Thematic Course: Interdisciplinary Land Use and Natural Resource Management

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An exploration of the impacts of climate adaptation plans on Green Space Management, Water Management and Participation & Governance: A case study of the Grønnehave Bæk Project

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Chapter 2

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This report is based on two weeks of supervised field work (data collection). The report expresses the analysis and views of the students, which may not necessarily correspond with the views of the persons and institutions who the students have engaged with, or the University of Copenhagen.

Chapter 3
Abstract

In Denmark, it is expected that climate change will lead to unprecedented weather events and significant changes in seasonal weather patterns resulting in increased risk of flooding from the sea and extreme rainfall. In 2010 the Danish government made a national climate adaptation strategy, in which climate adaptation would occur on an ad hoc basis. In 2012 it was made mandatory in Danish planning law for municipalities to make climate adaptation action plans. However, municipalities could still decide autonomously on how to address climate adaption. This study examines: *"What are the impacts of Grønnehave Bæk project on Green Space Management, Water Management and Participation & Governance (through measuring aquatic biodiversity, water quality, inclusivity and recreational value)?"* Semi-structured interviews, in-situ walking interviews, questionnaires, Minisass and water quality sampling, were used to collect data to assess GB as a case study of CAP. The preliminary results of the research project show that water quality parameters are within a safe range for freshwater; aquatic biodiversity has improved and is in a natural state; and that the Nature Based Solutions (NBS) categories of Water Management and Green Space Management have been achieved by the Municipality. Participation & Governance was proven to be part of a tradeoff, making it a moderately achieved challenge. The research group believes that the GB case study can easily be considered a NBS to climate adaptation, as it uses natural green space to manage the effects of climate change (increased and unpredictable rainfall) in the town of Nykøbing Sjælland.

Word Count: 231

Chapter 4
Introduction

4.1: Climate Change in Denmark

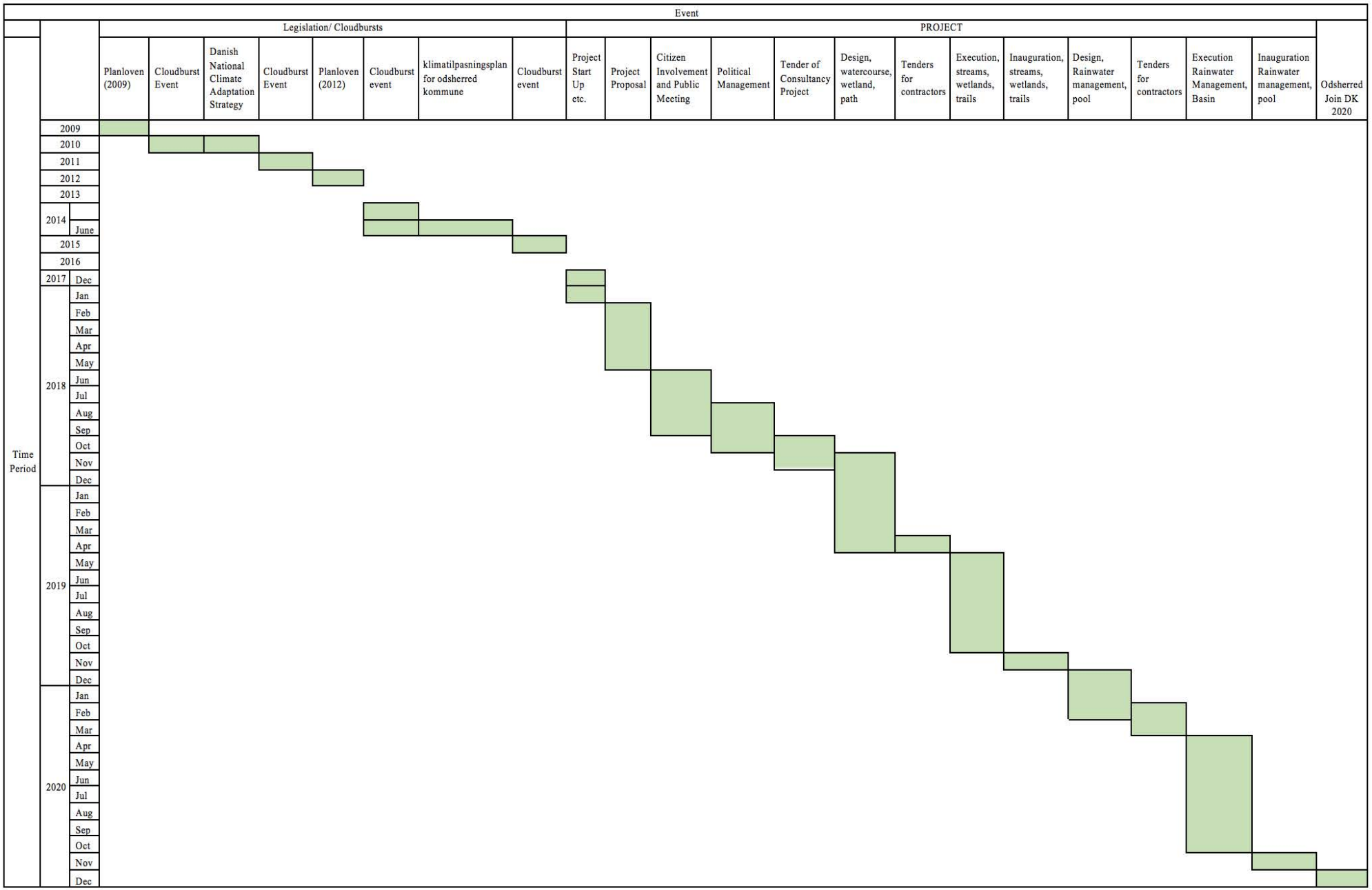
Odsherred and the town of Nykøbing Sjælland are the focus of this report, in relation to the broader context expanded upon in the subsequent sections of the introduction. Odsherred municipality must adapt to increased and more unpredictable rainfall as a consequence of climate change. Odsherreds Climate Adaptation Plan (CAP) involves multiple adaptation projects including the 'Grønnehave Bæk' (GB) project. GB project commenced in 2017 and finished on November 1st 2020.

Climate change is leading to unprecedented weather events and significant changes in seasonal weather patterns. In Denmark winter weather will be wetter with higher general rainfall. In summer there will be heavier unexpected showers and precipitation events (cloudbursts) that induce flash flooding. Flash floods damage many facets of society in Denmark such as agriculture, housing, transport and also pre-existing biodiversity of protected areas (Precipitation and climate change., n.d.).

Copenhagen faced the effects of extreme weather events in 2011, 2014 and 2015, consequently drawing citizens' attention to the impacts of climate change in their lives (Baravikova, A., 2019). Nykøbing Sjælland is considered very vulnerable to flooding from storm surges and cloudburst events because of their low lying terrain in conjunction with their positioning along the coastline (S., 2019, May 6).

4.2: Legislation

Projects such as GB developed due to knowledge of how climate change continues to affect Danish cities and towns and adaptations to historical legislation. The evolution of the GB project in relation to the legislative changes in Denmark and the European Union, can be seen in Figure 1.


Event
Legislation/ Cloudbursts
PROJECT
Time Period
Planloven (2009)
Cloudburst Event
Danish National Climate Adaptation Strategy
Cloudburst Event
Planloven (2012)
Cloudburst event
klimatilpasningsplan for odsherred kommune
Cloudburst event
Project Start Up etc.
Project Proposal
Citizen Involvement and Public Meeting
Political Management
Tender of Consultancy Project
Design, watercourse, wetland, path
Tenders for contractors
Execution, streams, wetlands, trails
Inauguration, streams, wetlands, trails
Design, Rainwater management, pool
Tenders for contractors
Execution Rainwater Management, Basin
Inauguration Rainwater management, pool
Odsherred Join DK 2020
2009
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2011
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In 1991 the initial planning law *Promulgation of the Planning Act 2018 (MTI) 287 (DK)*, was introduced. Municipalities have various options to increase resilience through the planning act (Lund et al., 2012). In the 2000's the planning law required municipalities to make a 12 year municipal plan, which was revised in the fourth year (Lund et al., 2012). This planning law did not specify the content of the plan or the means, which they should use in this plan (Lund et al., 2010). In 2009, a number of themes to be tackled in this planning strategy were made mandatory, but climate adaptation was not mentioned.

In 2010 the Danish government made a national climate adaptation strategy, in which climate adaptation would occur on an ad hoc basis. All actors were required to respond to climate change from their own initiative and in their own time. No extra funds would be given by the state for climate adaptation, giving municipalities complete autonomy over climate adaptation design and planning (Lund et al., 2012).

After 2010, the period within which Lund et al. conducted their research, changes in legislation were made. In 2012 it was made mandatory in the planning law for municipalities to make climate adaptation action plans. However, municipalities could still decide autonomously on how to address climate adaption.

4.3: The Case Area and Case of GB

Grønnehave Bæk,Wetland

Odsherreds Climate Adaptation Plan (CAP) involves multiple adaptation projects including the GB project. The GB project commenced in 2017 and finished on November 1st 2020. It spans over 2 km² area consisting of wetlands and forest adjacent to the city of Nykøbing. Excess runoff from Nykøbing and surrounding agricultural land now runs through Grønnhave wetland and forest via GB, to reduce the flood risk, manage nutrients and water flow before entering Isefjord.

The GB project aims to be a synergy project, tackling several different challenges posed by climate change in the area, which could not have been resolved individually. All of which are included in one holistic approach as laid out in the official projects objectives below;-

1. To develop more climate proof sewer and drainage systems in Nykøbing Sjælland
2. To reduce the quantity of rainwater passing through the Nykøbing treatment plant
3. To reduce the nitrogen content of the agricultural runoff, while simultaneously achieving higher biodiversity in the associated wetland and stream, which are protected by nature conservancy status
4. Beautification of the recreational area by establishing optimised pathways and additional benches.

These goals were found by the research group to be characteristics of Nature Based Solutions (NBS). The European Commission defines a NBS as “Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience”(Raymond et al., 2017). Following this change, Odsherred Municipality created their own Klimatilpasningsplaner og klimalokalplaner, in which GB project aimed at reducing the effects of flash flooding due to climate change.

The guidelines from the Danish Parliament require a participatory approach from Municipalities and broad inclusion of stakeholders (Klimatilpasningsplaner og klimalokalplaner., 2013). The CAP of Odsherred seeks the reduction of the impacts of floods by implementing a “green solution for urban areas”(Odsherred CAP, 2019). That generates benefits in terms of decreasing impacts for the affected population and synergically increasing the recreational natural value of the area, improving the stream's biodiversity too (Odsherred CAP, 2019).

4.4: Recent initiatives

Since the completion of GB, other climate adaptation initiatives have been introduced. Namely the DK 2020, which requires municipalities to produce local climate adaptation plans (CAP) (Klimatilpasningsplaner og klimalokalplaner., 2013). Lund et al. (2012) points out the technical nature of CAPs and calls for more participatory methods of developing CAPs in Denmark. Planloven §33a also serves to push a more participatory, inclusive and engaged means of fostering sustainable development, as well as climate adaptation.

Further research conducted (Lund et al., 2012; Westoby et al., 2021, Washington and Pijanowsky, 2012) suggests there are also significant gaps in designing, planning, implementing and monitoring of climate adaptation plans at international, national and municipal levels. The critique especially concerns the poor integration of top-down directives and bottom-up engagement of citizens at the local level.

4.5: Knowledge Gap

The research conducted in this report is situated in the aforementioned knowledge gap. After highlighting the lack of participatory planning methods, the technical nature of CAPs in Denmark, and the exclusion of issues stemming from climate change such as biodiversity and health industry provisioning (Lund et al., 2012), it was evident to this research group that climate adaptation planning in 2010 was not holistic in its nature.

Lund et al. (2012) calls for new legislation that may act as a form of *meta-governance*[1] through which municipalities are better able to achieve inclusive CAPs. Since then new legislation and voluntary initiatives were put in place, which may act as a form of *meta-governance* (Lund et al., 2012). Hence, this case study of GB and our research explores this gap between the lack of holistic CAPs in Denmark, and new meta-governance or legislation that may affect changes in CAPs. The aforementioned case study is used to explore this knowledge gap through research objectives and questions in the following section.

4.6: The Research Question and Objectives

Based on the above our overall research question is:

"*What are the impacts of Grønnehave Bæk project on Green Space Management, Water Management and Participation & Governance (through measuring aquatic biodiversity, water quality, inclusivity and recreational value)?"*

In order to answer the research question the study will be organized based on the following objectives:

1. Assess a case study of climate adaptation, after changes to land planning law in 2012 to see if new meta-governance has affected the implementation of CAPs after Lunds et al. research in (2010).

[1] Meta-governance as defined in Lund et al. (2012) is a tool to create coordination, coherence and integration in a fragmented governance network, while still allowing autonomy and self regulation of governance networks. Meta-governance enables governments to regulate more traditional governance that would not be able to foster and implement solutions for complex problems such as climate change by themselves, due to fragmented governance of different sectors.

2. We will assess whether the GB Project as a case of CAP is a nature based solution, and if it achieves the synergies listed in the plan of the Municipality.
3. This will be done by using the nature based solutions framework, through the following means; -
    a. Assessing Grønnehave Bæk's project objectives and aims with focus on aquatic biodiversity and water quality.
    b. Assessing the project's influence on short term changes to Green Space Management, Water Management (flood risk) and Participation & Governance (through measuring inclusivity and recreational value).
    c. Understanding the level and type of participation of the GB project.

Chapter 5
Framework and Research

5.1: Research Review

It is evident that climate change and its impacts must be considered from a holistic stance (Lund et al., 2012). Therefore, supporting the belief of this research group that climate adaptation plans should mirror the holistic nature of climate change, and tackle the effects of climate change as complex multi-pronged issues.

Through cross-sector collaboration, extra value can be added to CAPs, to establish common policy frames that shape problem solving methods (Lund et al., 2012). Climate adaptation research in Denmark highlights that municipalities have focused on technical solutions to issues such as water management, which struggle to involve citizens and socio-economic analysis. Although, some policy integration is evident when wetland plans and overflow areas for water management are coupled with nature conservation and recreational areas. This gap inspired the research for a climate adaptation method that is more holistic, in giving those who are most affected, the ability to influence plans that affect them. From this desire, the Nature Based Solution (NBS) Framework was selected as a tool through which to conceptualise, plan and evaluate climate adaptation in a more holistic, inclusive and collaborative manner.

5.2: Nature Based Solutions (NBS) Framework

The NBS Impact Assessment Framework assists countries in implementing climate adaptation projects, supported by ecosystem services approach, ecosystem-based adaptation and sustainable urban infrastructure (Raymond et al., 2017). According to Kabisch (2016) NBS are recognized to perform more than one function at a time and therefore provide several co-benefits and costs on different challenge areas highlighted by the framework. Several adaptation measures can create synergies, while addressing different challenges. However, trade-offs among challenges can not be avoided.

The EWG (EKPLISE Working Group) also recognizes the variability of NBS according to spatial scales (street, urban, national, international), and different challenges related to climate mitigation and

adaptation, as seen in Figure 2. Challenges are analysed on specific indicators, assessing trade-offs and synergies that are expected to arise during the planning and implementation phase.

Figure 2: The 10 challenges of NBS (Raymond et al., 2017)

The principles of co-benefits have recently been included in the climate change adaptation discourse, which is multidisciplinary, as benefits may arise in different realms of society and nature. The promotion of single outcomes can have unintended co-benefits as well (Spencer et al., 2016)

The generation of co-benefits should be emphasized when discussing climate adaptation strategies. Hereby NBS can serve as social added benefits, as they legitimate policy actions in front of public opinion by integrating society and natural science (Rübbelke, 2002). The most important impact is given in terms of mainstreaming climate change policy into the objectives of climate adaptation projects (Spencer et al., 2016).

The case study of the GB project is a NBS, on which Participation & Governance (PG), Green Space Management (GSM), and Water Management (WM) challenges will be assessed for scaling up adaptation.

5.2.1: Water management and Flood risk

WM challenges identified in the case of GB stem from the increasing rainwater combined with the urbanisation of the area and pollution of sewage water, street waters and agricultural runoff. The first aim of the GB is to mitigate the risk of floods and prevent polluted water from flowing into the adjacent fjords. NBS for adaptation to increased flood risk have been referred to as “urban green spaces enhancing blue ecosystem services”(Haase, 2015); hence WM is combined with recreational

use of green-urban infrastructure. Co-benefits are increased biodiversity and creation of natural areas (Haase, 2015). Natural Flood Management (NFM), which improves systemic resilience, instead of providing a solution for one single negative externality, requires high levels of inclusion and diversity of governmental arrangements. Despite being site-specific, NFM allows for the creation of significantly greater co-benefits with respect to hard measures. The requirement is the assessment of trade-offs and synergies at the local level and within the decision-making processes and the broad involvement of stakeholders (Iacob et al., 2014).

5.2.2: Green Space Management

Benefits generated by the implementation of green spaces in urban areas as part of the local plans for adaptation can be summarized as: recreational value, education and increasing public support for conservation of biodiversity. The creation and maintenance of NBS according to conservation principles will increase the richness of species in the long-run (Elands, Wiersum, Buijs, & Vierikko, 2015). Active engagement of the public will synergistically increase participation and ownership of green areas (Frantzeskaki & Kabisch, 2016). Increased trade-offs might occur with lack of participatory management of green areas and with the presence of numerous different stakeholders (Andersson et al., 2014).

5.2.3: Participatory & Governance and grassroot involvement

NBS rely on active engagement of citizenship. Particularly concerning the co-production of knowledge, the inclusivity of different knowledge types, which legitimizes policies and thereby increases people's sense of ownership towards the ecosystem (Frantzeskaki & Kabisch, 2016). Participation in such projects might enhance a sense of belonging to the area, therefore increasing the probability of co-maintenance between the governmental institutions and citizens (Buchel & Frantzeskaki, 2015).

In addition participatory approaches generate co-benefits for conservation of biodiversity. Preserving the naturalistic memory of a green area has been identified as crucial to foster community identity, proving that such spaces also generate community cohesion. The stewardship created

through citizen involvement improves the success rate of adaptive management to the environment, by having co-managers of natural resources in society. However, empirical data, demonstrating the positive and long-term impact on the management of green areas needs more research (Dennis & James, 2016).

Participation has a role in avoiding maladaptation. A deficit in climate adaptation research arises from the assumption of homogeneity among communities, stability and homogeneous risk perceptions of environmental stressors (Westoby et al, 2021). But challenges of climate change are not homogeneous in their impacts. Hence learning from experience is crucial. Locally driven adaptation is key in closing the gap between expert driven CAPs and reducing the probability of unsustainable maladaptive solutions to climate change (Westoby et al., 2021). Nonetheless, climate adaptation remains expert-driven, resulting in inefficiency, increased vulnerability and diminishing overall adaptive capacity. Shifting to bottom-up adaptation would enable the perception of impacts occurring due to present hierarchies, socio-cultural dynamics and inequities, which, if overrun, might reduce resilience. When local people lead the process of adaptation, CAPs have a higher chance to tackle vulnerabilities, with a deeper integration of knowledge and processes into society.

Chapter 6
Methodology

6.1 Social Science

	Disseminated	Responses	Final Sample Size
Questionnaire	100 QR 100 Questionnaires	55	32
Homeowner Interviewer	200	22	4
In-Situ Interview	14	11	11
Stakeholder Interview	9	8	7

Table 1: Descriptive statistics table - social methods

6.1.1: Stakeholder Interviews

Semi-structured interviews were conducted with stakeholders of different powers and interests. This method allowed the collection of in-depth information within four thematic areas: (1) the perception of WM within the project; (2) the degree to which citizens were involved in GSM; (3) efforts undertaken to enable participatory planning and governance; (4) identification of relevant stakeholders, relations and power structures. After identification of a key-stakeholder, snowball sampling was used to identify other organisations and individuals. By following this method, the research group expected to be led to other relevant stakeholders and thus supplementing the previously identified stakeholders based on the project literature. However in some instances it was difficult to estimate the quality of knowledge and importance of a suggested next interview-partner before the conversation.

The semi-structured method ensured approaching the conversation with clearly defined questions while leaving enough flexibility to address each stakeholder in their unique role. Definitions of thematic areas were too broad and did not give appropriate guidance in order to produce the desired knowledge. The majority of contacted stakeholders reacted cooperatively and were interested in participating, answering questions extensively and without restraint. However a minority of stakeholders were hesitant and reluctant in agreeing to an interview-date or declined the invitation. Nonetheless, the interview guide and follow-up questions provided sufficient guidance to unassertive responders, producing useful knowledge for the research.

Snowball sampling was an efficient method for identification. If similar research were to be conducted in the future, it is advisable to hold focus group interviews before initiating individual stakeholder interviews. Through this other insights about stakeholder relations and power structures would have become apparent at a very early stage and in an efficient manner. The collected qualitative data was subsequently transcribed and thematically analysed on information concerning the challenges, identified by the NBS framework: WM, GSM and PG. Results are presented in a table (see Appendix 11.8).

6.1.2: Questionnaire Methods

A sample questionnaire is visible in Appendix 11.5; All questions were made optional to answer and some used a scaling effect to elicit respondents perceptions of their participation (Question 13, 17). Asking question 25 allowed us to identify residents who would be willing to participate in a semi-structured phone interview. A pretest of the questionnaire was conducted asking 5-10 people randomly chosen while using the GB recreationally to give feedback on questionnaire clarity, comprehensiveness and acceptability (Rea & Parker, 2014). Following this the questionnaire was adjusted.

