Challenges in flood risk management planning

An example of a flood risk management plan for the Finnish-Norwegian River Tana

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RAPPORT

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Challenges in Flood Risk Management Planning

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Abstract: This example of a flood risk management plan describes the challenges in flood risk management planning in the Norwegian-Finnish watercourse Tana. The plan describes the new paradigm underlying the Flood Directive and some of its potential implications. It presents the catchment area of Tana and gives a description of the Sámi indigenous culture in the region. The plan also describes the specific challenges related to floods caused by ice jam processes and the possible effect of flood related climate change in the area. Different categories of measures are suggested, including a new category of cultural and philosophical measures. At the end, a summary of the lessons learned and further recommendations are presented.

Key words: Tana, EU's Flood Directive, SAWA, flood risk, flood risk management plans, indigenous context, measures against flood risk

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Preface

This report is a contribution to the Strategic Alliance for Integrated Water Management Actions (SAWA) project. SAWA is an EU Interreg IVB North Sea Regional Development project concerned with reducing the risk of flooding. An intermediate target of SAWA is to exchange experiences on how to meet the demands of the European Flood Directive (Directive 2007/60/EC). The Flood Directive establish a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Community.

As partner in SAWA, the Norwegian Water Resource and Energy Directorate (NVE) has undertaken to deliver flood risk management pilot plans in two river basin districts; the Tana River and the Gaula River. The following report documents the work related to Tana. Within the SAWA project, this task contributes to Work Package 1 – Adaptive Flood Risk Management, phase 4, activity 1.8.

The Tana River Basin District was selected as a pilot project due to being an example of a trans-boundary water course. The river marks the frontier between the northern part of Norway and Finland. Further on this river basin district is characterised by dispersed settlement, flood problems cause by ice jam processes and cultural issues related to indigenous people of the North Calotte, the Sámi. The main object of this report is to discuss challenges in flood risk management in the pilot area, with weight on these distinctive natural and cultural characteristics, and not to produce a complete flood risk management plan.

A preliminary flood risk assessment for the Tana Rive Basin District has been carried out as a joint project between Norway and Finland. In the transboundary catchment area (288 km of the river) no areas were pointed out as potential significant flood risk areas. However, at the Norwegian side of the watercourse Karasjok Township at the brink of Karasjokha River, a tributary to Tana, was pointed out as potential significant in relation to flood risk. The report has therefore a specific focus on the area around Karasjok Township.

The report has been written by Eirin Annamo in cooperation with Gunnar Kristiansen. Both are employed at NVE. Gunnar Kristiansen, Knut Hoseth and Niina Karjalainen have contributed to the preliminary flood risk assessment for Tana River Basin District. The first two are employed by NVE, while Niina Karjalainen is employed by ELY-centre for Lapland (Centre for Economic Development, Transport and the Environment).

Steinar Schanche
Head of Section, Land Use and Watercourse Safety

Introduction

In 2002 the Water Directors of the European Union, Norway, Switzerland and Candidate Countries agreed to take an initiative on flood prediction, prevention and mitigation. The background is to be found in the recent major damaging and catastrophic floods at the European continent, and the fact that there was no legal instrument at the European level for the protection against flood risks. The team agreed on three points (Pasche, 2009):

1. Traditional flood risk management strategies, centred on building infrastructure had failed to ensure safety for people, real estate and goods to the extend it was supposed.
2. Risk will become more frequent in the future as a result of climate change, uncontrolled human activities and human intervention into the processes of nature and growing impact of floods on human health and economic losses.
3. Concerted and coordinated action at the level of the European Community would bring considerable added value and improve the overall level of protection.

As a result of these outcomes, the European Community passed in 2007 a new legal instrument: the Directive on the Assessment and Management of Flood Risks (EC 2007/60), which entered into force on November 26, 2007. The new Flood Directive covers all types of floods within river basins, sub-basins, stretches of coastline for which potential significant flood risks exists, through riverine floods, flash floods, urban floods, coastal floods and floods caused by heavy rainfall.

