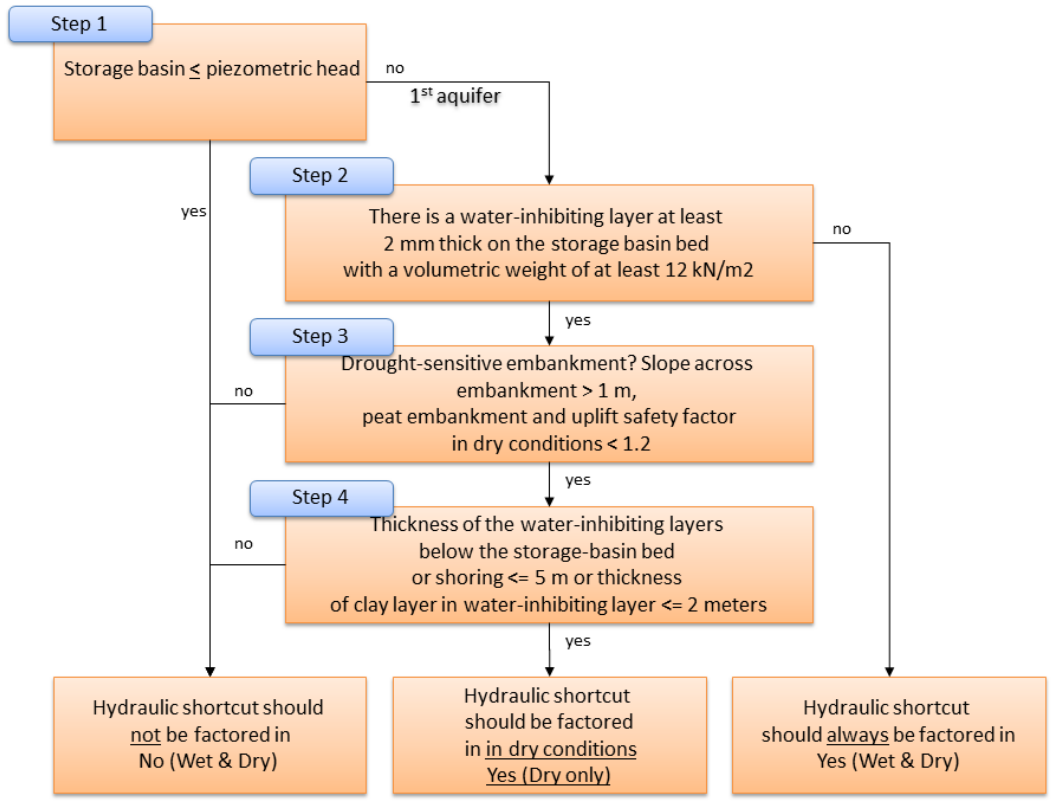

Figure 3.3: *FlowcharHydraulicShortcut*

RRD Scenario	Condition	Hydraulic Shortcut	Uplift	Model
1	Dry	yes	yes	Uplift
2	Dry	no	yes	Uplift
3	Wet	yes	yes	Uplift
4	Wet	no	yes	Bishop
5	Dry	yes	yes	Bishop
6	Dry	no	yes	Bishop
7	Wet	yes	yes	Bishop
8	Wet	no	yes	Bishop
9	Dry	yes/no	yes	Horizontal equilibrium
10	Wet	yes/no	yes	Piping
11	Dry	yes/no	yes	Piping

Table 3.1: *RRD scenarios*

3.7 REQ Calc.Operational.Sensor
3.8 REQ Calc.Design.Geometry
3.9 REQ Calc.Design.NWO

This will not be part of the first implementation of DAM Engine and therefor this paragraph has not yet been written.

3.10 REQ Failuremechanism

The DAM Engine provides calculations for following failure mechanisms, so the DAM Clients can provide this functionality.

1 Macrostability inwards
2 Macrostability outwards
3 Piping

3.11 REQ Output.format

The DAM Engine has a defined format for the data output, so DAM Clients know how to present the output data.

3.12 REQ Data.Content

The DAM Engine has a defined content for the data output, so DAM Clients know how to present the input data.

4 Literature

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