A systematic sampling method was used, individuals living on Saxildsalle, Odsherredbanen and Egebjergvej (flooded areas) who registered their address with www.krak.dk were recorded in the sample population. The population was ordered alphabetically, every 3rd member of the target

population was asked to participate in the questionnaire. If every third resident was unavailable the prior house was approached.

Upon reflection, this systematic sampling method was adapted to opportunistic sampling due to low response levels. Researchers and translators asked every resident in the aforementioned streets to participate, widening the sample population and increasing response numbers. The streets chosen to disseminate the questionnaire were re-evaluated to include streets listed in Appendix 11.13. Widening the dissemination allowed us to investigate GB in relation to Future Flooding areas (FFA), (see Appendix 11.12.7) and Past Flooding Areas (PFAs), (see Appendix 11.12.9). Future flooding areas were defined by the research team based upon flood risk maps from the utility company and Ministry of environment.

With the goal of reaching as many residents as possible, the tool SurveyXact was used. This online programme facilitates questionnaire creation that can be distributed in multiple languages and ways, while allowing the responses collected to be collated and analysed homogeneously.

To maximise the number of responses QR codes leaflets were distributed into mailboxes and to residents. During the fieldwork a door to door approach was used, asking residents if they would complete the questionnaire with us in person, either in Danish or English. A translator was present to translate the questions and participants' responses in Danish. In the analysis phase, the data set was cleaned and statistical tests were performed using excel software, patterns and trends in the questionnaire data were also assessed.

Upon reflection the questionnaire reached the expected benefits of understanding key areas of knowledge as perceived by residents in the area of Nykøbing Sjælland We expected that this method would assist us in seeing how different locations of residents had different experiences and perception of flooding based on their location. This method did achieve these expectations to some degree but this tool was more beneficial in identifying residents to interview regarding PG during the course of the GB project. The questionnaire enabled us to gain insights of residents' engagement, or lack thereof, in the course of the GB CAP initiative.

The use of the tool SurveyXact in the field was challenging: data loss due to survey changes after dissemination, and, due to a desire to maintain a reduced length of questioning, the

understanding of certain topics was undermined. These factors mean that despite some insightful data production, there were also areas where the data produced didn't reach the standard expected. The complexion of larger pre-test of the questionnaire to ensure a more comprehensive nature, and a deeper software knowledge prior to survey dissemination, would have been more efficient.

6.1.3: Residents semi-structured Interviews

Responders of the survey who fulfilled two criteria were contacted for a in-depth semi-structured interviews: (1) they indicated that they had participated in the project by either attending the citizen meeting and/or tried to communicate with the municipality in another format; (2) they were willing to be contacted again for follow-up questions. Six residents were contacted.

The questions were drawn according to Pretty's (1995) typology of participatory learning in sustainable agriculture (see Appendix 11.2), in order to elicit the dimension of participation. Seven distinct categories and estimates of stakeholders participation are described with little long lasting effects (typologies 1-4) or some long lasting effects (typologies 5-7). The aim was to assess residents' engagement and if the requirement to use participatory approaches has been met by Odsherred CAP, at which level.

Extending the research on residents, proved to be a successful choice of method. The in-depth information received complemented the closed-question character of the survey very well. Information was gathered that is estimated as eminent to answer the questions posed by this research.

6.1.4: In-Situ Walking Interview

Walk-along in-situ interviews with users of the GB forest were conducted with the expectation of producing knowledge in three thematic areas: (1) use of the green space; (2) perception of flood risk; (3) inclusion into participatory planning for project development of the green space.

Individuals were identified through an opportunistic approach, people walking in the park were randomly selected. The walk-along interviews allowed a direct experience of citizens' use of the area. The informal surroundings posed a very low threshold for interviewees to engage in the research and people were curious. After identifying the hours of the day when the area is most

frequently visited, data collection proved to be easy and without major challenges. Selected walking routes during the interviews were tracked by using GPS (see Appendix 11.13.1-3). It was concluded that the method complemented the qualitative research and produced a distinct body of data. The qualitative data produced during the walking interviews was transcribed and thematically analyzed on information concerning the NBS challenges: WM, GSM and PG. Results are presented in a table (see Appendix 11.7).

Widely acknowledged weaknesses of the method in the realm of participant observation and interviewing were bypassed. Participant observation was completely neglected in this instance and interview questions were kept very easy to avoid loss of data during walk-along interviews (Kusenbach, 2003).

6.1.5: Stakeholder analysis

To triangulate stakeholder interviews, resident semi-structured interviews and in-situ walks a stakeholder analysis has been conducted based upon Reed's (2009) typology. The aim was to differentiate and investigate relationships between stakeholders and their interests in the project The stakeholders were analytically categorized according to the results of the aforementioned methods. The analysis assessed the presence of a thematic area in the interview transcriptions to create a scoring system based on the amount of times a specific reference to a theme was made (see Appendix 11.8). The assessment of the thematic area was relevant for that stakeholder and could potentially mirror its interests. (Results, section 7.6, Table 14)

Secondly, Eden and Ackermann´s (1998) “influence versus interest” matrix was applied to map out stakeholders' position in the *crowd, subjects, key players or context setters*, gaining in-depth knowledge on the strategy undertaken to implement the project according to each stakeholder involved (Results, section 7.6, Fig. 7).

Finally, stakeholders' positions in the matrix were calculated upon a simplification of Matsaert (2005) actor-linkage matrix, which assesses the flow of information from one stakeholder to the other. This is done in order to ensure that critical links among stakeholders are considered, and give them relevant or irrelevant value. The analysis is conducted to: (1) Present which functions that

have been of the highest interest; (2) understand the level of participation by different stakeholders in the GB project (3) gain knowledge on the relationships among stakeholders in the project implementation.

6.2: Natural Science

6.2.1: GPS Methods

The expected benefits of GPS tools was to pinpoint desired locations of water quality sample, and MiniSass locations with accuracy and map the tracks walked for In-Situ Interviews, routes taken to deliver questionnaires and QR-Codes. Once recorded, the information could be used to provide directions from waypoint A to waypoint B in real time. The GPS required minimal skill and training. It helped with monitoring the amount of time that was spent talking to a person during an interview or the time needed for samples collection.

After collecting the data a map of the area was created to depict the study area. Looking back on the process, using the GPS was simple but couldn't pinpoint locations greater than 3m accuracy. Accurate reading in the forest was hindered by the tree cover, thus making it not as useful as we originally perceived it to be.

6.2.2: Water Quality

Nitrate, phosphorus, pH were selected as the monitoring indicators, as per GB's aims. Electrical conductivity was selected as an indicator later on during the lab analysis. Musselman, R. (2012). *Sampling procedure for lake or stream surface water chemistry* method was selected to measure pH, nitrate and soluble phosphate in the water at Getsøgrøften. The expected benefits of the methods was to avoid sample contamination when field collecting, transporting, and processing surface water samples for laboratory analysis (Musselman, 2012). Using replicates offers three advantages: (1) Replicates can be used to measure variation in the experiment so that statistical tests can be applied to evaluate differences. (2) Averaging across replicates increases the precision of gene expression measurements and allows smaller changes to be detected. (3) Replicates can be compared to locate

outlier results that may occur due to aberrations within the array, the sample, or the experimental procedure (Thompson, 2007).

Upon reflection, a second water sample after a rain event would have been beneficial, as they could have simulated flooding events and provide an opportunity to observe any significant changes in the levels of nitrate, phosphorus, pH, and electrical conductivity before and after flooding.

Water samples collection, Grønnehave Bæk

Additionally, analyzing the lake/stream bed's sediments could've given more insight into the phosphorus present in GB and Getsøgrøften. Due to the stream's shallow profile; it was difficult to submerge the water bottle to collect the sample. The depth of the stream also made it difficult to ensure that there weren't any air bubbles or sediments. Lastly, because of the cold water temperature (2°C) collecting the water samples was uncomfortable because of numbness.

Water Samples collection, Marina

The pH was collected using a Standard pH Meter (PHM210). A conductivity Meter was used to collect the electrical conductivity for each sample. A Flow injection analyzer (FIAstar 5000) was used to determine the amount of nitrates and phosphorus present (this was done by lab assistants and not the research team themselves, see Foss Application Note 5200 for nitrite, & 5240 for phosphate).

6.2.3: MiniSass

In April 2018, a Danish Stream Fauna Index (DSFI) investigation of GB (station nr. 51000652) was conducted by Odsherred municipality. The investigation showed that the stream had a DSFI score of 4, described as slightly degraded biological quality (Appendix 11.9). This score is used as a baseline for pre-project aquatic biological quality. To examine the stream's present state, the MiniSass method (Graham, 2018) was used. The MiniSass is useful for quick investigation of a stream. The assessment is done by collecting macroinvertebrates. After the collection of macroinvertebrates, a dichotomous key is used to identify different species with different scores. An average score is calculated to identify the health of the stream. MiniSass scores can be uploaded to a web page, making it possible to share findings (Graham, 2018).

MiniSass Workshop with Kindergarten.

The collection of macro-invertebrate is fun and easy. After a few attempts, all research groups members were able to identify different species using the dichotomous key. To promote citizen science in CAPs, a kindergarten was invited to participate and try the MiniSass method**.**

MiniSass Workshop with Kindergarten, Grønnehave Bæk

The kids were introduced to the stream and explained what was going to happen simplistically. The dichotomous key was a straightforward way for the kids to differentiate between species, e.g, by counting pairs of legs. It is relevant to try out the method on other levels, e.g., public schools or high schools, and later measure increased awareness about human impacts on biodiversity.

MiniSass also has limitations, some species could not be identified with the dichotomous key, making it difficult to assess positive or negative influence on the total score. Therefore, the convenience of identifying species in the field becomes the method's weakness. In comparison the method DSFI collects all macroinvertebrates and brings them to a laboratory where the identification is performed (Skriver, 2000). By doing so, all species can be identified and included in the total score of the stream.

Chapter 7
Analysis

7.1 Water Quality and Aquatic Biodiversity

The results of water samples and macroinvertebrate investigation will be presented in the subsequent sections. To examine the post-project short term impacts on water quality and aquatic biodiversity an investigation of the constructed lake and stream has been conducted (Appendix 11.12.1). Five water samples and an examination of macroinvertebrates were done to enlighten the present status.

7.1.1: Water Quality Results

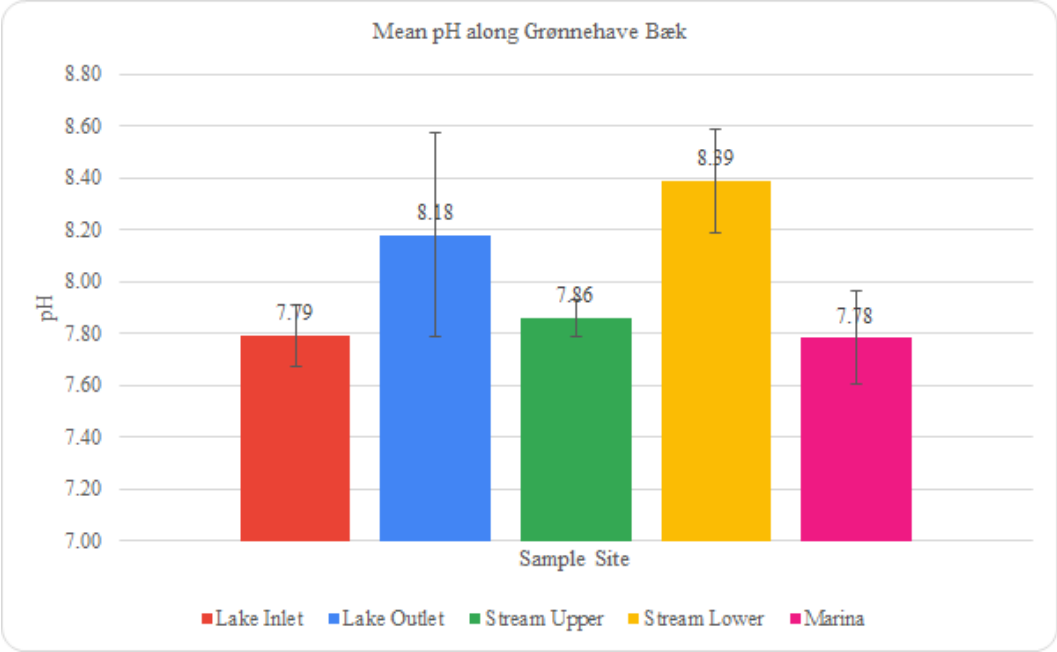

Figure 3: Mean pH (±2SD) of GB stream at five (5) different sites. Lowland freshwater usually has a pH between 6.5 - 8. The data suggest there is no significant variation in pH along Getsøgrøften.

pH is a measure of how acidic/basic water is, ranging from 0 to 14, with 7 being neutral. pH's of less than 7 indicate acidity, whereas greater than 7 indicates a base. (Swenson & Baldwin, 1965). pH was selected as an indicator because, if the pH of water is too high or too low, the aquatic organisms living init will die. pH can also affect the solubility and toxicity of chemicals and heavy metals in the water.

The majority of aquatic creatures prefer a pH range of 6.5-9.0, though some can live in water with pH levels outside of this range (Card, Rose, Kemker, Kelly, & Fitch, 2019).

pH Range	**Effects of aquatic species**
5.0 - 6.0	Unlikely to be harmful to any species unless either the concentration of free C02 is greater than 20 ppm, or the water contains iron salts which are precipitated as ferric hydroxide, the toxicity of which is not known.
6.0 - 6.5	Unlikely to be harmful to aquatic species unless free carbon dioxide is present in excess of 100 ppm.
6.5 - 9.0	Harmless to aquatic species, although the toxicity of other poisons may be affected by changes within this range.

Table 2: Range of pH and there associated effects (Beck, 1976)

Water samples show the stream is within the normal range associated with fresh water. However, the mean pH recorded at the Lake Outlet and Stream Lower sites are greater than the pH range associated with lowland freshwater ecosystems. The shift of pH in either instance may indicate the presence of a pollutant in the stream. Additionally, pH of freshwater depends on several factors like; watershed geomorphology. For example streams in limestone rich watersheds contain high concentrations of bicarbonate ions, resulting in alkaline waters (Kreger, 2004). This might explain alkalinity at the lake outlet and stream lower site, as many of Denmark's waterways are limestone.

Electrical conductivity is a measure of the levels of salts in water and is measured on a scale from 0 to 50,000µS/cm (microsiemens per centimeter). Freshwater is usually between 0 and 1,500µS/cm and typical sea water has a conductivity value of about 50,000µS/cm. Low levels of salts can be found in fresh waterways and are important for the growth of plants and animals. When salt levels in freshwater are high it causes problems for aquatic ecosystems and human uses (Wedlock et al.).

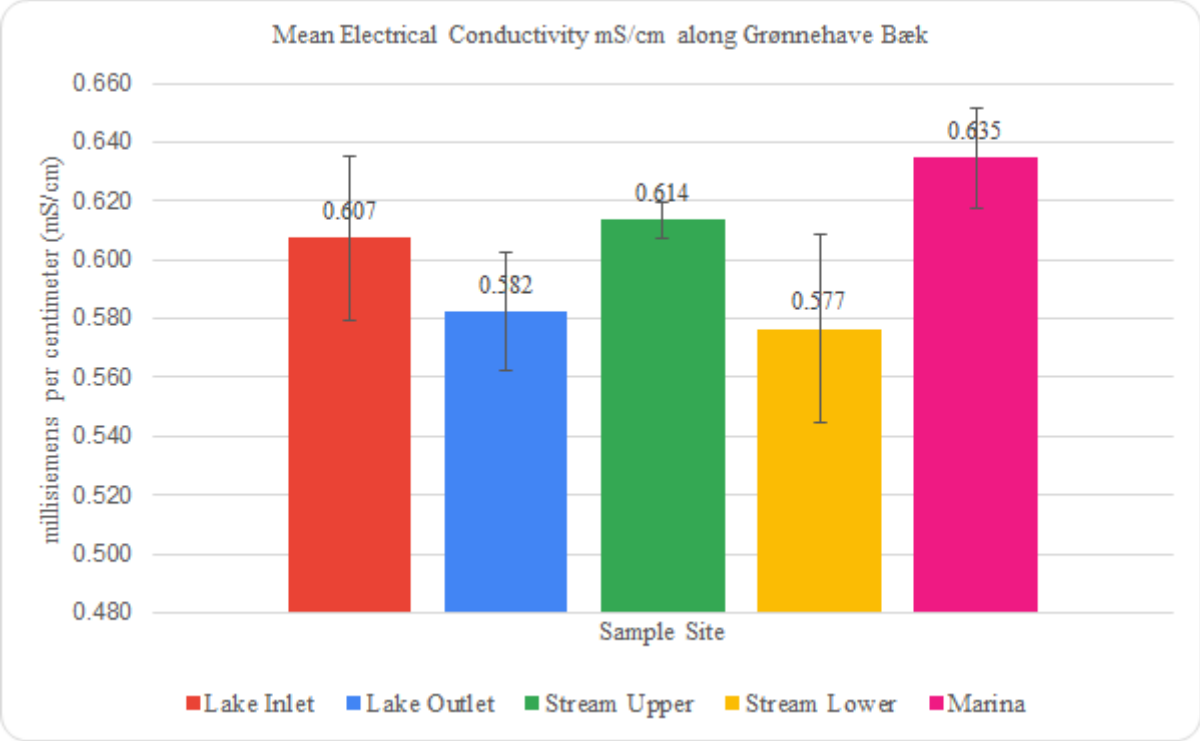

Figure 4: Mean electrical conductivity (±2SD) of GB stream at five (5) different sites. Fresh water usually has a conductivity value between 0 - 1,500µS/cm (1 microsiemens per centimeter = 0.001 millisiemens per centimeter ex. 0.607mS/cm = 607µS/cm). The data suggest there is no significant variation in salt levels along GB.

µS/cm	**Use**
0 - 800	• Good drinking water for humans (provided there is no organic pollution and not too much suspended clay material) • Generally good for irrigation, though above 300µS/cm some care must be, particularly with overhead sprinklers, which may cause leaf scorch on some salt sensitive plants. • Suitable for all livestock

Table 3: Freshwater electrical conductivity and associated uses (Wedlock et al.)

The mean conductivity value for lowland streams is approximately 580µS/cm, and samples taken at the Lake Inlet, Upper Stream, and Marina are greater than the mean. The higher conductivity value in water coming into the lake may be a result of the Odsherred municipality salting the roads during the winter, which might have been transported into the lake along with the road water runoff. The higher conductivity value at the Stream Upper site may be the result of human impact and interference, like pollution (Thompson, n.d.)

Dissolved nutrients like nitrogen and phosphorus are key indicators of water quality in aquatic ecosystems., Nitrogen and phosphorus can have significant effects on plant growth, oxygen concentrations, water clarity, and sedimentation hence, they were selected to be monitored (Register, 2006).

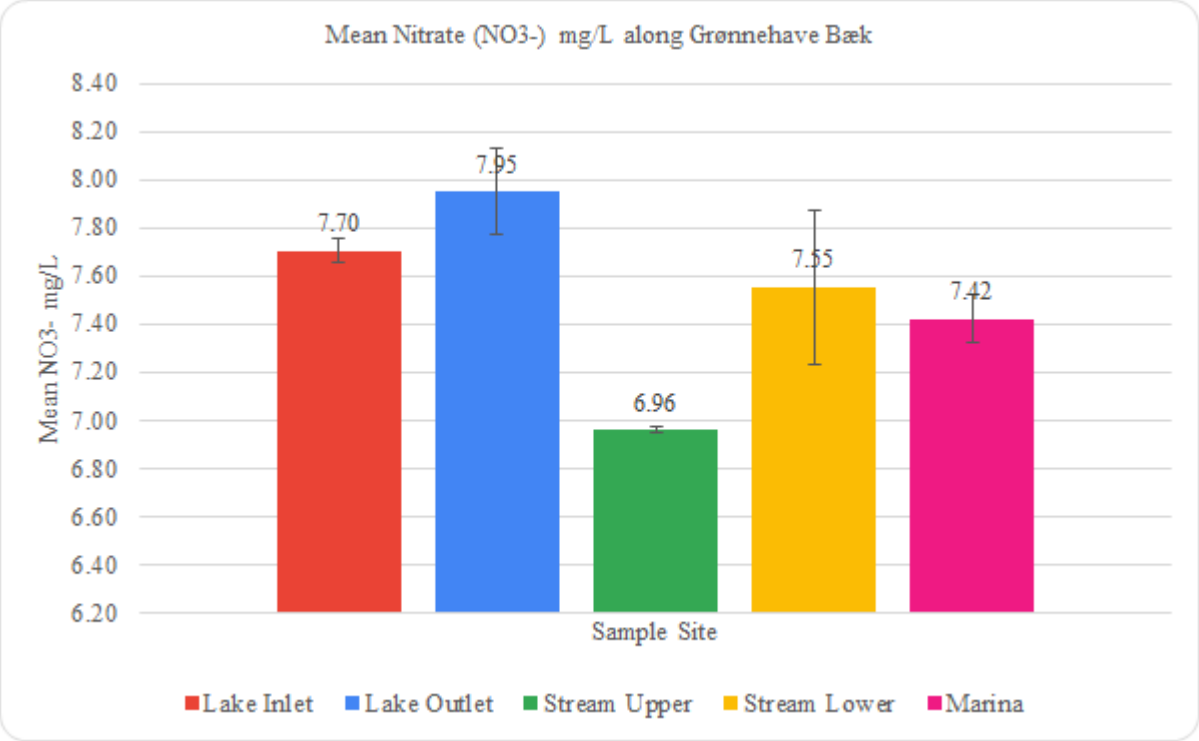

Figure 5: Mean Nitrate (NO3-) mg/L (±2SD) of GB lake/stream at five (5) different sites. In Denmark the limit value for Nitrate in drinking water and in watercourses is 50 mg/L. The data suggest there is no significant variation in Nitrate levels along GB.