Norway is connected to the European Union as an EFTA country, through the Agreement on the European Economic Area (EEA). The Flood Directive is not adopted as a part of the EEA Agreement, and the directive is therefore not implemented into Norwegian legislation. Nevertheless, through the SAWA co-operation The Norwegian Water and Energy Directorate (NVE) decided to try out flood risk management planning according to the guidelines in the Flood Directive, supposing this will be a useful experience independent on Norway's formal connection to the Flood Directive.[1]

[1] NVE is a directorate under the Ministry of Petroleum and Energy (OED) and is responsible for administration of the nation's water and energy resources. NVE's mandate is to ensure an integrated and environmental sound management of the country's water recourses and bears overall responsibility for maintaining national power supplies. The Directorate is also national authority for flood risk management, including flood inundation mapping; flood forecasting and early warning; guidelines for land use planning; and financial assistance related to physical protection work and emergency preparedness.

1.1 Purpose of the Flood Directive

The purpose of the Flood Directive *is to establish a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Community (Article 1 of the Flood Directive).* A successful implementation of flood risk management plans asks, according to the Flood Directive, for a harmonization of the Flood Directive with the Water Framework Directive (EC 2000/60), and for public participation procedures in the preparation of these plans. Long term developments, including climate change, as well as sustainable land use practice in the flood risk management cycle shall also be taken into consideration.

Implementing the Flood Directive means on the one hand to put into action a new paradigm related to flood risk management, and on the other hand to express this new way of thinking in the development of the new practical means of flood hazard maps, flood risk maps and flood risk management plans. Flood risk management plans should therefore in addition to the presentation of objectives, measures and action to take to reduce flood risk also communicate the new paradigm underlying the Flood Directive.[2]

The new paradigm underlying the Flood Directive reflects the recognition of a necessary change of paradigm from flood protection to sustainable flood risk management and the implementation of an integrated and holistic approach towards flood risk management. A holistic approach to flood risk management is shown in the figure below. This approach lays the ground of this plan but will also be expanded on.

[2] What is important to understand is that a new paradigm introduces a new understanding with the potential to develop the very way we use to think about something. This is why this report has given more space to different aspects related to the new paradigm than would be the usual approach in flood risk management planning.