Excess nitrogen can harm water bodies	**Excess nitrogen in water can harm people**
Excess nitrogen can cause exponential growth of aquatic plants and algae. Excessive growth of these organisms, in turn, can use up dissolved oxygen as they decompose, and block sunlight to deeper waters. Lake and reservoir eutrophication can occur, which produces unsightly scums of algae on the water surface, can occasionally result in fish kills, and can even "kill" a lake by depriving it of oxygen. The respiration efficiency of fish and aquatic invertebrates can occur, leading to a decrease in animal and plant diversity, and affects our use of the water for fishing, swimming, and boating.	Too much nitrogen, as nitrate, in drinking water can be harmful to young infants or young livestock. Excessive nitrate can result in restriction of oxygen transport in the bloodstream.

Table 4:Effects of Excess Nitrates (Mueller & Helsel, 1996)

According to the water samples collected at GB, nitrate levels are significantly less than the 50 mg/L limit value. This may be a result of the time of year the data was collected, winter, and the lack of agricultural activity (Mueller, Helsel, & Kidd, 1996).

Phosphorus can enter waterways through agricultural runoff, other natural and man-made sources. Phosphorus, like nitrogen, is a critical nutrient required for all life. High concentrations of phosphorus in lakes and streams can cause algal blooms,resulting in eutrophication. Phosphorus is not toxic to people or animals unless it is in high concentrations (Mueller, Helsel, & Kidd, 1996).

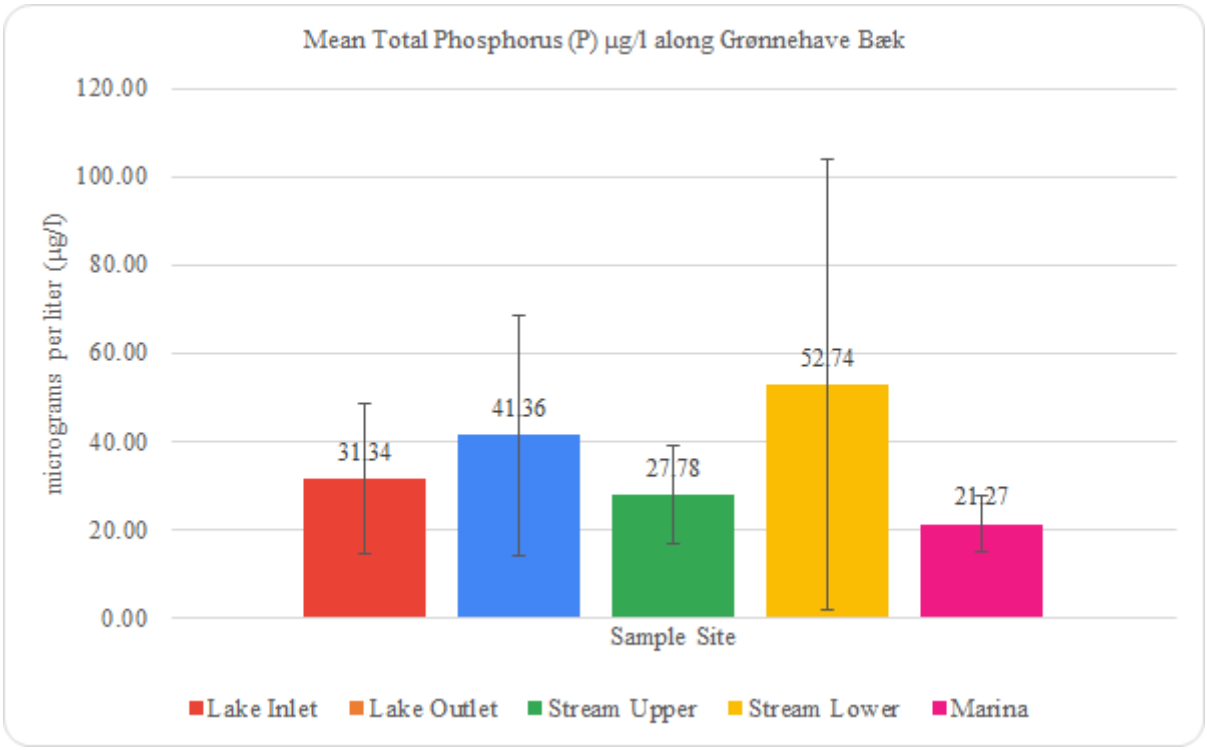

Figure 6: Mean total phosphorus (±2SD) of GB lake/stream at five (5) different sites. The natural levels of phosphate in water usually range from 0.005 to 0.05 mg/L (1 microgram per Liter = 0.001 milligram per Liter ex. 31.34µg/L = 0.03134mg/L). The data suggest there is a significant variation in phosphorus levels along GB.

P Concentration (mg/L)	**Effects**
0.1	Total phosphorus stimulates plant growth to surpass natural eutrophication rates
0.03	Total phosphorus contributes to increased plant growth (eutrophication)

Table 5:Effects of Excess Phosphoru (Register, 2006)

The water samples collected at GB, show that most of the lake/stream are within the usual range of phosphorus levels in water except for the Lake Outlet and Stream Lower sites. The elevated

levels of phosphorus and the significant variations within the sample itself may be the results of iron and soil particles floating within the sample. Phosphorus tends to attach to soil particles and can move into surface water from runoff or erosion of stream/lake bed. It should also be noted that during the lab analysis the iron levels were increased in those two samples that could contribute to high phosphorus levels (Mueller, Helsel, & Kidd, 1996).

7.1.2: Mini Sass results

Map 1: MiniSass and water samples conducted 1-2 march 2021 (Appendix 11.12.1)

To examine aquatic biodiversity in "Getsøgrøften" an investigation of macroinvertebrates has been conducted (Map 1). The Minisass method (Graham, 2018) was applied to examine 5 sites. Mini Sass Site (MS) 1-4 was selected after a walk along the stream. MS 5 was selected to monitor a previous DVFI investigation from 2018 (appendix 11.9) showing a slightly degraded biological state. The Mini Sass results (table 6) show that Getsøgrøften is either of good quality or in a natural state. The present condition at MS 5 is an improvement compared with the DVFI from 2018.

Site name	Score	GPS Lat(s) Long (E)	Notes	Clarity
MS1	6,0 (Good)	55.91660, 11.65993	Sandy Bottom	Clear
MS2	7,5 (Natural)	55.91680, 11.66178	Rocky bottom	Clear

MS3	7,0 (Good)	55.91730, 11.66320	Rocky bottom	Clear
MS4	7,0 (Good)	55.91613, 11.66517	Rocky bottom	Clear
MS5	7,75 (Natural)	55.91473, 11.66572	Rocky bottom	Clear

Table 6: Results from MiniSass 2021

In Spring 2021 “stoneflies” and “cased caddis flies" are observed (Appendix 11.10), both groups have high scores in the MiniSass index, and represent some of the most pollution sensitive groups, (Graham, 2004).

The level of aquatic biodiversity can be a result of an appropriate amount of nutrients (nitrates and phosphorus) directed from the constructed lake into the stream. As well may the pH between 7.86 - 8.39 create good living conditions (table 7). This investigation is only conducted once, to assess long term changes regular monitoring is needed. No measurement of waterflow, temperature or dissolved oxygen was done.

Sample name	**No3- mg/l**	**Phosphorus µg/l**	**pH**
Stream upper	6.96	27.78	7.86
Stream lower	7.55	52.74	8.39

Table 7: average values of nutrients and pH conducted in the stream

7.2 Discussion of Water Quality and Aquatic Biodiversity

One of the project's goals is to hold back nutrients entering the sea at Isefjord by directing agricultural water and rainwater into a newly constructed lake (CAP). The results of water quality samples and aquatic biodiversity are in line with the aim of NBS for management of flood risk, to create co-benefits that increase water quality and biodiversity. The water sampling showed low amounts of nutrients in the water from both the lake and stream, nevertheless, seasonality may affect this. Water Samples were conducted in spring, before periods of adding fertilizers (nutrients) to the surrounding agricultural land. The stakeholder interviews revealed that there are plans to monitor nutrients in the water. This shows that the *key players* of the project are making an active effort to ensure monitoring of water quality, which the ministry of environment have pointed out to be missing in similar projects (Interview, Municipality).

The research group performed a MiniSass assessment of the aquatic biodiversity in the stream to analyse whether the project had a positive impact. The MiniSass tool goes beyond academic use the tool provided interactive learning for the research team, supervisors, and a local Kindergarten that participated in a MiniSass data generation. It allowed researchers and local stakeholders to learn about biodiversity's role in the ecosystem. It also allows volunteers to participate in data generation, making it possible for this method to be used in investigating both short and long term changes in aquatic biodiversity.

Stakeholder interviews showed that there are no common plans to monitor aquatic biodiversity in the stream; the MiniSass tool is an effective method for filling this gap to ensure a long term evaluation of the project, which the NBS framework indicates as crucial. In the MiniSass workshop with the kindergarten, the level of engagement was high in terms of both education and recreation. This is ratified by the kindergarten teacher, who expressed the desire to implement the MinisSass, using the forest to teach about sustainability", thus, showing the high potential of the forest to become a space for education.

7.3 Green Space Management, Water Management (Flood Risk) and Participation & Governance

7.3.1 Green Space Management

Semi-structured interviews, In-Situ walking interviews, in-depth interviews with residents and dissemination of questionnaires were conducted in order to assess the GB projects influence on the NBS challenges of GSM, WM and PG.

Semi-structured interviews show an overall endorsement of the project's implications on all themes of GSM (Table 8). Accessibility to the area is high, as is the perception of a high natural value. Additionally, a slim majority perceived the recreational value to have increased by means of the project. Equally strong is the approval of the green space as a venue of educational and cultural value to residents and visitors.

NBS Challenge	Thematic Area	Incidence
Green Space Management	Accessibility	6
	Perception of high natural value	5
	Increase of recreational value	4
	Educational/cultural value of Green Space	4

Table 8: Thematic analysis of transcribed semi-structured Stakeholder Interviews

The depiction of GSM concluded by Stakeholder Interviews was underscored by results of the In-Situ walking interviews (table 12). All of the interviewees described the area of forest and Bæk as having a high recreational value to them. This was indicated by a close distance to their homes (majority of cases walking distance), a high frequency of usage (majority of cases use the area everyday), and a broad spectrum of the areas recreational utility (athletic use, dog walking, educational purposes).

82% (n = 55) of questionnaire respondents use GB for recreation. Additionally, respondents were asked if they would be interested in using this space for municipality organised activities, with 36% (n = 55) of respondents indicating a desire to participate.

7.3.2 Water Management (Flood Risk)

Questionnaire responses were stratified into two groups of residents : in the past flooded areas (PFA) and areas predicted to be flood-prone in the future (FFA).

Six pairs of variables were used to perform chi-squared tests of independence as shown in table 9. All of these tests were not significant, indicating that there is no association between these pairs of variables. In some cases the assumptions to perform a chi-squared test of independence were not met due to a small sample size and low number of responses. Therefore a Fisher's exact test was performed. Fisher's exact tests were performed on nine other pairs of variables, all of which were not significant at $p < .05$ as seen in Table 8.

Variables	Fischers	Chi -squared	Result
Flooding location // flooding prevention measures	N = 32, P = 0.631	X^2 (1, N = 32) = 0.235, p = .627	Not significant at $p < .05$
Respondent's knowledge of the project // their experience of flooding	N = 32, P = 0.671	X^2 (1, N = 32) = 0.5397, p = .463	Not significant at $p < .05$
Respondent location // flooding experience	N = 32, P = 0.625		Not significant at $p < .05$
location // flooding frequency			Values where too low to perform tests

flooding prevention // knowledge of the project	N = 32, P = 1	X^2 (1, N = 32) = 0.3559, p = .5508	Not significant at p < .05
education level // respondents gave input to the GB project	N = 32, P = 0.0933		Not significant at p < .05
project knowledge // knowledge of GB being protected	N = 32, P = 1	X^2 (1, N = 32) = 0.0299, p = .862	Not significant at p < .05
flooding experience // invitation to participate	N = 32, P = 0.671	X^2 (1, N = 32) = 0.539, p= .463	Not significant at p < .05
using GB area for recreation // knowledge of GB being protected	N = 32, P = 0.395		Not significant at p < .05

Table 9 : Indicating the type of statistical test performed and the result of significance or non-significance on questionnaire data

During semi-structured interviews a minority of interviewees indicated that the project had reduced the risk of flooding. For the majority of stakeholders the project's effects had either not changed the persisting flood risk or otherwise flood risk was never perceived as high. Therefore irrelevant in this instance.

However, five out of seven interviewees perceived the natural value of the Bæk to have increased by means of the project, indicating that these individuals recognize this objective successfully met by the municipality.

NBS Challenge	Thematic Area	Incidence
Water Management	Flood Risk Reduction	3
	Perception of increased natural value of Bæk	5
	Intention to monitor aquatic Biodiversity	0
	Modelling/monitoring of expected improvements of water quality	2

Table 10: Thematic analysis of transcribed semi-structured Stakeholder Interviews

Data produced by In-situ interviews is unambiguous on this topic: Questioned on the regional flooding incidences not one of the interviewees reported being affected within their own house or garden. However two interviewees answered with knowledge of flooding in other areas than their own home (while also not having experienced flooding themselves) (Table 12).

7.3.3 Participation & Governance (PG)

On the NBS challenge of participation the data from semi-structured interviews is thematically categorized into (1) the legitimacy of different knowledge, (2) the openness of the process and (3) the education of citizens on the topics on hand. A slim majority of stakeholders replied that they felt their knowledge was recognized and included in the process. Others felt excluded because the knowledge they possessed was not deemed valid to serve the project. Furthermore, only a minority perceived the municipality's efforts to create an open participatory process was successful. The greater part was either not invited to participate, or their participation was seeked at a negligible level (s. chapter 7.5).

NBS Challenge	Thematic Area	Incidence
Participation	Legitimacy of Knowledge in participatory processes	4
	Openness of participatory processes	3
	Education concerning urban ecosystems and their function/services/vulnerability	5
Governance	Creation of cross-sectoral communication and interaction	1
	Inter-departmental collaboration	2
	Continuous policy learning	1

Table 11: Thematic analysis of transcribed semi-structured Stakeholder Interviews

Lastly a majority of interviewees approved of the municipality's efforts to educate citizens on the local urban ecosystems and its differing functions and services as well as its vulnerability in the face of climate change.

Stakeholder interviews showed only scarcely prevalent recognition of the project's governance processes. The creation of cross-sectoral communication and interaction was only attested by one stakeholder. Two of the interviewees indicated that during the course of the project inter-departmental collaboration was prevalent. Continuous policy learning, a continuum of review and realignment of policies in accordance with stakeholders input, was only perceived by one stakeholder to be prevalent. Overall stakeholders indicated very little approval of the municipalities efforts to create transparent and collaborative governance.

During in-situ walking interviews it was concluded that a majority interviewees had great awareness of their natural surroundings. This notion was based on accounts of changes to the natural area (the new lake, the new bridges over the wetland, construction of new flow of Bæk, new benches). None of interviewees had received an invitation by the municipality to participate in the GB project. Following up with an inquiry as to their wish to participate in the future projects, the majority did not wish to do so. Their willingness to engage, and thereby their ownership of the area, was low. Only 18% (n = 55) of total respondents participating in the meetings gave feedback, with 60% (n = 10) of the invited respondents not experiencing flooding.

NBS Challenge	Thematic Area	Incidence
Green Space Management	Recreational Value	11
Water Management	Affected by Flooding	-
	Knowledge about Flooding elsewhere	2
Participation & Governance	Awareness of natural surrounding	8
	Ownership and willingness to engage	4
	Received invitation from Municipality to participate	-

Table 12: Thematic analysis of transcribed In-Situ walking Interviews

7.4 Discussion of Green Space Management, Water Management (Flood Risk) and Participation & Governance

7.4.1 Green Space Management

It is clear that the CAP has positively achieved GSM. GB and the surrounding areas are used by 82% (n = 55) of questionnaire respondents, the increased value with regards to recreation has satisfied most of the residents of Nykøbing. Although there was incomplete knowledge regarding the GB in terms of the different elements of the project, which explains the low number of respondents indicating a desire to be involved in future development of the forest. Some in-situ interviewees mentioned observed changes in the forest, but were lacking a comprehensive view of the aims of the project. This further supports scattered project knowledge and explains the lack of desire for future involvement. It also mirrors the general lack of holistic approach in the management of urban green spaces for climate adaptation, related to the inclusion or outreach to citizens. For such spaces, citizens often do not feel as if those spaces generate a sense of identity and ownership (Frantzeskaki & Kabisch, 2016). This

effect could be counteracted by responsibly using the space through Municipality led activities (s. chapter 7.3).

For some respondents their age did not make it sensible to engage in managing the area through future involvement. The larger proportion of older residents in this area, as illustrated in the descriptive statistics of our questionnaire in (appendix, Table 11.14) makes this a particularly valid explanation for this lack of engagement.

In line with the top down nature of the project and the restricted nature of power dynamics during implementation, networks of interactions and agreements formed outside of the formalised implementation structure of this CAP were witnessed. For example, an unofficial agreement had been formed between the angler society, which uses the marina for fishing and the forest manager. The anglers volunteer in monitoring the stream for fish and maintenance of stones and branches that might benefit/hinder the stream. Conversely the *key players* of the project have not been present in this agreement or future management of the stream.

7.4.2 Water Management

Understanding if the PFA or FFA citizens that could potentially suffer from floods or have suffered from floods were considered in the development of GB as a CAP was vital to this research. 82% of respondents were from PFAs (n = 50), making it possible to explore the experience and perception of the residents living in this area. Although only 18% (n = 50) of respondents resided in FFAs, comparison of how these two resident-groups perceive flood risk has deficits in informative value because of different sample sizes.

89% (n = 9) of FFA respondents, perceive the risk of flooding to be low (1-2 on a Likert scale), with only 2/9 of these respondents to have experienced flooding due to heavy rainfall. Comparatively, 46% (n = 41) of PFA respondents perceive the risk of flooding to be low, thus showing that across all areas, flood perception is low. The PFA flood perception is particularly unexpected as we would have assumed to see a higher proportion of citizens who perceive risk of floods to be more imminent due to flooding experience.

The low level of risk perception in these areas can be interpreted with recent literature. Perception of flood risk relates to three factors: *awareness, preparedness and worry* (Lechowska, 2018). The low perception of an imminent risk in GB suggests a general lack of those elements. Understanding the risk perception of the most affected can increase the adaptive capacity of the population and prepare/suggest useful behaviors that can increase resilience in society. In disaster risk management it is common that advocacy for public perception of risk to be at the core of adaptation policies, via spreading information, increasing awareness and, consequently, trust in the government (Lechowska, 2018). In order to reduce this gap, participatory planning and governance are key factors to promote successful adaptation. Therefore, residents' low risk perception in the GB case study can be explained by (1) their lack of awareness regarding flooding in their area; (2) their estimation that they are not or will not be particularly affected by this issue; (3) not being informed about the issue (*awareness, preparedness and worry*).

7.4.3. Participation & Governance

Town hall meetings organized by the municipality had a discrete success on recreational aspects e.g. new nature, but lacked an informative section regarding the households being vulnerable to floods. Interviewees and respondents had some understanding regarding recreational elements, but they did not have a holistic insight of reducing the risk of floods.

60% (n = 10) of the invited respondents had not experienced flooding. This appears to be paradoxical, since those are the residents specifically targeted for involvement by the municipality. 70% (n = 10) of those invited to participate perceived low flood risk, which acts as a feedback mechanism to support the reason why so many invited residents did not give any input to the GB project.

When considering elements of knowledge, openness of the participatory process and the creation of spaces for confrontation, missing inclusivity is apparent - especially when aiming to reduce flood risk. The municipality voted for a technical intervention excluding citizens, decreasing the openness of the participation process, the creation of confrontation spaces and sharing of decision-making. Nonetheless, citizens were included in enhancing the recreational value of the forest as

adjustments were made to the project regarding the trails and the area created. Town hall meetings aimed at collecting feedback on the green space area (s. chapter 7.5).

Furthermore results show that although the citizens' utilization of the natural area is high they have not been invited to participate in the project concerning the same area. Citizens such as the Kindergarten teacher, who use GB everyday were not invited to engage in the project's design, being also a non-resident.This illustrates a question of municipal scope, to considered whether non-residents, who are highly invested in this green space, should be given the opportunity to participate.

7.5 Results and Discussion of level and type of Participation

Responder	Level	Reason	Typology of Participation
1	3	had opportunity to say/raise concerns, but did not feel heard	Participation by consultation
2	2	not being asked questions; was only an information meeting	Passive Participation
3	2	not being asked questions; was only an information meeting	Passive Participation
4	2	not being asked questions; was only an information meeting	Passive Participation

Table 13: Level of participation

In-depth interviews with residents produced knowledge on type and level of residents participation in the GB project. Using a participatory ladder, an overall low level of engagement from the proponents of the project towards the affected citizens was evident (*level two* of passive participation, as defined by Pretty Typology (Appendix 11.2). As shown in the table 13, 75% (n = 4) of participants rated their engagement as passive. During citizens' meetings, the relevant stakeholders presented information on the final construction of the project. Residents do not recount being consulted regarding their input.

Only one out of four felt that he could raise concerns regarding the project, but at the same time feeling that his concerns were not subsequently included in further considerations.

Citizens were addressed by administration and experts in a process, which only sporadically consulted citizens input and did not allow any share in decision-making regarding the outcomes of the project. These findings were validated by questionnaire data. 25 % (n = 10) of responders which had been invited to participate rated the degree to which they felt their input was acknowledged at a degree of 1-2, out of a five point scale. On the other hand another 25 % (n = 10) experienced a degree of 4-5. The complementing 50 % (n = 10) of responders that had been invited to participate did not rate the acknowledgement of their input to the project. Nonetheless, the above results show that invited citizens did either not attend the meeting after being invited or refrained from giving input. As from the in-depth interview with the Municipality, a *level three* of engagement, participation by consultation (Pretty, 1995) is evident. The purpose was to include citizens in selected aspects, beside the technical issues.

7.6 Stakeholder Analysis of GB project

The aim of this stakeholder analysis was to analytically categorize the stakeholders in the GB, as a proactive and non conflict situation. The stakeholders have been evaluated in their interest according to the project synergies, on the influence or power according to the type of influence they exert and the source of this influence, based on the analysis of the stakeholder interviews (Appendix 11.8). The results are visible in the table below

	Interest				Influence				
	Synergy Project functions				Instruments of power		Sources of Influence		Organization
	Water management	Green Space Management		Participatory governance	Compensatory	Conditioning	Personality	Property	
		Recreational Value	Bio-diversity						
Municipality	xxx	xx	x	xx	xxx	xx	-	xxx	xxx
Utility company	xxx	-	-	-	-	xx	-	xxx	xxx
Danish Nature Agency	x	x	xx	-	-	xx	-	x	xx
Danish Nature Conservation	x	x	xx		-	-	-		x
Homeowners at Gartnervænget	xx	xx		xx	-	x	x	xx	x
Farmer	xx	x	-	-	-		-		
Kindergarden	-	xx	x	-	-	-	-	-	-
Lynghus Consult	xx	x	xx	x	-	xxx	xx	-	x
Residents of flooded area	x	x	-	x	-	-	-	-	-
Green Space Users	-	xxx	-	-	-	-	-	-	-

x- not significant; xx-somewhat significant; xxx; highly significant

Table 14: Scoring index for evaluation of interest and influence

Based on the results from the table, a stakeholder matrix has been performed as a mid-step to identify the type of flow of information. This is stated to be *regular* when stakeholders mentioned to have worked closely with another stakeholder with regular interactions; *irregular* when the interaction was only characterized by presence at town-hall meetings; *Empty* when it never occurred. The red squares signal the missing interaction between the homeowners and the flooded residents.

		A	B	C	D	E	F	G	H	I	J
		Municipality	Utility company	Danish Nature Agency	Danish Nature Conservation	Homeowners at Gartnervænget	Farmer	Kindergarten	Lynghus Consult	Residents of flooded area	Green Space Users
1	Municipality		Regular	regular	Irregular	Regular			Regular	Irregular	
2	Utility company	Regular				Irregular			Regular		
3	Danish Nature Agency	Regular									
4	Danish Nature Conservation	Irregular									
5	Homeowners at Gartnervænget	Regular	Irregular								
6	Farmer										
7	Kindergarten										
8	Lynghus Consult	Regular	Regular	Irregular	Irregular	Irregular				Irregular	
9	Residents of flooded area	Irregular									
10	Green Space Users										

Table 15: Matrix indicating flow of information between stakeholders

The results of both the tables presented are functional to the creation of the power-interest grid below (figure 7). The Power-Interest grid presents the analytical assessment of the stakeholder interviews through the Reed et al., 2008 typologies.

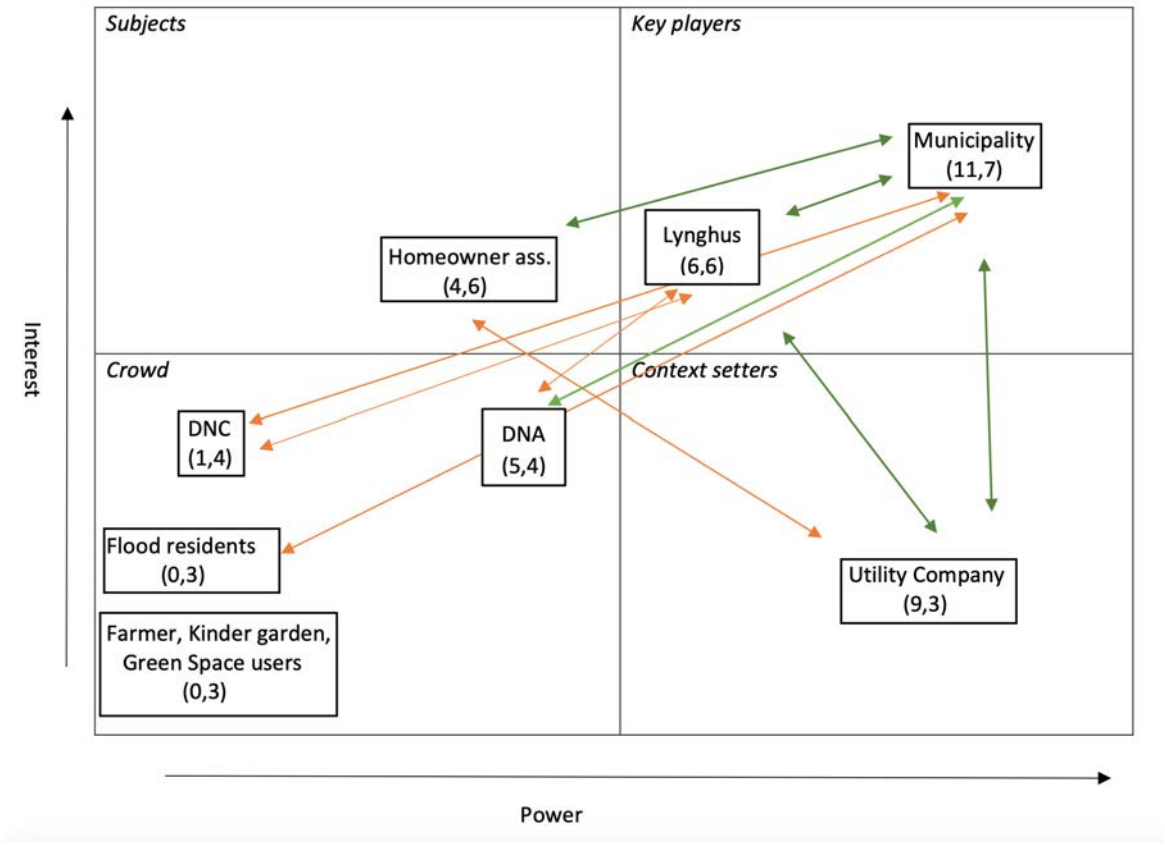

Figure 7: Interest / power matrix of stakeholders. X axis: power. Y axis: Interest. Green arrows: Regular flow of information. Red arrows: Irregular flow of information

The homeowners association is represented as a *subject* to keep satisfied, they have a significant interest and are the most affected by the creation of the project, as well as being the most exposed to the risk of flooding, but have low power to influence. Among the *key players*, the Municipality and a consultancy firm are represented as having significant interest and high power in influencing the outcome of the project. The utility company is placed as a *context-setter* as having substantial power (knowledge, property and organizational power) to influence the outcome of the project, but their interest is not holistic in nature, merely technical. In the *crowd* we find the stakeholders which, in the project have been engaged as having low-interest and low-power: users of the green space, Danish Nature Agency, Danish Nature Conservation, Farmer, kindergarten, residents from the total flooded area.

The results show the presence of a regular linkage of flow of information between the Municipality, the utility company, the homeowners association, Lynghus consult and the Danish

Nature Agency, together with the homeowners association as the subjects of the project in place. The stakeholders among which the links are highlighted in green, share a higher source of power with respect to the others involved in the project, with varying individual interests. As a consequence, the residents of the flooded area are placed in the crowd. The grid shows the high level of top-down strategy for the implementation of the project as the main successful interactions occur among context-setters and key players.

7.7 Discussion of Stakeholder Analysis

Lund et al. (2012) illustrates that in municipalities adaptation remains technical, occasionally couples with recreational purposes: “At best the citizens are informed about initiatives and options on homepages, at public meetings and by means of traditional hearings.” (Lund et al., 2012; p. 623) This finding is directly mirrored in our results, despite Lund et al. 's (2012) hopes that new legislation introduced after their research would act as metagovernance, counteracting this effect.

The stakeholder analysis also confirms a mismatch in the design and planning of the project, emphasis should have been placed on the choice of the *subjects* in the project, as illustrated by the relationships of power and interests among the relevant stakeholders. Again mirrored in Lund et al., (2012) illustrating the lack of bottom-up integration.

Interestingly, the *subjects* showed satisfaction towards the project, as the complaints they raised over trails were heard and successfully taken care of. The chairman of the association stated that residents in this network never experience floods and were not worried about the risk of being flooded, in opposition to municipal maps which indicated this to be both a PFA and FFA. Other residents of the same risk area, that do not belong to the association, were relegated to ‘*the crowd’*, despite being most affected by flood risk, theoretically making them *subjects* for whom the intervention was initially made for (Reed. et al., 2009). As organizations have more power than single individuals, the homeowners association could influence the project outcome as an official network, while the rest of the flooded residents were not engaged. Nonetheless, as both homeowners and

flooded residents share the common interest of decreasing flood risk it is interesting to note that there was no communication between them as pointed out in the matrix.

This lack of communication between stakeholders, can be explained by the generalized low awareness of risks and climate change. As awareness is built through thorough information, we conclude that the key stakeholders could have played a better role in the explanation of risks and vulnerabilities. Due to low engagement and awareness of their own position, residents were considered individuals to monitor, instead of being the main beneficiaries of the project itself to keep informed and engaged.The connection between recreational benefits and climate mitigation was not addressed in public meetings, showing a lack of investigation regarding the main subjects and their perception of the surroundings.

7.8: Trade offs and Synergies

The NBS framework allows for evaluation of the cross-sectoral impacts, such as synergies and trade-offs. This co-benefits approach allowed for gaps to be easily identified and the proposition of perspectives which should be considered in the future. In the GB project there are several examples of synergies and trade-offs.

Our results have shown a general disengagement of the citizenship in flood risk management, due to the required technical knowledge. The utility company did not engage in cross-sectoral discussion, as spaces for allowing this type of interaction were not created. The project was presented in its finalized stage during the town-hall meetings.

This approach fails to meet the requirement of inclusivity of citizens. Westoby et al. (2015) mention that the experience of the most severely impacted should drive the action of experts in implementing adaptation plans, thereby (1) producing long-term solutions, (2) fostering a sense of belonging to the area that is being created, (3) serving the purpose of inclusion and legitimization of those policies. Thereby increasing potential of the number of co-benefits of such plans. Inclusion has suffered in relation to the challenge of flood risk creating a trade-off between Participation & Governance and Water Management challenges.

The recreational value of this green urban space has increased with the presence of several elements, the stream and wetland have been noticed by park users. In fact, questionnaire respondents were predominantly green space users and confirmed that the beautification goal has been met. The municipality has welcomed feedback with regards to the distribution of recreational facilities in the forest.

The management of the green space has created a synergy with regards to the biodiversity increase and water quality. Despite achieving this synergy more work has to be done in CAPs, with regards to openness and knowledge, in terms of addressing the issue of conservation, monitoring and wildlife management, which has the potential to add more value and promote citizens inclusion in green spaces. The investment that needs to be made affects the educational and cultural value of these projects “the best way to protect is to allow for responsible use” (Palle, DNA, 2021). The use of MiniSass with the kids is an example of a synergy between biodiversity and education easily achieved as part of this CAP .

The possibility of achieving synergies and exploring trade-offs is a crucial element that should be addressed in CAPs, at the design and planning phase, in order to tackle the complexity of climate adaptation.This requires thorough assessment of stakeholders and impacts that may occur as a consequence of any intervention.

Chapter 8
Conclusion

8.1 Conclusion on Research Objective

Throughout this research we aimed at exploring the following research objectives; -

1. Assess a case study of climate adaptation, after changes to land planning law in 2012 to see if new meta-governance has affected the implementation of CAPs
2. Assess whether the GB Project as a case of CAP is a nature based solution, and if it achieves the synergies listed in the plan of the Municipality.
3. Assess GB's project objectives and aims
4. Assess the projects influence on short term changes to Water Management, Green Space Management and Participation & Governance
5. Understanding the level and type of participation of GB project, after the changes to the land planning act were implemented in 2012.

It is evident throughout this report that the case study of GB is a case study of a CAP. Moreover, the GB case study can easily be considered a nature based solution to climate adaptation, as it uses natural green space to manage the effects of climate change in the town of Nykøbing Sjælland. The case study of GB was assessed via numerous characteristics, allowing for the evaluation of this case study using the NBS framework.

Firstly, water quality, as the nitrates, phosphorus, pH and electrical conductivity of GB are within safe ranges. Secondly, aquatic biodiversity is in a natural state with high scoring macroinvertebrate groups. Finally, it is evident that , when evaluating the NBS category of Water Management, this case study has achieved the management of flood risk in Nyøobing Sjælland in a technical and efficient fashion by the municipality and other key stakeholders, allowing two co-benefits to flourish ; - water quality maintenance and aquatic biodiversity.

When assessing the category of GSM, the recreational value of GB, the adjacent forest and wetland has been maintained, if not improved. This was partly achieved by the municipality through allowing selective participation of the public and implementing their feedback on how they wanted

this green space to be. However the NBS framework allows us to see that there have also been some potential oversights in this area.

When assessing the category of Participation & Governance it is evident that many of the interviewees and questionnaire respondents were content not to be engaged. Furthermore, the relatively low numbers of questionnaire respondents indicated a desire to be involved in future changes to this area. As was the case for interviewees of in-situ interviews. This stands in relation to Lund et al. 's (2012) suggestion, that there was a participation gap in municipalities implementation of CAPs in Denmark, and their hope that changes to the planning law in 2012 would reduce this gap. It is evident from this CAP project implemented after this legislation change that a participation gap is still present. Admittedly it appears that most of the general public are content with the top-down CAP implementation by municipalities. The absence of an intention to participate is either due to a general inertia to engage or a more profound lack of personal knowledge and information about how these CAPs will directly affect people..

In light of the current means of legislation (DK 2020) that drives action at a local level, this gap in citizens' motivation to be involved can be reduced by educating them about ecosystem services of urban green areas and vulnerabilities arising due to climate change. By the use of these means, citizens would potentially be encouraged in engaging in CAPs and, as the most affected members of the public, would thereby be placed at the centre of climate adaptation projects.

It is evident from using the NBS tool that a trade-off occurred between Water Management (flood risk reduction) and Participation in order to efficiently achieve reduction of flood risk. Although citizens in the town do not seem to object to their lack of involvement in order to achieve this tradeoff. The NBS tool also allowed us to assess the increased biodiversity as a GSM synergy, achieving some of the synergies it aimed for.

Finally, conceptualisation, planning and implementing of climate adaptation solutions needs a more holistic manner, so that multiple aims can be achieved simultaneously. This research has illustrated that using the NBS framework can be made available to municipalities for tackling multiple aims and the complexities of climate change at a local and state level.

8.2 Reflections on Methods

In the fieldwork period, diverse methods were used from various different disciplines. Inverting the construction of this research and report, to a bottom up working process, allowed the group to consider which methods to utilize. Then the research topic, aims and objectives were tailored to our desire to implement questionnaires, in-situ walking interviews, MiniSass assessments, water samples, and NBS for a holistic CAP evaluation. This bottom up approach stretched our knowledge capacity to perform, and evaluate various methods eminently.

This approach created time and space needed to reflect upon our ability to use our methods, experiences and refinement. The subsequent sections will expand upon these topics by asking self-reflective questions; -

1. What were our mistakes in fieldwork ?

For the stakeholder interviews most of our mistakes came down to a lack of proper planning, example: interview questions should've been pre-tested on a focus group to see if the correct questions were being asked and revealed the proper responses. During the analysis process of the interviews it felt as though the data was not precise enough and were lacking in substance. Additionally, we should’ve contacted some of the key stakeholders two weeks earlier, like the Municipality, Forsyning, and some Homeowners, to help improve our ability to organize, and gather more information about who the stakeholders were.

In the cast of the questionnaire most of our mistakes came from a lack of preparation again. Creating, and analyzing the questionnaire on SurveyXact caused us the most trouble during this research project. However, some of the problems could have been avoided with better planning like, creating the questionnaire before fieldwork started, instead of creating and making changes to it in the field. Making changes to the questionnaire during the fieldwork caused us to lose a lot of data and time because we didn’t understand the interface.

Our biggest mistake for the natural science portion of the project was we didn’t make a proper connection between it and social science in the beginning. For example utilization of the GPS, though

it was very easy to use we didn’t really know how to incorporate it into the social science portion and felt like it was left out on its own.

2. How can we evaluate our ability to conduct these methods/tools and what have we learned from them ?

Since no one in the team had used questionnaires as a research tool prior to this fieldwork period, our ability to use questionnaires significantly improved after the project. We learnt a lot from the methods/tools like, pre-testing the questionnaire, and underestimating the importance of utilizing the Danish language to convey meaning and the translators to deliver them out. The totality of constructing an accurate questionnaire to gather the precise data to fill knowledge gaps was indispensable. Interestingly, the research group learnt that due to the pandemic limiting social interactions, there was an increase in disseminating questionnaires causing a positive response rate from the public. However, there is still room for improvement in the construction, utilization and dissemination of questionnaires in future research.

When using interviews a variety of techniques were evaluated. Some of the group had conducted lengthy in-depth interviews before, and therefore chose to focus on new methods of interviewing such as in-situ interviews, while others methods they weren't familiar with. One valuable lesson learnt was disseminating between helpful interviewees (providing concise and relevant information to the project). Making this division between *interesting - but not as useful - interviews* was at times difficult and confusing, particularly when tasks were divided among group members, making individuals dependent on the co-students' recounts. Therefore, extra time is needed for reflection when making this decision and reaching a unanimous conclusion about how to evaluate data meaningfully.

Chapter 10

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Chapter 11

Appendices

11.1 Data Matrix

Overall objective: To assess ecosystem services, implementation and biological quality in order to find co-benefits and negative externalities of the Grønnehave bæk project						
	Raymond et al. Indicator	Research Questions	Sub Question	Data Requirement	Methods	Equipment
Natural Science	Water Management	What is the impact of the project on the stream/water quality?	Has nutrient pollution decreased?	Dissolved Nutrients (nitrate and phosphorus), electrical conductivity, and pH	Water samples (Appendix 5.7)	Pencil, Labels, Cooler, GPS, 250 mL Water Sampling Bottles, Wader, Fieldnotes
	Green Space Management	How is the biological status of the protected stream	Has biodiversity in the stream increased?	Number of macroinvertebrate groups	Mini sass	Handnet, Plastic tray, Waders, Dismochous key, Magnifier, Fieldnotes, Scorecard, GPS, Pencil

Social Science	Water Management	Has the project successfully reduced flood risk?	Have you ever experienced floods? When did you experience the last flood event? Where did you experience flood events? From 1-5: How much do you perceive the risk of more floods happening? (1 being very low; 5 being very high) Did you take precautionary measures to prevent being flooded? Were you aware of the increased risk of flood, due to the increased rainfall?	Questionnaire Answers - ideally 30+	Questionnaire or Survey for residents of areas affected by flooding (Appendix 5.5)	Paper handouts; Ipad; Pencils; phone , chargers, power banks
	Green Space Management	Does the stakeholder have knowledge about the green area?	How many times did you visit the area? What kinds of activities do you carry? How much time do you spend there? How accessible is the area? Have you noticed any changes? Do you know that the stream is protected? Do you use the green spaces around Grønnehave Bæk for recreation? Have you been informed about the natural benefits of this solution?	Transcriptions of in - situ walking interviews + Questionnaire	In situ walking interview (in Gronnehave Baek wetland space) (5.4)	Paper, pen, GPS

			Would you like to take part in activities that promote the use of this natural area for sports, education, etc. ? Would you like to be involved in the process for future improvements of the natural area?			
	Participatory Governance	How much has the population been involved in the development of the project?	Would you like to take part in activities that promote the protection of this natural area? (ownership) Would you like to be involved in the decision-making process for future ameliorations of the current status? Did you hear about the project of Grønnehave Bæk, conducted by the Municipality of Odsherred? Have you been invited to participate in the project?(co-design, openness of the process, transparency) From 1-5: How satisfied were you with the way your input was treated? (1 not satisfied at all, 5 very satisfied)(socio-cultural values)	Transcriptions of in - depth interviews + Questionnaire	Semi-structured interviews (Appendix 5.3)	paper , pen

11.2 Pretty (1995) Participatory Methods Typology

Typology	Characteristics of each type
1. Manipulative participation	Participation is simply a pretence, with "people's" representatives on official boards but who are unelected and have no power.
2. Passive participation	People participate by being told what has been decided or has already happened. It involves unilateral announcements by an administration or project management without any listening to people's responses. The information being shared belongs only to external professionals.
3. Participation by consultation	People participate by being consulted or by answering questions. External agents define problems and information gathering processes, and so control analysis. Such a consultative process does not concede any share in decision making, and professionals are under no obligation to take on board people's views.
4. Participation for material incentives	People participate by contributing resources, for example, labor, in return for food, cash or other material incentives. Farmers may provide the fields and labor, but are involved in neither experimentation nor the process of learning. It is very common to see this called participation, yet people have no stake in prolonging technologies or practices when the incentives end.
5. Functional participation	Participation seen by external agencies as a means to achieve project goals, especially reduced costs. People may participate by forming groups to meet predetermined objectives related to the project. Such involvement may be interactive and involve shared decision making, but tends to arise only after major decisions have already been made by external agents. At worst, local people may still only be coopted to serve external goals.
6. Interactive participation	People participate in joint analysis, development of action plans and formation or strengthening of local institutions. Participation is seen as a right, not just the means to achieve project goals. The process involves interdisciplinary methodologies that seek multiple perspectives and make use of systemic and structured learning processes. As groups take control over local decisions and determine how available resources are used, so they have a stake in maintaining structures or practices.
7. Self-mobilization	People participate by taking initiatives independently of external institutions to change systems. They develop contacts with external institutions for resources and technical advice they need, but retain control over how resources are used. Self-mobilization can spread if governments and NGOs provide an enabling framework of support. Such self-initiated mobilization may or may not challenge existing distributions of wealth and power.