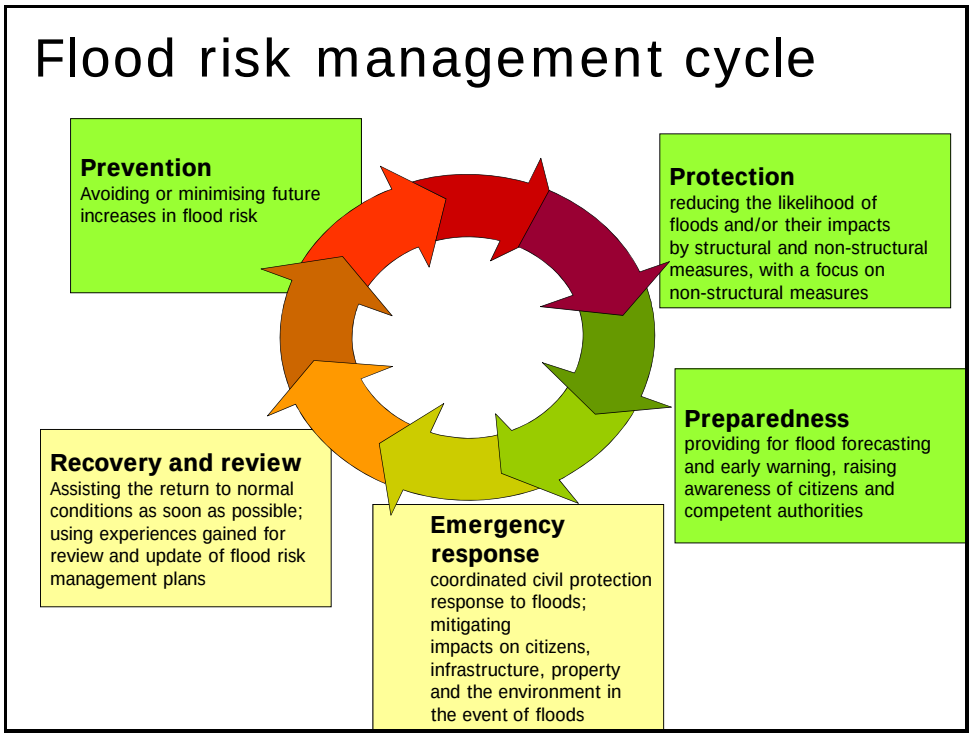

Figure 1: Holistic view of flood risk management with an emphasis on prevention, protection and preparedness.

1.2 SAWA – A New Perspective

The Flood Directive is according to SAWA based on a change of paradigm *from flood protection towards sustainable flood risk management*. Underlying this policy shift is an understanding of flooding as a natural phenomenon and the realisation that we must learn to live with and adapt to flood events. Structural or engineered solutions to manage existing risks will still be an important part of the flood risk management, but the direction forward is to be found in an integrated, holistic, non-structural and catchment-based approach to flood risk management. The key messages of the Flood Directive can be summarized as follow (Pasche, 2009):

1. Floods are natural phenomena that cannot be completely prevented.
2. Flood risk will increase due to climate change and rising vulnerability on flood prone areas.
3. Risk management is the appropriate strategy to deal with this challenge.
4. The approach to manage the risk of natural hazards requires a change of paradigm, from defensive action against hazards to *living with floods*. Human uses of flood plains should be adapted to the existing hazards. Mitigation by non-structural measures is more sustainable than flood defence by building infrastructures and should be enhanced to reduce the vulnerability of human beings and goods exposed to flood risk.

5. Human interference into the processes of nature should be reversed, compensated and, in the future prevented.
6. It should give back space to the river wherever possible and promote appropriate land use and agricultural and forestry practises throughout the river basin.
7. The whole catchment area of watercourses has to be covered in a holistic way by taken into account all relevant aspects of water management, soil management, spatial planning, land use, the vulnerability of the area and natural conservation.
8. Flood risk management needs to be coordinated with other existing water directives, leading to an integrated river basin management in which the different processes benefits from the mutual potential for synergies.
9. Everybody who may suffer from the consequences of flood events has the responsibility to take own precaution measures. A certain degree of public participation is therefore required.
10. The water authorities are obliged to support the public by raising public risk awareness through information about all important parameters. This includes education about how to act during flood events and the establishment of flood alert systems to give correct flood warnings and forecasts by real time media coverage.
11. Solidarity is essential. Flood risk management should be coordinated cross-border, cross-disciplinary and cross-institutionally.

The principles of the new paradigm can also be described as follow:

1. Living with flood instead of defending ourselves against it. This leads to a new concept of nature.
2. Living with climate change and risk. This implies a future oriented relationship to life.
3. Stakeholder’s involvement and creative learning. This reflects a new way of cooperation and a beginning new concept of governance.
4. Non-structural solutions. This implies a move from survival and defense to new possibilities.
5. Integrative and interdisciplinary thinking. This is necessary if one wants to develop the management concept and create new possibilities in culture, consciousness and society.

1.3 Flood and Flood Risk

The risk of flooding has always been a threat to humanity, since water, essential to all life, has caused people to settle along the big floods and lakes and along the coast. Rivers, lakes and the ocean have provided people with food and fresh water; they have served as a means of transport and are also the source of different

forms of energy. The beauty and serenity water gives to a landscape is also a strong factor why people choose to live close to water. One therefore has to bear in mind that people, as long as possible, will choose to settle along water sources. On the other hand there is today a growing awareness of the increasing flood risk due to a growing population, a strong trend of urbanization, increasingly complex and vulnerable communities and climate change.