Source: adapted from Pretty (1994), Satterthwaite (1995), Adnan, Alam and Brustnow (1992), and Hart (1992).

11.3 In-Situ Interview Guide

Area: Grønnehave Bæk paths and areas for recreational purposes (exact points will have to be defined on site).

Target Group: Residents and Citizens from nearby towns who are using Grønnehave Bæk for recreational purposes on a regular basis. Two approaches to responders are identified:

1. *Opportunistic* – Approaching people available in park while we are on site.
2. *Voluntary* – Meeting people in the park for an interview after they have voluntarily identified themselves to us in the questionnaire and agreed to meet.

Practicalities

1. Introducing ourselves
- inform the interviewees that this will be a semi structured interview, while walking around Grønnehave Bæk and will cover the following themes of green space management, water management and perceptions of flood risk
2. Presenting the topic we are investigating
3. Informed consent
4. Inquiry on place of residence (at least name of municipality, if possible name of street)

Thematic Areas and Questions

1. Green Space Management

- How much do you know about this ecosystem?
- How many times did you visit the area?
- What kinds of activities do you carry?
- How much time do you spend here?
- How accessible is the area? KM/travel time
- Were you aware of the process around changes to the wetlands? Show them the area
- Have you heard of them?
- Did you notice any changes within the area?

2. Water management

- Do you live in the adjacent area of Saxildsalle, Odsherredbanen and Egebbjergvej, IF YES go on with the Water Management
- Have you experienced flooding in your street/house/garden?
- Do you perceive the flood risk differently today than in the past?
- Were you facing costs related to flooding?
- Have you heard of the Grønnehave Bæk project and its aims concerning flood control?

3. Participatory Planning and Governance

- Have you been informed about ecosystem services/ climate change risks for the area in which you live?
- Have you ever heard about the meetings with the municipality for this project? (co-design, openness of the process, transparency)
- Have you ever participated?
- Did you have different aspirations/expectations about the project? (socio-cultural values)
- Would you like to take part in activities that promote the protection of this natural area? (ownership)
- Would you like to be involved in the decision-making process for future ameliorations of the current status? (ownership)

Debriefing

Thank you for participating in this research, we really appreciate the time you have taken to engage with us. You have the right to withdraw your interview from this research if you wish in the next 2 weeks. If you have any further questions regarding the questions then, feel free to ask any of the team members.

11.4 Semi-Structured Stakeholder Interview Guide

Area: Grønnehave Bæk project and town of Nykobing Sjaelland

Target Group: Stakeholders identified in stakeholder analysis. Two approaches to sampling

1. *Systematic* - Conducted a stakeholder analysis and contacted each stakeholder organisation to ask if they are will to participate in interview
2. *Snowballing* - Stakeholders are asked to identify other key stakeholders during at the end of their interview, and contacts person for those stakeholders where possible

Practicalities

1. Introducing ourselves
    - inform the interviewees that this will be a semi structured interview regarding Grønnehave Bæk project and will cover the following themes of green space management, water management, perceptions of flood risk and future project plans.
2. Informed consent
3. Inquiry on place of residence (at least name of municipality, if possible name of street)

Thematic Areas and Questions

Demographic

1. **Tell** us about yourself and your role/ involvement with The project 'Grønnehave Bæk'?

Water Management

1. The project has a number of objectives (Reduction of agricultural-based nutrient pollution of Nykøbing Bay and the Isefjord and Reduced floods due to heavy rainfall and cloudbursts in the Saxildsallé district etc.) Can you briefly explain how the CAP achieves its objectives?
2. Besides Water retention, are there any other activities that the stream will be used for ?
3. Has there been any major challenges in implementing the project, if yes what were they?
4. Do you know of an impact of the project on the stream water quality and biodiversity?
5. Are there any plans for monitoring the biological quality of the stream?

Green Space Management

1. Was citizens input used in the project proposal?
2. Were you informed/did you inform members of the public about the green aspects of this solution?
3. Were you informed or did you inform members of the public about understanding the ecosystem services this measure could bring about?
4. Was the public aware/did you make the public aware of the environmental value this measure

could promote?
5. Are there any programs in place, for which the public could become involved in maintaining this green area?

Participatory planning and Governance

1. Were citizens invited to pre-project meetings?
2. Were citizens considered primary stakeholders since the beginning?
3. How was citizens' input implemented?
4. Did any citizens contact you about negatives/positive results after the project was presented?
5. Do you know of any ways the project was promoted prior to its formulation and implementation ?

Stakeholder Interest

1. Who are the relevant stakeholders in this project, and in what ways is this project understood/ perceived by the different stakeholders as a tool to manage future or contemporary threats of climate change?
2. Are there any conflicts between the stakeholders or complaints?
3. How has the Odsherred Municipality facilitated communication and participation between itself and the relevant stakeholders?
4. How was citizens' input implemented?
5. Is there any future for the project, or anything you wish to achieve with the project that you weren't able to achieve in the beginning?

Future Project Plans

1. Do you know of any future plans regarding the project such as the new housing initiative ?
2. Regarding the new housing initiative at what point in the project timeline is this initiative ?
3. How is this new project being implemented?
4. What is the process of planning and implementing?
5. How does the new housing affect the green space that has been created?

Final question: Can you identify any other stakeholders in this project we should contact, and if so do you have contact details for them ?

Debriefing

Thank you for participating in this research, we really appreciate the time you have taken to engage with us. You have the right to withdraw your interview from this research if you wish in the next 2 weeks. If you have any further questions regarding the questions then, feel free to ask any of the team members.

11.5 Questionnaire

En gruppe af studerende fra Københavns Universitet laver en undersøgelse om Grønnehave Bæk klimatilpasningsprojekt i forbindelse med et kursus. Målet med kurset er at opnå og anvende empirisk data gennem indsamling og analyse.

Grønnehave Bæk projektet er et klimatilpasningsprojekt der er blevet implementeret af Odsherred Kommune for at forhindre oversvømmelse i områderne omkring Saxildsalle som følge af mere intense og øgede nedbørsmængder, ved at reducere mængden af vand der skal igennem rensningsanlægget. Derudover er en del af formålet med projektet også at øge naturværdien i kommunen ved at skabe et grønt bymiljø på baggrund af det nye vådområde der opstår, når vandløbene omkring bliver ændrede.

Formålet med dette spørgeskema er at inkludere beboere der har oplevet oversvømmelser i løbet af de seneste par år.
Din deltagelse i denne undersøgelse vil være en stor hjælp til at forstå klimatilpasningsprojekter og deres betydning i Danmark bedre.

Dine svar vil blive behandlet fortroligt og anonymt. **Generel personlig information**

1. Kønsidentitet

- ☐ Mand
- ☐ Kvinde
- ☐ Andet: _____

2. Etnicitet

- ☐ Dansk
- ☐ Grønlandsk
- ☐ Færøsk
- ☐ Syrisk
- ☐ Srilankansk
- ☐ Thailandsk
- ☐ Tysk
- ☐ Polsk
- ☐ Svensk

- ☐ Norsk
- ☐ Foretrækker ikke at oplyse
- ☐ Anden

3. Alder

- ☐ 18 - 24 år
- ☐ 25 - 34 år
- ☐ 35 - 44 år
- ☐ 45 - 54 år
- ☐ 55 - 64 år
- ☐ 65 - 74 år
- ☐ 75 eller ældre

4. Hvad er det højeste uddannelsesniveau nogen I din husholdning har gennemført?

- ☐ Grundskole (9. Klasse)
- ☐ Gymnasial uddannelse
- ☐ Erhvervsfaglig uddannelse
- ☐ Kort videregående uddannelse (3 år)
- ☐ Mellemlang videregående uddannelse (3-5 år)
- ☐ Lang videregående uddannelse (5 år eller mere, f.eks. 3 års bachelor og 2 års kandidat)
- ☐ Ph.D.

5. Hvor mange personer bor der I din husstand?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ Mere

6. Er din bolig en:

- ☐ Ejerbolig
- ☐ Lejebolig
- ☐ Andelsbolig

7. Hvilken type bolig bor du i?

- ☐ Lejlighed
- ☐ Rækkehus

☐ Villahus/parcelhus
☐ Landsted
☐ Sommerhus

8. Hvilken gade i Nykøbing Sjælland bor du på?

_____
_____
_____

9. Hvor længe har du boet i Nykøbing Sjælland?

☐ 0 til 5 år
☐ 6 til 10 år
☐ 11 til 15 år
☐ mere end 15 år

Regnvandshåndtering

10. Har du oplevet oversvømmelse grundet store mængder nedbør mens du har boet i Nykøbing?

☐ ja
☐ Nej

11. Hvornår har du sidst oplevet en oversvømmelse?

☐ 0-5 år siden
☐ 6-10 år siden
☐ 11-15 år siden
☐ Mere end 15 år siden

12. Hvor har du oplevet en oversvømmelse?

☐ På min vej/i min gade
☐ I min have
☐ I mit kvarter
☐ I mit hjem
☐ Andet _____

13. Fra 1 -5, I hvor høj grad føler du at er risiko for flere oversvømmelser (1 = meget lav, 5= meget høj)?

☐ 1
☐ 2
☐ 3
☐ 4

☐ 5

14. Har du truffet nogen forebyggende forholdsregler for at undgå at blive oversvømmet?

☐ Nej
☐ Hvis ja, hvilke?

Borgerinddragende forvaltning

15. Har du hørt om Grønnehave Bæk projektet oprettet af Odsherred Kommune?

☐ Nej
☐ Hvis ja, hvor og hvornår hørte du første gang om projektet?

16. Er du blevet inviteret til at deltage i Grønnehave Bæk projektet?

☐ Nej
☐ Hvis ja, hvordan? _____

17. På en skala fra 1 til 5, hvor 1 er meget utilfreds og 5 er meget tilfreds, hvor tilfreds har du været med den måde hvorpå dine input og kommentarer til projektet er blevet behandlet?

☐ 1
☐ 2
☐ 3
☐ 4
☐ 5
☐ Jeg har ikke givet input til projektet.

Forvaltning af grønne områder

18. Benytter du dig af de grønne områder omkring Grønnehavebæk til rekreative formål? (f.eks. gåture, hundeluftning etc.)

☐ Nej
☐ Hvis ja, hvorden?

19. Vidste du, at bækken Grønnehave Bæk er beskyttet af naturbeskyttelseloven?

☐ Nej
☐ Hvis ja, hvordan?

20. Vil du gerne deltage i aktiviteter organiseret af kommunen, der

fremmer brugen af Grønnehave?

- ☐ Ja
- ☐ Nej
- ☐ Ved ikke

21. Hvilken type aktivitet(er) vil du gerne deltage i?

- ☐ Guidede naturvejlederture
- ☐ Fuglekigning
- ☐ Løbe på løbesti
- ☐ Cykle på cykelsti
- ☐ Camping
- ☐ Sankning (svampe, bær, osv.)
- ☐ Vandring
- ☐ Fotografi
- ☐ Andet

22. Kunne du tænke dig at blive involveret i processen omkring fremtidige forbedringer af Grønnehave Bæk?

- ☐ Ja
- ☐ Nej
- ☐ Ved ikke

23. Hvordan vil du gerne blive involveret i fremtidige forbedringer af Grønnehave og Grønnehave Bæk?

- ☐ Forsamlingsmøde organiseret af kommunen
- ☐ Informeret gennem brev
- ☐ Informeret gennem e-mail
- ☐ Én kommer og banker på din dør
- ☐ Informeret på sociale medier
- ☐ Informeret gennem avisen

24. Føler du at Grønnehave Bæk projektet har hjulpet med at mindske risikoen for oversvømmelser?

- ☐ Ja
- ☐ Nej

25. Er du interesseret i at deltage i et opfølgende inteview?

- ☐ Nej
- ☐ Hvis ja, angiv venligst din kontaktinformation her:

11.6 In-situ Interview transcriptions

02/03/2021	
P.1	Female White 40-50 years of age
	Proximity + GSM - Lives close to the area in the yellow houses on the eastern side of park - Uses the park everyday - Walks in the park everyday - Comment she liked to walk in the nature very much - Has not experience any flooding
	Project - Knows that this park is part of the UNESCO protected area - Does not know any specific changes about the park - Does not know any changes in the park - Does not know any specifics of water management project
	Participation - Has read about project/meetings in the newspaper - Would like to be informed or involved in future changes to the park space - Would like to be communicated by email or facebook - Commented 'lots of communication about the park on facebook
P.2	White Male 50+
	Proximity and GSM - Lives close by in the area - Walks there everyday - Enjoys walks in the park because they are quiet/ peaceful - No knowledge of flooding - Never experienced flooding
	Project - No knowledge of any changes to the park - No knowledge of the project - Has not noticed any changes in the park
	Participation - Never participated

	- No interest in participating
P.3	White Female 40+ White Male 40+ Proximity + GSM - Live in the next town but work at Odesherred STU school near marina - Walk in nature all around Odesherred with the students most days, in the forest every other day - Use the forest for educational purposes - Experience with floods in the school in the marina, but coming from ocean, not rain - Not other flood experience - Perceive the chance of floods in the future as high; because of low lying area and because of climate change and stronger weather events Project - Have not heard about the project - Have noticed construction of project - Saw the lake for the first time today Participation - Have not participated - Would like to participate in future projects affecting the forest
P.4	White, female, 40+ White, female, 10+ Proximity + GSM - Lives on western part of forest - Uses it to walk trough and reach the city center - Walk through forest 1-2 times a week - Does not use for other purposes - Has not experienced any floods Project - Has not perceived any changes in the forest - Has heard from the Project through mouth-to-mouth, people in her building

	Participation - Has not been invited to participate - Has not participated in any way - Is not interested in participating in future projects
P.5	Women White 40+ Proximity and GSM - 10 min foot walk from home - Come everyday - Have not experienced flooding - Have not observed any changes Project - Saw sign of the projects - Observed construction of brook redirecting Participation - Were not invited to participate - Are not interested in participating in the future
P.6	Male white 30+ Woman white 30+ Proximity and GSM - 5 minute walking distance from the forest - Use it everyday to walk the dog - Never experienced flooding themselves - But heard about flooding in the city Project - Saw the sign of the project - Noticed the new wooden walk-way over the wetlands Participation - Have not been invited to participate - Are not interested to participate in the future

P. 7	Women White 30+ Proximity and GSM - 5 minute walking distance - Come 2-3 times a week for waking dog - Have not experienced floods - Have not heard about floods elsewhere Project - Do not know about the project - Noticed the new lake Participation - Have not been invited to participate - Are not interested to participate in future
P.8	Women White 50+ Proximity and GSM - Come by car (10 min) - 3 times a week in the forest for dog walk - No flooding experience Project - Heard about the project from other dog walker - Noticed the new lake Participation - Have not been invited to participate - Are not interested to participate in the future
P.9	Men White 70+ Proximity and GSM - 5 minute walk - Come 2-3 times a week - Have experienced flooding in their house but from marina not from rainfall Project - Have not heard from the project - Saw the lake for the first time today Participation - Are not interested in future participation

	in the project
P.10	Women White 60+ Proximity and GSM - Come every day - Walking distance very close - Come every day for dog walking Project - Noticed more people in the forest - Followed project implementation from the beginning - Saw the signs Participation - Would like to be included in future projects - Would like to be informed on facebook
P.11	Women White 50+ Proximity and GSM - Walking distance - Come everyday for walking the dog Project - Noticed changes to the stream and the wetland - Noticed the project on facebook Participation - Would like to be included in future projects - Would like to be informed on facebook

11.7 In-Situ Analysis

NBS Challenge	Thematic Area	1	2	3	4	5	6	7	8	9	10
Green Space Management	Recreational Value										
Water Management	Affected by Flooding										
	Knowledge about Flooding elsewhere										
Participation & Governance	Awareness of natural surrounding										
	Ownership and willingness to engage										
	Received invitation from Municipality to participate										

11.8 Key-Stakeholder Analysis

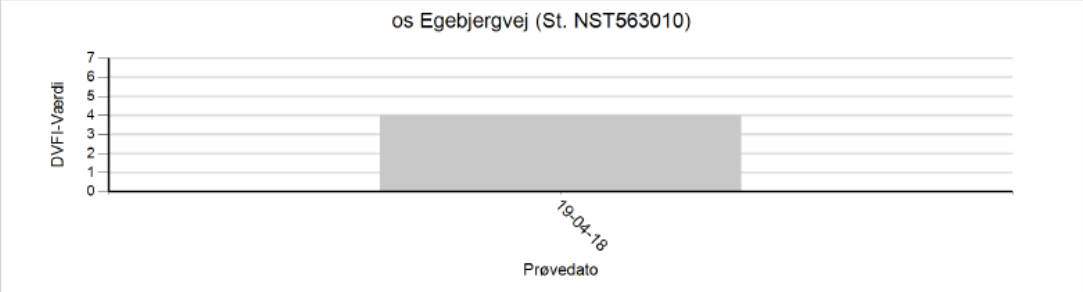
NBS Challenge	Thematic Area	Stakeholder							
		1	2	3	4	5	6	7	
Water Management	Flood Risk Reduction								1= Municipality
	Perception of increased natural value of Bæk								2=Kindergarten
	Intention to monitor aquatic Biodiversity								3= Home Owners Assosc.
	Modelling/monitoring of expected improvements of water quality								4 = Danish Nature Conservation Agency (NGO/ Nora)
Green Space Management	Accessability								5 = Danish Nature Agency (Pelle)
	Perception of high natural value								6 = Farmer
	Increase of recreational value								7 = Lynghus
	Educational/cultural value of Green Space								
Participation	Legitimacy of Knowledge in participatory processes								

	Openness of participatory processes								
	Education concerning urban ecosystems and their function/services/vulnerability								
	Creation of cross-sectoral communication and interaction								
	Inter-departmental collaboration								
Governance	Continuous policy learning								

11.9 Biological assessment of Grønnehave Bæk

Dansk VandløbsFaunaIndeks

Stationsnr	WinBio Stationsnr	Stednavn	Lokalitet	Stationsejer
51000652	NST563010	os Egebjergvej	Grønnehave Bæk	Miljøcenter Roskilde



Dato	Tilsynsejer	DVFI klasse	DVFI klasse betegnelse	Kvalitetssikringsniveau	Kvalitetsstatus
19-04-2018	Odsherred kommune	4	Noget forringet biologisk kval	IndK	GODK

11.10 MiniSass Results:

SITE INFORMATION TABLE	
River name: Grønnehave Bæk	Date (dd/mm/yr): 01 Mar 2021
Site name: Getsøgrøften	Collector's name: Alana & Brynton
GPS co-ord Lat(S): Long(E): 55.91660, 11.65993	School/organisation: KU
Site description: Downstream from Grønnehave Bæk lake along the stream, Getsøgrøften.	Notes: Site 1, Sandy bottom
pH: N/A Water temp: 2 C Dissolved oxygen: N/A mg/l Water clarity: 35 cm	

Groups	Sensitivity Score	Present
Flatworms	3	No
Worms	2	Yes
Leeches	2	No
Crabs or Shrimp	6	No
Stoneflies	17	Yes
Minnow mayflies	5	Yes
Other mayflies	11	No
Damselflies	4	No
Dragonflies	6	No
Bugs or Beetles	5	No
Caddisflies (cased & uncased)	9	No
True Flies	2	Yes
Snails	4	Yes
Total Score	**30**	
Number of Groups	**5**	
MiniSass Score (Avg)	**6.00 Good**	

Ecological category (Condition)	River Category	
	Sandy Type	Rocky Type
NATURAL CONDITION (Unchanged/untouched – Blue)	> 6.9	> 7.2
GOOD CONDITION (Few modifications – Green)	5.9 to 6.8	6.2 to 7.2
FAIR CONDITION (Some modifications – Orange)	5.4 to 5.8	5.7 to 6.1
POOR CONDITION (Lots of modifications – Red)	4.8 to 5.3	5.3 to 5.6
VERY POOR CONDITION (Critically modified – Purple)	< 4.8	< 5.3

SITE INFORMATION TABLE	
River name: Grønnehave Bæk	Date (dd/mm/yr): 01 Mar 2021
Site name: Getsøgrøften	Collector's name: Mikkle
GPS co-ord Lat(S): Long(E): 55.91680, 11.66178	School/organisation: KU
Site description: Downstream from Grønnehave Bæk lake along the stream, Getsøgrøften.	Notes: Site 2, Rocky bottom
pH:N/A Water temp: 2 C Dissolved oxygen:N/A mg/l Water clarity: 35 cm	

Groups	Sensitivity Score	Present
Flatworms	3	No
Worms	2	Yes
Leeches	2	No
Crabs or Shrimp	6	No
Stoneflies	17	Yes
Minnow mayflies	5	No
Other mayflies	11	No
Damselflies	4	No
Dragonflies	6	No
Bugs or Beetles	5	No
Caddisflies (cased & uncased)	9	Yes
True Flies	2	Yes
Snails	4	No
Total Score	**30**	
Number of Groups	**4**	
MiniSass Score (Avg)	**7.50 Natural**	

Ecological category (Condition)	River Category	
	Sandy Type	Rocky Type
NATURAL CONDITION (Unchanged/untouched – Blue)	> 6.9	> 7.2
GOOD CONDITION (Few modifications – Green)	5.9 to 6.8	6.2 to 7.2
FAIR CONDITION (Some modifications – Orange)	5.4 to 5.8	5.7 to 6.1
POOR CONDITION (Lots of modifications – Red)	4.8 to 5.3	5.3 to 5.6
VERY POOR CONDITION (Critically modified – Purple)	< 4.8	< 5.3

SITE INFORMATION TABLE	
River name: Grønnehave Bæk	Date (dd/mm/yr): 02 Mar 2021
Site name: Getsøgrøften	Collector's name: Mikkel & Maria
GPS co-ord Lat(S): Long(E): 55.91730, 11.66320	School/organisation: KU
Site description: Downstream from Grønnehave Bæk lake along the stream, Getsøgrøften.	Notes: Site 3, Rocky bottom
pH:N/A Water temp: 2 C Dissolved oxygen: N/A mg/l Water clarity: 35cm	

Groups	Sensitivity Score	Present
Flatworms	3	No
Worms	2	Yes
Leeches	2	No
Crabs or Shrimp	6	No
Stoneflies	17	Yes
Minnow mayflies	5	No
Other mayflies	11	No
Damselflies	4	No
Dragonflies	6	No
Bugs or Beetles	5	No
Caddisflies (cased & uncased)	9	No
True Flies	2	Yes
Snails	4	No
Total Score	**21**	
Number of Groups	**3**	
MiniSass Score (Avg)	**7.00 Good**	

Ecological category (Condition)	River Category	
	Sandy Type	Rocky Type
NATURAL CONDITION (Unchanged/untouched – Blue)	> 6.9	> 7.2
GOOD CONDITION (Few modifications – Green)	5.9 to 6.8	6.2 to 7.2
FAIR CONDITION (Some modifications – Orange)	5.4 to 5.8	5.7 to 6.1
POOR CONDITION (Lots of modifications – Red)	4.8 to 5.3	5.3 to 5.6
VERY POOR CONDITION (Critically modified – Purple)	< 4.8	< 5.3

SITE INFORMATION TABLE	
River name: Grønnehave Bæk	Date (dd/mm/yr): 02 Mar 2021
Site name: Getsøgrøften	Collector's name: Mikkel & Maria
GPS co-ord Lat(S): Long(E): 55.91613, 55.91613	School/organisation: KU
Site description: Downstream from Grønnehave Bæk lake along the stream, Getsøgrøften.	Notes: Site 4, Rocky bottom
pH:N/A Water temp: 2 C Dissolved oxygen:N/A mg/l Water clarity: 35 cm	

Groups	Sensitivity Score	Present
Flatworms	3	No
Worms	2	Yes
Leeches	2	No
Crabs or Shrimp	6	No
Stoneflies	17	Yes
Minnow mayflies	5	No
Other mayflies	11	No
Damselflies	4	No
Dragonflies	6	No
Bugs or Beetles	5	No
Caddisflies (cased & uncased)	9	No
True Flies	2	Yes
Snails	4	No
Total Score	**21**	
Number of Groups	**3**	
MiniSass Score (Avg)	**7.00 Good**	

Ecological category (Condition)	River Category	
	Sandy Type	Rocky Type
NATURAL CONDITION (Unchanged/untouched – Blue)	> 6.9	> 7.2
GOOD CONDITION (Few modifications – Green)	5.9 to 6.8	6.2 to 7.2
FAIR CONDITION (Some modifications – Orange)	5.4 to 5.8	5.7 to 6.1
POOR CONDITION (Lots of modifications – Red)	4.8 to 5.3	5.3 to 5.6
VERY POOR CONDITION (Critically modified – Purple)	< 4.8	< 5.3

SITE INFORMATION TABLE	
River name: Grønnehave Bæk	Date (dd/mm/yr): 02 Mar 2021
Site name: Getsøgrøften	Collector's name: Mikkel & Maria
GPS co-ord Lat(S): Long(E): 55.91473, 11.66572	School/organisation: KU
Site description: Downstream from Grønnehave Bæk lake along the stream, Getsøgrøften.	Notes: Site 5, Rocky bottom
pH:N/A Water temp: 2 C Dissolved oxygen:N/A mg/l Water clarity: 35cm	

Groups	Sensitivity Score	Present
Flatworms	3	Yes
Worms	2	No
Leeches	2	No
Crabs or Shrimp	6	No
Stoneflies	17	Yes
Minnow mayflies	5	No
Other mayflies	11	No
Damselflies	4	No
Dragonflies	6	No
Bugs or Beetles	5	No
Caddisflies (cased & uncased)	9	Yes
True Flies	2	Yes
Snails	4	No
Total Score	**31**	
Number of Groups	**4**	
MiniSass Score (Avg)	**7.75 Natural**	

Ecological category (Condition)	River Category	
	Sandy Type	Rocky Type
NATURAL CONDITION (Unchanged/untouched – Blue)	> 6.9	> 7.2
GOOD CONDITION (Few modifications – Green)	5.9 to 6.8	6.2 to 7.2
FAIR CONDITION (Some modifications – Orange)	5.4 to 5.8	5.7 to 6.1
POOR CONDITION (Lots of modifications – Red)	4.8 to 5.3	5.3 to 5.6
VERY POOR CONDITION (Critically modified – Purple)	< 4.8	< 5.3

11.11 Water Quality Results:

11.11.1 pH raw data

Sample Site	pH	Replicate
Lake Inlet	7.87	1a
Lake Inlet	7.90	2a
Lake Inlet	7.64	3a
Lake Inlet	7.76	4a
Lake Outlet	8.34	1a
Lake Outlet	7.76	2a
Lake Outlet	7.98	3a
Lake Outlet	8.64	4a
Stream Upper	7.83	1a
Stream Upper	7.91	2a
Stream Upper	7.92	3a
Stream Upper	7.78	4a
Stream Lower	8.29	1a
Stream Lower	8.65	2a
Stream Lower	8.43	3a
Stream Lower	8.19	4a
Marina	7.81	1a
Marina	7.54	2a
Marina	7.80	3a
Marina	7.98	4a

Sample Site	Mean pH	Standard Deviation
Lake Inlet	7.79	0.028
Lake Outlet	8.18	0.020
Stream Upper	7.86	0.006
Stream Lower	8.39	0.032
Marina	7.78	0.017

11.11.2 Electrical Conductivity raw data

Sample Site	millisiemens per centimeter (µS/cm)	Replicate
Lake Inlet	0.614	1a
Lake Inlet	0.602	2a
Lake Inlet	0.573	3a
Lake Inlet	0.640	4a
Lake Outlet	0.561	1a
Lake Outlet	0.603	2a
Lake Outlet	0.596	3a
Lake Outlet	0.569	4a
Stream Upper	0.618	1a
Stream Upper	0.616	2a
Stream Upper	0.615	3a
Stream Upper	0.605	4a
Stream Lower	0.597	1a
Stream Lower	0.560	2a
Stream Lower	0.540	3a
Stream Lower	0.609	4a
Marina	0.612	1a
Marina	0.631	2a
Marina	0.648	3a
Marina	0.647	4a

Sample Site	Avg. Millisiemens per Centimeter (mS/cm)	Standard Deviation
Lake Inlet	0.607	0.028
Lake Outlet	0.582	0.020
Stream Upper	0.614	0.006
Stream Lower	0.577	0.032
Marina	0.635	0.017

11.11.3 water samples_nitrate

No.	mg/L NO3-N	mg/L NO3	Sample Site
1	1.707	7.55	Stream Lower
2	1.7049	7.54	Stream Lower
3	1.7117	7.57	Stream Lower
4	1.7058	7.55	Stream Lower
5	1.6008	7.08	Stream Upper
6	1.5901	7.04	Stream Upper
7	1.4692	6.50	Stream Upper
8	1.6325	7.22	Stream Upper
9	1.6763	7.42	Marina
10	1.6746	7.41	Marina
11	1.7051	7.54	Marina
12	1.6521	7.31	Marina
13	1.6448	7.28	Lake Inlet
14	1.7688	7.83	Lake Inlet
15	1.7694	7.83	Lake Inlet
16	1.7806	7.88	Lake Inlet
17	1.7924	7.93	Lake Outlet
18	1.7415	7.71	Lake Outlet
19	1.8262	8.08	Lake Outlet
20	1.8275	8.09	Lake Outlet

Sample Site	Average nitrate-nitrogen mg/L NO3-N	Standard Deviation	Average nitrate mg/L NO3	Standard Deviation
Lake Inlet	1.74	0.06	7.70	0.05
Lake Outlet	1.80	0.04	7.95	0.18
Stream Upper	1.57	0.07	6.96	0.32
Stream Lower	1.71	0.003	7.55	0.01
Marina	1.68	0.02	7.42	0.10

11.11.4 water samples_totalP

No	P (µg/l)	Sample Site
1	43.241	Stream Upper
2	16.764	Stream Upper
3	24.365	Stream Upper
4	26.752	Stream Upper
5	24.233	Stream Lower
6	28.666	Stream Lower
7	129.305	Stream Lower
8	28.754	Stream Lower
9	22.605	Marina
10	29.579	Marina
11	15.972	Marina
12	16.940	Marina
13	37.697	Lake Inlet
14	14.157	Lake Inlet
15	21.252	Lake Inlet
16	52.261	Lake Inlet
17	82.104	Lake Outlet
18	23.958	Lake Outlet
19	29.854	Lake Outlet
20	29.513	Lake Outlet

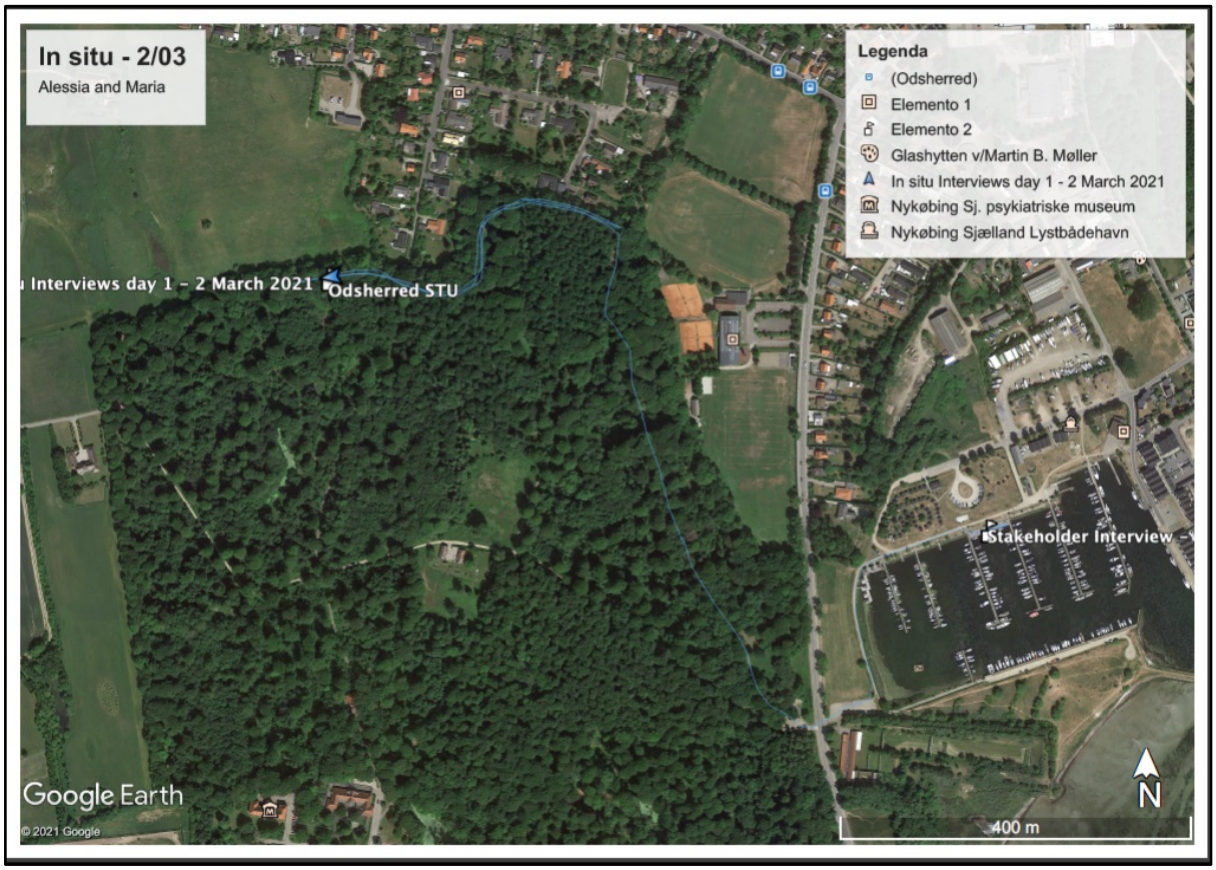
Note: yellow marks are outliers within the sample.

Sample Site	Mean P micrograms per liter (µg/l)	SD
Lake Inlet	31.34	17.08
Lake Outlet	41.36	27.30
Stream Upper	27.78	11.15
Stream Lower	52.74	51.09
Marina	21.27	6.26

11.12 GPS Points/ Maps

11.12.1 Investigation of “Getsøgrøften”

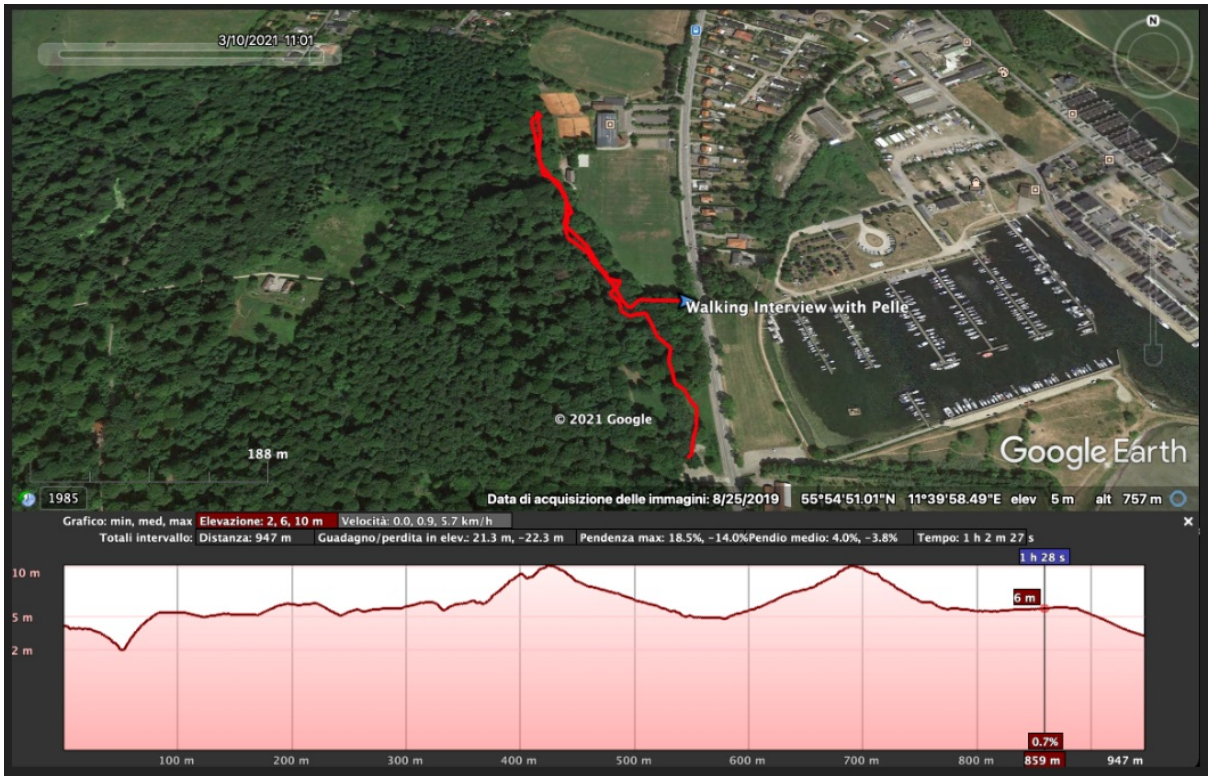
11.12.2 1-2 March 2021 In-Situ Walks



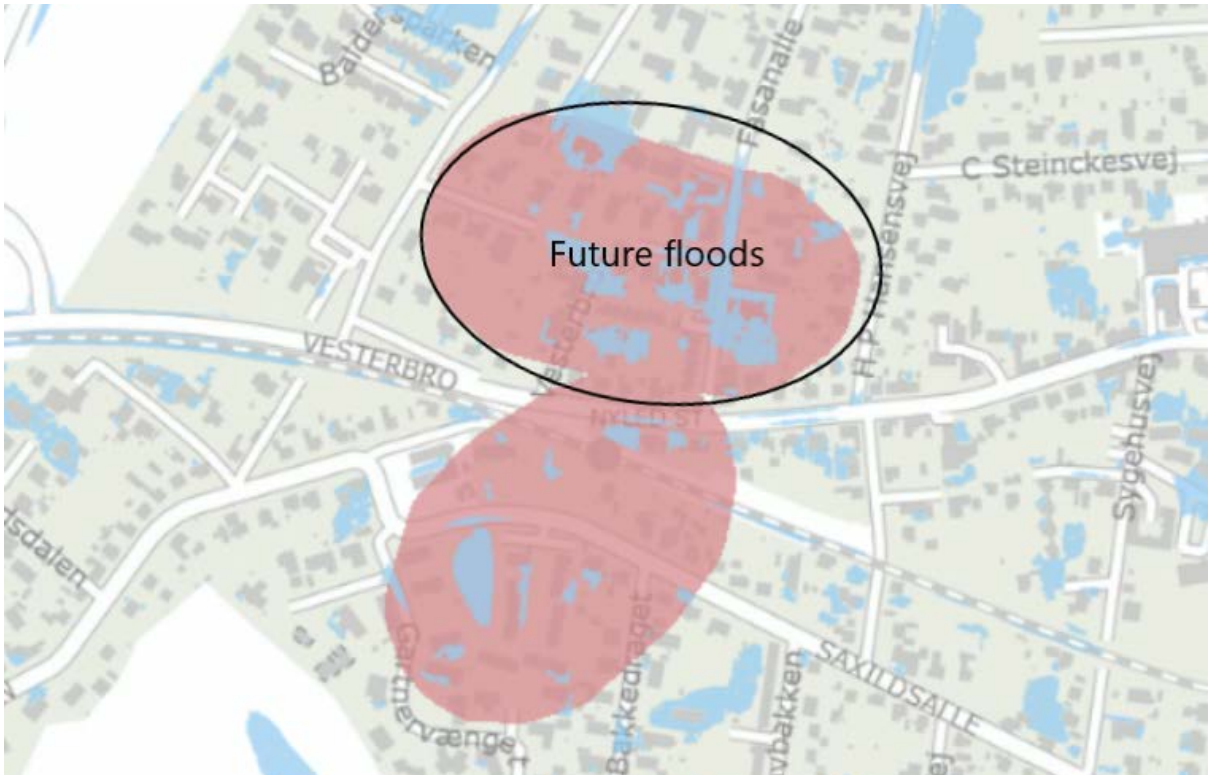
11.12.3 03/02/2021 In-Situ Walks

11.12.4 03/04/2021 In-Situ Walks

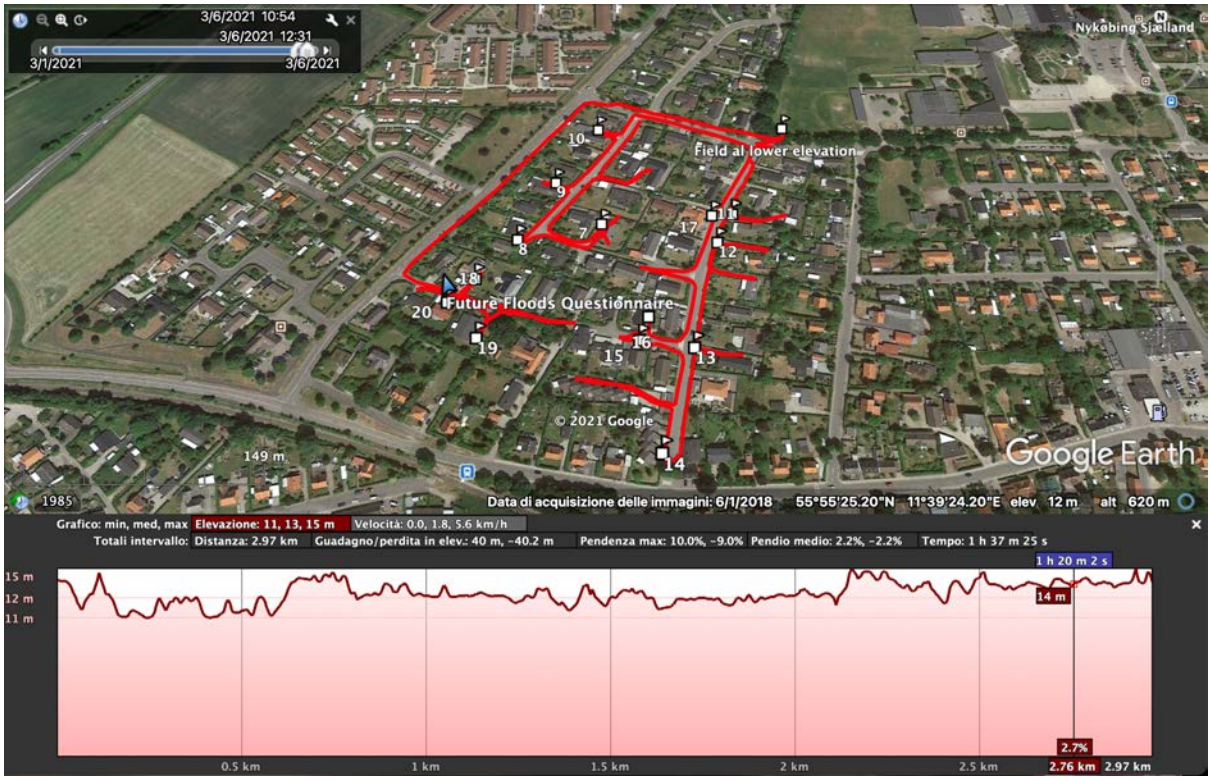
11.12.5 Interview with Pelle



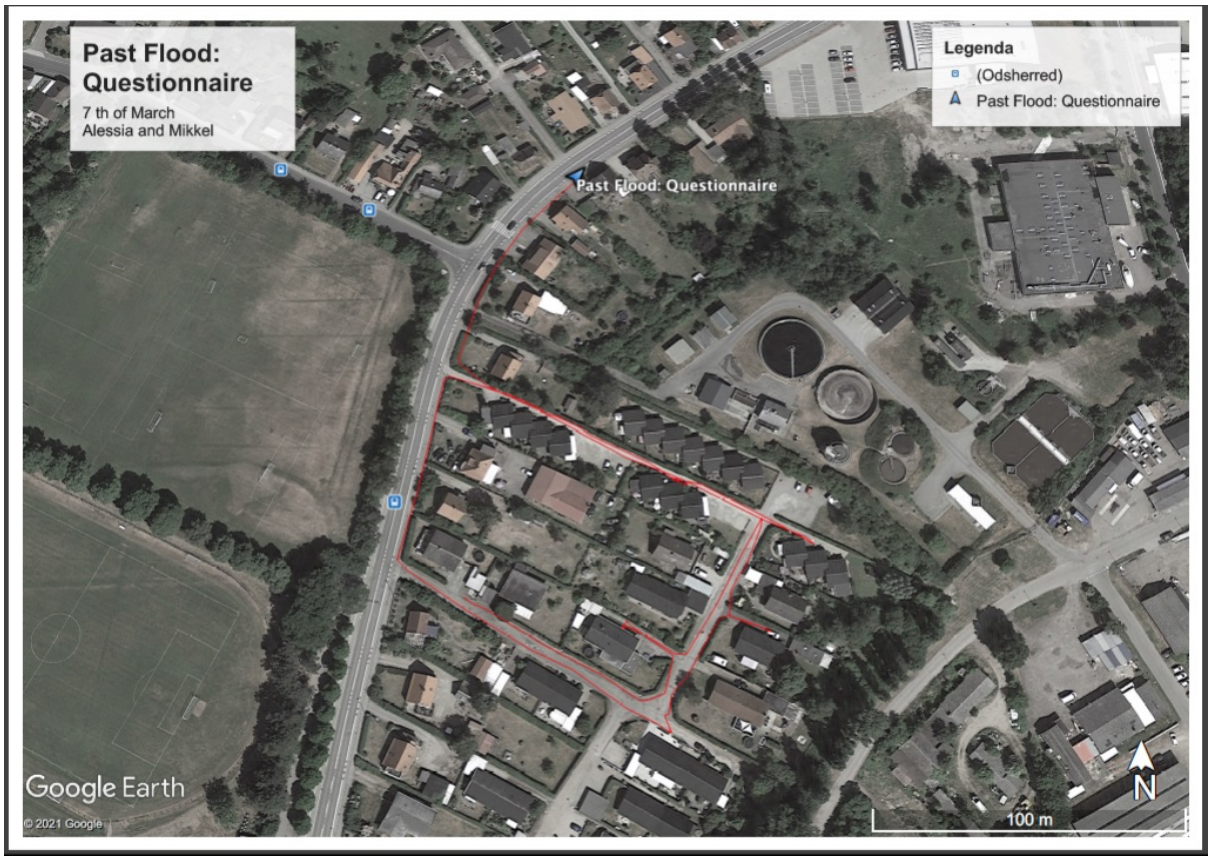
11.12.8 Map of the Municipality Flood zone



11.12.7 Questionnaires handed out to streets that are expected to experience flooding in the future



11.12.9 Questionnaires handed out to streets that experienced flooding in the past



11.13 All Streets of Questionnaire Dissemination (including past flooding areas and future flooding areas)

Saxildsalle
Egebjergvej
Vesterbro
Dr Schadsvej
Anemonevej
Isefjordvej
Algade
Søkanten
Grønnehavestræde
Syrenstien
Fjordvej
Skovbakken
Møllegårdsalle
Gartnervænget
Bjarkesvej
Egehegnet
Bjarkesvej
Nyledsbakken
Kildestræde
Fasanalle

An exploration of the co-benefits and negative externalities of the climate adaptation plan on aquatic biodiversity, water quality, risk perception and participation for the Grønnehave Bæk Project.

Alana Benjamin, Maria Lamotte, Brynton Johnson, Alessia Malito, Mikkel Haupt

Chapter 1 - Introduction

Climate change is leading to unprecedented weather events and significant changes in seasonal weather patterns. Therefore, Denmark will experience more extreme weather in the future. In winter the weather will be wetter with higher general rainfall. In summer there will be heavier unexpected showers and unexpected precipitation events (cloudbursts) that induce flash flooding. Flash flooding damages many facets of society in Denmark such as agriculture, housing, transport and also pre-existing biodiversity of protected areas (Precipitation and climate change., n.d.).

Copenhagen faced the effects of extreme weather events in 2011, 2014 and 2015, consequently drawing citizens' attention to the impacts of climate change in their lives (Baravikova, A., 2019). Areas of Denmark such as Nykøbing Sjælland are considered very vulnerable to flooding from storm surges and cloudburst events because of their low lying terrain in conjunction with their positioning along the coastline (S., 2019, May 6). Hence, the DK 2020 initiative was introduced which required municipalities to produce local climate adaptation plans (CAP), to achieve net zero emissions by 2050 and demonstrate what measures the municipality will implement to adapt to climate change (Klimatilpasningsplaner og klimalokalplaner., 2013). Odsherred municipality was among the first wave of municipalities to sign up and is located in northwestern Sjælland.

Odsherred and the city of Nykøbing Sjælland will be the focus of this synopsis and the subsequent report. Odsherred must adapt to increased rainfall, more unpredictable rainfall, and rising sea levels increasing flood risk. Odsherred CAP involves multiple adaptation projects including the Grønnehave Bæk one. The Grønnehave Bæk project commenced in 2017 and was completed on November 1st 2020. It spans an area of over 2 km² consisting of wetlands and forest adjacent to Nykøbing. Excess runoff from Nykobing Sjaelland and the surrounding agricultural land is now drained through the wetland, to manage water flow and reduce the flood risk. Excess water now runs through Grønnhave wetland and forest via Grønnehave Bæk, before entering Isefjord.

Objectives of Grønnehave Bæk project are;

1. to develop more climate proof sewer and drainage systems in Nykøbing Sjælland
2. To reduce the quantity of rainwater passing through the Nykøbing treatment plant

3. To reduce the nitrogen content of the agricultural runoff, while simultaneously achieving higher biodiversity in the associated wetland and stream, which are protected by nature conservancy status (Grønnehave Bæk., n.d.).

The guidelines from the Danish Parliament to the country's municipalities on how to develop the aforementioned CAPs require a participatory approach, broad in its inclusion of stakeholders (Klimatilpasningsplaner og klimalokalplaner., 2013). The CAP of Odsherred seeks the reduction of the impacts of floods by implementing a "green solution for urban areas"(CAP, pg 29), aiming at generating benefits in terms of decreasing impacts for the affected population and synergically increasing the recreational natural value of the area and improving the stream's biodiversity (CAP, pg.29). Lund et al. (2012) documented in their study of Danish municipalities a severe lack of participation of the relevant affected stakeholders, indicating a potential knowledge gap regarding participation in CAPs such as the Grønnehave Bæk project. Since the implementation of the Grønnehave Bæk project, no assessments of these knowledge gaps with regards to participation in project implementation, increasing the recreational value of the project area and increasing Gronnehave baek's biodiversity have been conducted. Hence this research aims to fill these gaps through the following research objectives:

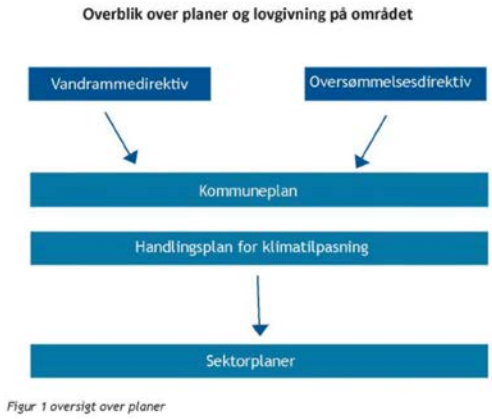
1. Understand the participatory process conducted here.
2. To understand different incentives of the involved stakeholders and the factors that influenced their role in the participatory process.
3. To understand the project's influence on short term changes to aquatic biodiversity and water quality in the associated wetland and stream, according to the CAP goals

These objectives will be achieved by investigating the following research question, "*What are the co-benefits and negative externalities of the CAP, on both biological indicators (aquatic biodiversity and water quality), socio-political and cultural indicators (stakeholder, citizen inclusion, flood risk perception) of the Grønnehave Bæk project in Odsherred?"*

Chapter 2 - Theoretical Framework

2.1 Legislation

It is solely the municipality's responsibility to develop a CAP and manage resources for the designated areas of interventions, this is then subject to a national CAP. The CAP of Odsherred Municipality, focuses on mapping the risks of flooding and implementing the measures according to the European Water Framework Directive (EWFD) 2000/60/EC and the European Flood Directive 2007/60/EC.



(Figure retrieved by CAP , pg. 9)

European Law requires the presence of an Environmental Impact Assessment (EIA), Directive (85/337/EEC) in force since 1985. According to Annex 2, it is at the discretion of Member States to perform a screening of the interventions: the national authorities have to decide whether an EIA is needed in the implementation of a project.

Not only is the project subjected to the European directives implemented at the state level, the Danish Nature Agencies states in the Nature Conservation Act Paragraph 3, that lakes are protected if they cover 100 m2 including its broader vegetation. Additionally lakes are protected regardless of size if they are part of a protected stream, without having to be officially registered. Adjacent fauna and flora is included in this protection (LBK nr 933 af 24/09/2009)

2.2 Co-benefits approach to Climate Change: A framework for assessment

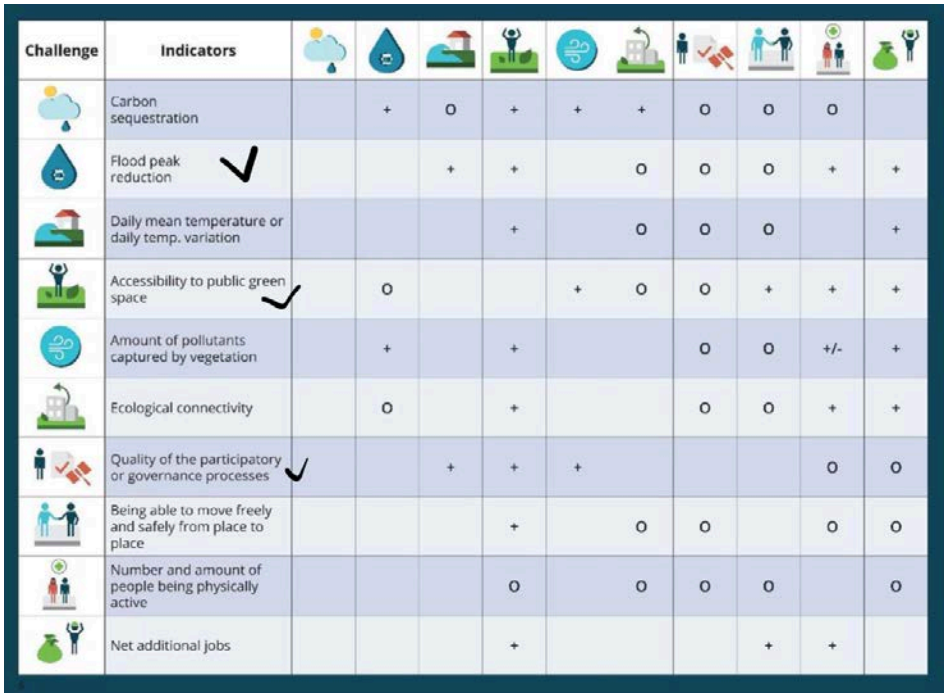
The Municipality aimed at ameliorating the current condition by introducing a measure which could also allow for the beautification of the area and increase its value. For the purposes of this research a Nature Based Solution (NBS) framework will be used to analyse the Grønnehave Bæk project and its

co-beneficial impacts or negative externalities. There is overall agreement around the provision of co-benefits by NBS, which enhance health, attractiveness and quality of life in areas in which such adaptation strategies are implemented (Cohen-Schaham et al., 2016). The framework developed by Raymond et al. (2017) aims at simultaneously including different dimensions while implementing NBS:

1. Benefits/Co-benefits for human health and well-being
2. Integrated Environmental Performance;
3. Trade-offs and synergies to biodiversity, health and economy;
4. Potential and citizen's involvement in governance and monitoring;

The dimensions chosen identify ten challenges linked to NBS presented in Figure 1. For each of those we can identify actions, expected impacts of NBS objectives, indicators and methods for assessment.

Figure 2 The 10 challenges of NBS (Raymond et al., 2017)



Challenge	Indicators										
	Carbon sequestration		+	o	+	+	+	o	o	o	
	Flood peak reduction			+	+		o	o	o	+	+
	Daily mean temperature or daily temp. variation				+		o	o	o		+
	Accessibility to public green space		o			+	o	o	+	+	+
	Amount of pollutants captured by vegetation		+		+			o	o	+/-	+
	Ecological connectivity		o		+			o	o	+	+
	Quality of the participatory or governance processes			+	+	+				o	o
	Being able to move freely and safely from place to place				+		o	o		o	o
	Number and amount of people being physically active				o		o	o	o		o
	Net additional jobs				+				+	+	

Figure 3 Examples of different types of indicators for assessing the impacts of NBS across different challenge areas (Raymond et al., 2017)

The cross-sectional character of this framework is entailed in the three main steps to undertake:

1. Environmental and socio-economic aspects (costs and benefits, implications and evaluations of stakeholders).
2. Identify the possible benefits and negative impacts that could be reached.
3. Implementation and monitoring of NBS by focusing on the long-term impacts and changes that can occur *in itinere* (Raymond et al., 2017).

In the case of Grønnehave Bæk Project, the climate adaptation plan expects the increasing beautification of the area and of its natural values, by introducing green solutions in the planning of flood reduction (CAP, pg. 29).

In accordance with this we aim at identifying the benefits/ co-benefits and trade-offs, impacts of flood reduction, aquatic biodiversity, water quality and the quality of the participatory governance. We also expect to elicit other co-benefits, for example the accessibility to the green space and the possibility to carry out activities in the same area, as we investigate more during the two weeks of research.

Furthermore, we aim at eliciting the perception of flood risk to which inhabitants of the area were exposed and in equal manner the interests several affected individuals had in participating in the project. The factors that influence risk perceptions can be identified as cognitive and situational, behavioral, socio-economic, demographic, informational, geographical and contextual (Lechowska, 2018).

Chapter 3 - Methods

For the purposes of this research Grønnehave Bæk will be analysed as a case study. Multiple samples will be used for quantitative and qualitative methods of data collection. Three key sample areas have been delimited for the collection of biological, socio-political and cultural indicators including; -

1. For biological indicators, the area covers a span of 2 km2 of wetland and forest in Nykøbing Sjaelland, in particular the §3 protected stream known as Grønnehave Bæk from its mouth, until it flows into Isefjord.
2. In-situ semi-structured walking interviews with green space users will equally be conducted in the mentioned wetland and forest areas around Grønnehave Bæk.
3. For questionnaires the sample area consists of residents of Saxildsalle, Odsherredbanen and Egebbjergvej in Nykobing Sjaelland and members of facebook groups regarding Nykobing Sjaelland

3.1 Qualitative Methods

Three qualitative methods and sampling methods have been chosen for completing qualitative research and each associated method of data collection (appendix: data matrix) as follows;-

1. Semi-structured Stakeholder Interviews - a snowballing sampling method will be used, after key stakeholders have been identified from the publically available project literature/documentation (appendix 5.3).
2. Random systematic questionnaires for flooding residents - purposive sampling methods will be used in order to disseminate questionnaires. All residents of three identified streets will be

approached at indicated times (fieldwork schedule week 1 and 2). In order to give them an opportunity to complete the questionnaire (appendix 5.5.).

3. Semi-structured in situ interviews with green space users - two sampling methods will be used: An *Opportunistic* approach, where people available in the park will randomly be selected during the times we are on site. In addition a *Voluntary* approach will be used to meet people in the park for an interview after they have voluntarily identified themselves to us in the questionnaire and agreed to meet (appendix 5.4).
4. Systematic sampling method - Individuals who live in/ on Saxildsalle, Odsherredbanen and Egebjergvej (flooded areas) and have registered their address with www.krak.dk will be recorded in the sample population. Then the population will then be ordered alphabetically and every 3th member of the target population will be asked to participate in the Stakeholder interview [see (Raw Data) Systematic sampling population].

3.1.1 Stakeholders

An identification of relevant stakeholders will be performed according to the typology by Reed et al. (2009). Stakeholders are identified through brainstorming based on available documentation of the Grønnehave Bæk project and its implementation. Considering aims, interests and power relations key stakeholders are identified. The research is conducted under the assumption of snowball-effects during key-stakeholder interviews and the identification of further stakeholders. At the outset of the research the following stakeholder are considered:

Key Stakeholders:

1. Odsherred Municipal Government
2. Odsherred Forsyning

Primary Stakeholders:

1. Residents of formerly flooded areas Saxildsalle, Odsherredbanen.
2. Users of Grønnehave Bæk for recreational purposes.

3. Landowner association
4. Farmers adjacent to Grønnehave Bæk
5. Danish Nature Agency
6. The Danish society for Nature Conservation

Secondary Stakeholders:

1. Lynghus Consult Aps
2. “Kongehallerne” sports association
3. Anglers

To understand stakeholder roles, and the participatory methods applied to engage stakeholders Pretty (1995) typology of participatory learning in sustainable agriculture will be used. Pretty (1995) re-imagine’s sustainable agriculture, so different levels of participation can be assessed using a typology, of seven categories. This will assess whether participation in the Grønnehave Bæk project by stakeholders and citizens has little long lasting effect (typologies 1- 4) or some long lasting effect (typologies 5-7). This typology allows assessment of participants in the research to assess the depth of their engagement, and if the requirement to use participatory approaches has been met by Odsherred CAP has been met and in what manner (appendix 5.9).

3.2 Quantitative Methods

3.2.1 - MiniSass

In April 2018, a fauna investigation of Grønnehave Bæk (station nr. 51000652) was conducted by Odsherred municipality using the danish DSFI method. The investigation showed that the stream had a DVFI score of 4, described as slightly impaired biological quality (appendix 5.6). This score is used as a baseline for previous biological quality. To examine the present status of the stream, a new set of data will be gathered .

To collect new data, the "MiniSass" method is applied. The miniSass method is useful for fast and easy investigation of the health of a stream. The method is very similar to the DSFI. The assessment is done by collecting macroinvertebrates. A net is used to collect samples of the stream sediment for further investigation and defining of species. In addition to the net collection, handpicking is used to collect invertebrates under stones at the bottom of the stream. After the collection of macroinvertebrates, a dichotomous key is used to identify different species. Different species have different scores - when all species have been registered, an average score is granted to identify whether the stream is healthy or not (Graham, 2018).

The Mini Sass method also allows the participants to upload the score into an online GIS web page, making it possible to share findings. In this way, it is possible to generate knowledge that is accessible for everyone (Graham, 2018).

3.2.2 Water Quality

Dissolved nutrients like nitrogen and phosphorus are key water quality indicators in aquatic ecosystems. Depending on their chemical compounds, nitrogen and phosphorus can have significant effects on plant growth, oxygen concentrations, water clarity, and sedimentation. Nitrogen's primary role in organisms is protein and DNA synthesis; plants also use this substance in photosynthesis. Phosphorus is critical for metabolic processes, which involve the transfer of energy. Because nitrogen and phosphorus play such important roles in the aquatic ecosystem, they were selected to be monitored (Register, 2006).

Additionally, pH was selected as an indicator to monitor because, if the pH of water is too high or too low, the aquatic organisms living within it will die. pH can also affect the solubility and toxicity of chemicals and heavy metals in the water. The majority of aquatic creatures prefer a pH range of 6.5-9.0, though some can live in water with pH levels outside of this range (Card, Rose, Kemker, Kelly, & Fitch, 2019).

Methods:

(See Appendix 5.7 for more details)

1. Locate Sample Site (Record GPS coordinates)
2. Label Bottles
3. Take Water Temperature
4. Collecting the sample (repeat 4 times per indicator at each sample site)
    i. Rinse Water Bottle x3
    ii. Collect the sample
    iii. Record the depth the sample was collected
5. Seal and Store Bottle

Water Quality Analysis

1. See Determination of nitrite in water by FIAstar 5000 for Nitrate lab analysis.

2. See Determination of ortho-phosphate in water by FIAstar 5000 for Phosphate lab analysis.

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Chapter 5 - Appendices

5.1 Data Matrix

Overall objective: To assess ecosystem services, implementation and biological quality in order to find co-benefits and negative externalities of the Grønnehave bæk project						
	Raymond et al. Indicator	Research Questions	Sub Question	Data Requirement	Methods	Equipment
Natural Science	Water Management	What is the impact of the project on the stream/water quality?	Has nutrient pollution decreased?	Dissolved Nutrients (nitrate and soluble phosphate) Temperature pH	Water samples (Appendix 5.7)	Marker, Cooler, Thermometer, GPS, Double A Battery, Ice/ ice-packs, Deionized Water (DIW), Zipper-lock bags, FIAstar 5000 Analyzer, Reagents, 250 mL Water, Sampling Bottles, Weighters, Labels Pencil/ Black

	Green Space Management	How is the biological status of the protected stream	Has biodiversity in the stream achieved an increase?	Number of species	Mini sass	Handnet, Plastic tray, Waders, Dismochous key, Magnifier, Fieldnotes, Scorecard, GPS, Pencil
Social Science	Water Management	Has the project worked in reducing flood risk?	What is the perception of flood risk for these residents ? Were you facing costs related to the floods? Do you still face them?Were you aware of the increased risk due to severe rainfall/ climate change? Do you feel that the implementation of the project has benefited your household?Are you feeling safe after the implementation of the project?	Questionnaire Answers - ideally 30+	Questionnaire or Survey for residents of areas affected by flooding (Appendix 5.5)	Paper handouts; Ipad; Pencils; phone , chargers, power banks
	Green Space Management	Has the stakeholder awareness and knowledge increased about the management of this Green Space?	How much do you know about this ecosystem? How many times did you visit the area? What kinds of activities do you carry? How much time do you spend there? How accessible is the area? KM/travel time	Transcriptions of walking interviews	In situ walking interview (in Gronneh ave Baek wetland space) (5.4)	Recording gadget

	Participatory Governance	How much has the population been involved in the development of the project?	Have you ever been involved in the designing of the project? Have you ever heard/ participated in a meeting with the municipality? (co-design, openness of the process, transparency) Have you ever been informed about the ecosystem services embedded in the solution? Did you have different aspirations/expectations about the project? (socio-cultural values) Would you like to take part in activities that promote the protection of this natural area? (ownership) Would you like to be involved in the decision-making process for future ameliorations of the current status?	Transcriptions of stakeholder interviews	Semi-structured stakeholder interviews (Appendix 5.3)	Recording gadget

5.2 Schedule of Fieldwork

***Our research team will split into two groups A (2 people) and B (3 people)**

WEEK 1					
	Monday	Tuesday	Wednesday	Thursday	Friday
Location	Arrive in Odsherred straight to Gronnehave Baek wetland area	Arrive in Odsherred straight to Gronnehave Baek wetland area	Residential areas for flooding Odsherredbanen and Saxildsallè districts	TBA	TBA
Departure	07:30	07:30	07:30	08:30	TBA
Arrival	09:00	09:00	09:00	10:00	TBA
09:00 - 10:00	Walk around the project area, to understand the park layout and decide on sampling points for mini SASS and Water samples Break off into groups A and B	A and B: Complete mini-SASS method (mouth) (so everyone can learn method together)	A + B: discuss which street has been targeted already. Practice introduction to questionnaire/ greeting as group		We will discuss uploading of question reponses and transcribing the in-situ interviews conducted so far
10:00 - 11:30	A: Complete first four water samples at site 1 (Entrance of Lake) B: Locate users of the park and	A: Complete mini-SASS method (middle of stream) B: Complete min SASS method (depositor of	A: Target one road for questionnaires B: Target second road for questionnaires	A + B: Key stakeholder interviews This time has been allotted to be used for in person key	All members will uploaded in person questionnaires they are in possession of to an online data forum to ensure that data collected is well

	conducted in situ interviews	stream)		stakeholder interviews	organised
12:00 - 13:30	A: Conduct water samples for site 2 in stream (exit of lake) B: Water samples of site 3 of stream (Source of Stream)	A: Locate users of the park and conducted in situ interviews (lunchtime users) B: Travel **(saxidalle)** to to identify streets that where most flooded	A: Target one road for questionnaires B: Target second road for questionnaires	A+ B: Lunch break and discussion of interviews	A: Will begin transcribing the in situ interviews they have conducted with nature space users B: will begin transcribing the in situ interviews they conducted with nature space users
14:00 - 16:00	A: Water samples of site 4 of stream (Middle of Stream) B: Water samples of site 4 of stream (Depositor of Stream)	A:Locate users of the park and conducted in situ interviews (afternoon users) B: Identify first street knock on doors and hand out questionnaires or online version to be completed	A + B: rejoin to discussion people they feel could be key to interview as residents, note locations and arrange days (next week) to complete an interview with key residents	A: Stakeholder interviews either in person or online B: questionnaires for residents	A: Will begin transcribing the in situ interviews they have conducted with nature space users B: will begin transcribing the in situ interviews they conducted with nature space users
back on Campus 17:30	If possible drop off all of water samples with dorette in labs to begin analysis	Return to campus	Return to campus	Return to Campus	

WEEK 2					
	Monday	Tuesday	Wednesday	Thursday	Friday
Location	TBA			TBA	TBA
Departure	07:30 from Frederiksberg Campus				
Arrival	09:00				
09:00 - 10:00	09:00 - 10:00 Discussion of data uploading completed on friday and how much data still needs to be uploaded from last week				
10:00 - 11:30	A + B: Key stakeholder interviews This time has been allotted to be used for in person key stakeholder interviews				
12:00 - 13:30	A + B: Lunch Break and discussion of interviews				
14:00 - 16:00	B: Stakeholder interviews either in person or online A: questionnaires for residents				

back on Campus 17:30	Return to Campus				

5.3 - In-Situ Interview Guide

Area: Grønnehave Bæk paths and areas for recreational purposes (exact points will have to be defined on site).

Target Group: Residents and Citizens from nearby towns who are using Grønnehave Bæk for recreational purposes on a regular basis. Two approaches to responders are identified:

1. *Opportunistic* – Approaching people available in park while we are on site.
2. *Voluntary* – Meeting people in the park for an interview after they have voluntarily identified themselves to us in the questionnaire and agreed to meet.

Practicalities

1. Introducing ourselves
- inform the interviewees that this will be a semi structured interview, while walking around Grønnehave Bæk and will cover the following themes of green space management, water management and perceptions of flood risk
2. Presenting the topic we are investigating
3. Informed consent
4. Inquiry on place of residence (at least name of municipality, if possible name of street)

Thematic Areas and Questions

1. Green Space Management

- How much do you know about this ecosystem?
- How many times did you visit the area?
- What kinds of activities do you carry?
- How much time do you spend here?
- How accessible is the area? KM/travel time
- Were you aware of the process around changes to the wetlands? Show them the area
- Have you heard of them?
- Did you notice any changes within the area?

2. Water management

- Do you live in the adjacent area of Saxildsalle, Odsherredbanen and Egebbjergvej, IF YES go on with the Water Management
- Have you experienced flooding in your street/house/garden?
- Do you perceive the flood risk differently today than in the past?
- Were you facing costs related to flooding?
- Have you heard of the Grønnehave Bæk project and its aims concerning flood control?

3. Participatory Planning and Governance

- Have you been informed about ecosystem services/ climate change risks for the area in which you live?
- Have you ever heard about the meetings with the municipality for this project? (co-design, openness of the process, transparency)
- Have you ever participated?
- Did you have different aspirations/expectations about the project? (socio-cultural values)
- Would you like to take part in activities that promote the protection of this natural area? (ownership)
- Would you like to be involved in the decision-making process for future ameliorations of the current status? (ownership)

Debriefing

Thank you for participating in this research, we really appreciate the time you have taken to engage with us. You have the right to withdraw your interview from this research if you wish in the next 2 weeks. If you have any further questions regarding the questions then, feel free to ask any of the team members.

5.4 Semi-Structured Stakeholder Interview Guide

Area: Grønnehave Bæk project and town of Nykobing Sjaelland

Target Group: Stakeholders identified in stakeholder analysis. Two approaches to sampling

1. *Systematic* - Conducted a stakeholder analysis and contacted each stakeholder organisation to ask if they are will to participate in interview
2. *Snowballing* - Stakeholders are asked to identify other key stakeholders during at the end of their interview, and contacts person for those stakeholders where possible

Practicalities

1. Introducing ourselves
    - inform the interviewees that this will be a semi structured interview regarding Grønnehave Bæk project and will cover the following themes of green space management, water management, perceptions of flood risk and future project plans.
2. Informed consent
3. Inquiry on place of residence (at least name of municipality, if possible name of street)

Thematic Areas and Questions

Demographic

1. **Tell** us about yourself and your role/ involvement with The project 'Grønnehave Bæk'?

Water Management

1. The project has a number of objectives (Reduction of agricultural-based nutrient pollution of Nykøbing Bay and the Isefjord and Reduced floods due to heavy rainfall and cloudbursts in the Saxildsallé district etc.) Can you briefly explain how the CAP achieves its objectives?
2. Besides Water retention, are there any other activities that the stream will be used for ?
3. Has there been any major challenges in implementing the project, if yes what were they?
4. Do you know of an impact of the project on the stream water quality and biodiversity?
5. Are there any plans for monitoring the biological quality of the stream?

Green Space Management

1. Was citizens input used in the project proposal?
2. Were you informed/did you inform members of the public about the green aspects of this solution?
3. Were you informed or did you inform members of the public about understanding the ecosystem services this measure could bring about?
4. Was the public aware/did you make the public aware of the environmental value this measure could promote?
5. Are there any programs in place, for which the public could become involved in maintaining this green area?

Participatory planning and Governance

1. Were citizens invited to pre-project meetings?
2. Were citizens considered primary stakeholders since the beginning?
3. How was citizens' input implemented?
4. Did any citizens contact you about negatives/positive results after the project was presented?
5. Do you know of any ways the project was promoted prior to its formulation and implementation ?

Stakeholder Interest

1. Who are the relevant stakeholders in this project, and in what ways is this project understood/ perceived by the different stakeholders as a tool to manage future or contemporary threats of climate change?
2. Are there any conflicts between the stakeholders or complaints?
3. How has the Odsherred Municipality facilitated communication and participation between itself and the relevant stakeholders?
4. How was citizens' input implemented?
5. Is there any future for the project, or anything you wish to achieve with the project that you weren't able to achieve in the beginning?

Future Project Plans

1. Do you know of any future plans regarding the project such as the new housing initiative ?
2. Regarding the new housing initiative at what point in the project timeline is this initiative ?
3. How is this new project being implemented?
4. What is the process of planning and implementing?
5. How does the new housing affect the green space that has been created?

Final question: Can you identify any other stakeholders in this project we should contact, and if so do you have contact details for them ?

Debriefing

Thank you for participating in this research, we really appreciate the time you have taken to engage with us. You have the right to withdraw your interview from this research if you wish in the next 2 weeks. If you have any further questions regarding the questions then, feel free to ask any of the team members.

5.5 Draft Questionnaire

QUESTIONNAIRE

Students from the University of Copenhagen are conducting a survey on the Grønnehave Bæk project.

The Grønnehave bæk project has been implemented by the Municipality to prevent floods in the

areas of Saxilds allé due to intense and increased rainfall, to reduce the amount of water passing through the treatment plant. The aim of the project is also to increase the natural value of the Municipality, by creating a green urban space with the construction of a wetland and modifying the connected stream.

The intention of this questionnaire is to include residents from neighborhoods that experienced serious floods in the past years.

Your participation would help us enormously to understand projects of climate adaptation in Denmark.

Please be assured that your responses will be treated confidentially and anonymously.

Responders information

Gender/ Gender Identity?

- ☐ Male
- ☐ Female
- ☐ Other: _____

Race and Ethnicity?

- ☐ Caucasian/ White
- ☐ Black (African, Afro-Caribbean, or African-American)
- ☐ Asian
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ Hispanic, Latino, or Spanish
- ☐ Native American
- ☐ Middle Eastern or Arab
- ☐ Mixed (Multi Racial)
- ☐ Prefer not to say

Age?

- ☐ Under 18
- ☐ 18 - 24 years old
- ☐ 24 - 34 years old
- ☐ 35 - 44 years old
- ☐ 45 - 54 years old
- ☐ 55 - 64 years old
- ☐ 65 - 74 years old
- ☐ 75 and older

How many people live in your households?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ More

Optional: Which street in Nykøbing Sjælland do you live on ?

_____
_____
_____

Water management

Have you experienced floods in your street AND/OR your house in the past 5-10 years?

- ☐ Yes
- ☐ No

From 1-5: How much do you perceive the risk of more floods ? (1 being very low; 5 being very high)

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

Did you take precautionary measures to prevent being flooded?

- ☐ Yes
- ☐ No

If yes, which ones?_____

Participatory Governance

Where you aware of the increased risk of flood, due to the increased rainfall

- ☐ Yes
- ☐ No
- ☐ If yes, how did you gain this information? (Newspaper, news, municipality, etc))

Did you hear about the project of Grønnehave Bæk, conducted by the Municipality of Odsherred?

- ☐ Yes
- ☐ No

If yes, when and where did you hear about it first? _____

Did you feel invited to participate or to voice your opinion and thoughts on the project?

- ☐ Yes
- ☐ No

Have you ever heard/ participated in a meeting with the municipality? (co-design, openness of the process, transparency)

- ☐ Yes
- ☐ No

If no, have you been informed about the meetings?_____

From 1-5: How satisfied were you with the way your input was treated? (1 not satisfied at all, 5 very satisfied)

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

If you were not satisfied with the way your input was treated, what did you miss?

_____
_____
_____
_____
_____
_____

Greenspace management

Would you like to take part in activities that promote the use of this natural area?

- ☐ Yes
- ☐ No
- ☐ Don't know

Would you like to be involved in the decision-making process for future ameliorations of the natural value of this project?

- ☐ Yes
- ☐ No
- ☐ Don't know

Do you use the green spaces around the Grønnehave Bæk for your recreation?

- ☐ Yes
- ☐ No

Have you been informed about ecosystem services for this solution?

- ☐ Yes
- ☐ No

Do you feel that the project has helped with the protection of your household?

- ☐ Yes
- ☐ No

Are you interested in a follow up interview?

- ☐ Yes
- ☐ No

If yes, please write up your contact information here:_____

Thank you very much for your time, it will help us a lot!

Observations for the team

- Is the respondent comfortable during the interview?

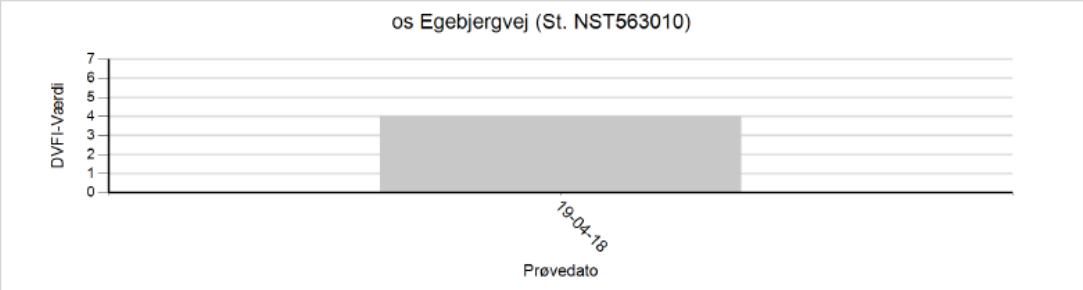
- Does she/he seem reliable?

- Characteristics of the house and immediate surroundings (barriers, ditches, sand bags, signs of flood

5.6 Biological assessment of Grønnehave Bæk

Dansk VandløbsFaunaIndeks

Stationsnr	WinBio Stationsnr	Stednavn	Lokalitet	Stationsejer
51000652	NST563010	os Egebjergvej	Grønnehave Bæk	Miljøcenter Roskilde



Dato	Tilsynsejer	DVFI klasse	DVFI klasse betegnelse	Kvalitetssikringsniveau	Kvalitetsstatus
19-04-2018	Odsherred kommune	4	Noget forringet biologisk kval	IndK	GODK

5.7 Water Quality Methods:

1. Sample Site: The streams will be sampled upstream from any bridge, culvert pipe, flume, or other artificial structure, and downtream before the water enters the marina. The lake will be sampled at its inlet and outlet to and from the stream. (Note) Approach the sampling location from downstream if possible. Use a GPS to record the latitude and longitude coordinates at each sample site and take a picture to help identify the location (Musselman, 2012).

2. Label Bottles: Sample bottles should be 250 ml. Using a black marker to write on the bottle the sample location, date and year, time of day, water temperature, and sampler's name (Musselman, 2012).
3. Take Water Temperature: Place a thermometer in the water near the sampling point, preferably downstream. Avoid disturbing the bottom at the sample site (Musselman, 2012).
4. Collecting the sample (repeat 4 times per indicator at each sample site):
    i. Prepare Bottle by first rinse the inside of the bottle, the inside of the cap, and the rim with the deionized water to avoid contamination. After the final rinse, place the cap back on. Now collect the sample (Musselman, 2012).
    ii. Collecting the Sample: Return to the sampling point and reach in as far as possible into the stream. Hold the cap on the bottle then immerse the bottle completely 10 cm deep, or half-way to bottom if the stream is shallow (write the depth the sample was collected on the field notes after the sample is collected and secured). If the stream is too shallow to immerse the bottle fully, collect as much as possible, being very careful not to touch the bottom where sediments can be disturbed and make sure no surface film flows into the bottle (Musselman, 2012).
    iii. Place the bottle flat on its side under water pointing the mouth of the immersed bottle upstream, and remove the cap. Fill the bottle about half full. Then place the cap back on while still underwater. Remove the bottle from the stream and shake (Musselman, 2012).
    iv. Rinse Bottle Three Times, Then Collect the Sample. (Note) Remember to pour out any remaining rinse water downstream of the sample point (Musselman, 2012).

v. Use the same procedure as before but fill the bottle completely. Tip the bottle up to remove all air bubbles before capping. If necessary, squeeze the bottle slightly as the cap is tightened so no air remains in the bottle (Musselman, 2012).

vi. Seal and Store Bottle: Once the final sample is collected, seal the sample bottle immediately in a zipper lock bag, place it in a cooler, and keep cold with frozen ice-packs or ice. (Note) Do not place ice in the same bag as the sample. Do not expose sample bottles to the sunlight (Musselman, 2012).

5.8 Consent Form

- I_____voluntarily agree to participate in this research study.

- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.

- I understand that I can withdraw permission to use data from my interview within two weeks after the interview, in which case the material will be deleted.
- I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
- I understand that participation involves answering questions within the survey, or taking part in an interview.
- I understand that I will not benefit directly from participating in this research.
- I agree to my interview being audio-recorded.
- I understand that all information I provide for this study will be treated confidentially.

- I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.

- I understand that disguised extracts from my interview may be quoted in a student presentation, and report.

- I understand that if I inform the researcher that myself or someone else is at risk of harm they may have to report this to the relevant authorities - they will discuss this with me first but may be required to report with or without my permission.

- I understand that under freedom of information legalisation I am entitled to access the information I have provided at any time while it is in storage as specified above.

- I understand that I am free to contact any of the people involved in the research to seek further clarification and information

Researchers: Alana Benjamin, Maria Lamotte, Brynton Johnson, Alessia Malito, Mikkel Haupt

Signature of research participant

_____ _____

Signature of participant Date

Signature of researcher
I believe the participant is giving informed consent to participate in this study

_____ _____

Signature of participant Date

Typology	Characteristics of each type
1. Manipulative participation	Participation is simply a pretence, with "people's" representatives on official boards but who are unelected and have no power.
2. Passive participation	People participate by being told what has been decided or has already happened. It involves unilateral announcements by an administration or project management without any listening to people's responses. The information being shared belongs only to external professionals.
3. Participation by consultation	People participate by being consulted or by answering questions. External agents define problems and information gathering processes, and so control analysis. Such a consultative process does not concede any share in decision making, and professionals are under no obligation to take on board people's views.
4. Participation for material incentives	People participate by contributing resources, for example, labor, in return for food, cash or other material incentives. Farmers may provide the fields and labor, but are involved in neither experimentation nor the process of learning. It is very common to see this called participation, yet people have no stake in prolonging technologies or practices when the incentives end.
5. Functional participation	Participation seen by external agencies as a means to achieve project goals, especially reduced costs. People may participate by forming groups to meet predetermined objectives related to the project. Such involvement may be interactive and involve shared decision making, but tends to arise only after major decisions have already been made by external agents. At worst, local people may still only be coopted to serve external goals.
6. Interactive participation	People participate in joint analysis, development of action plans and formation or strengthening of local institutions. Participation is seen as a right, not just the means to achieve project goals. The process involves interdisciplinary methodologies that seek multiple perspectives and make use of systemic and structured learning processes. As groups take control over local decisions and determine how available resources are used, so they have a stake in maintaining structures or practices.
7. Self-mobilization	People participate by taking initiatives independently of external institutions to change systems. They develop contacts with external institutions for resources and technical advice they need, but retain control over how resources are used. Self-mobilization can spread if governments and NGOs provide an enabling framework of support. Such self-initiated mobilization may or may not challenge existing distributions of wealth and power.

Source: adapted from Pretty (1994), Satterthwaite (1995), Adnan, Alam and Brustnow (1992), and Hart (1992).

5.9 Pretty (1995) Participatory Methods Typology

Typology	Characteristics of each type
1. Manipulative participation	Participation is simply a pretence, with "people's" representatives on official boards but who are unelected and have no power.
2. Passive participation	People participate by being told what has been decided or has already happened. It involves unilateral announcements by an administration or project management without any listening to people's responses. The information being shared belongs only to external professionals.
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