1.3.1 Definition of Flood

Flood is in the Flood Directive defined *as the temporary covering by water of land not normally covered by water*. This shall include floods from rivers, mountain torrents and lakes, flash floods, storm water floods and coastal floods/storm surge. Further on the Flood Directive states that flooding is a natural phenomenon that cannot be completely prevented. It can happen at any time in a wide variety of locations and its causes, extent and impacts are varied and complex. There is a consequent risk when people and human property, infrastructure, agricultural land, cultural heritages etc., are present in flood prone areas.

The concept of flood may also be defined by use of statistics. Different magnitudes of flooding have different probability of occurrence. This is the likelihood of a particular magnitude flood occurring in any given year. Thus a 10 % annual probability event describes a flood event which has a 10 % (or 10 in 100) chance of occurring in any given year. It should be noted that the likelihood of a flood event occurring in the future, whatever its probability, is independent of the time since the last flood of similar magnitude.

1.3.2 Definition of Flood Risk

As the Flood Directive defines risk *as the product of the probability of flooding and its negative consequences*, flood risk management in the new way does not only seek to reduce the flood probability but also includes an alternative perspective that considers the vulnerability of the flooded area (receptor) and the exposure of the receptor to the risk. This new perspective can be envisaged as a Source-Pathway-Receptor perspective. The source is the origin of the flood (e.g. rainfall or ice jam); the pathway is the way in which the flood is transmitted (e.g. the structure of the river channel), and the receptor represents the urban fabric and people with their activities on the flood plain which will be affected by the flooding. Traditionally flood risk management has in general been focused on river channel control through dikes and walls. According to the Flood Directive these measures don't have the flexibility to adapt efficiently to changes in the future projections of floods, and may therefore leads to higher flood risks (Pasche, 2009).

1.4 Non-structural Measures

Flood risk management in the sense of the new EU policy addresses all components of the Source-Pathway-Receptor system, and prioritises what is called Flood Probability Reduction Measures (FPRM) and Flood Resilience Measures (FRM) The first category includes those measures which have an impact on the source and pathway by restoring the retention potential of the

natural hydrological system or even enhance the detention for rain water through small retention basins, while the second category is measures that improve the flood resilience of the receptor by reducing its vulnerability and exposure to flooding. The FPRM and FRM are also referred to as adaptive or non-structural measures, pointing to the new perspective of living with water instead of defending ourselves against it. Some of these measures may be regarded as traditional, but most of them may be defined as emergent, as they are newly developing.

1.4.1 Flood Probability Reduction Measures (FPRM)

A key component of FPRM is what is called sustainable drainable systems (SUDS) – which are a sequence of management practices and control structures which can drain surface water in a more natural way than most conventional techniques.

An important point of SUDS is that besides ensuring individual safety and flood protection, they also aim to improve the urban environment through their potential for multifunctional use. Retention basin may, for example, providing flood water control as well as acting as recreational areas providing habitat for wildlife. SUDS are therefore a concrete manifestation of the new paradigm and points us to a future where *learning to live with water (nature)* becomes a potential not only for a better flood risk management, but also for a more creative future.

Measures that re-establish the natural potential of rivers and catchments to retain water should also be given preference in FPRM, such as the protection and restoration of wetlands and flood plains, the removal of obsolete flood defence infrastructures from rivers, the restoration of natural rivers and the enhancement of sustainable land use practices on a catchment level (for example deforestation).

At present time the FPRM measures seems to play a minor role for Tana, but may be of greater importance in a future change of climate, where for example pluvial floods and surface water flooding will constitute an increasing problem.

1.4.2 Flood Resilience Measures (FRM)

While the first category of measures (FPRM) influences the source and the pathway, the second category (FRM) is measures that improve the flood resilience of the receptor by reducing its vulnerability and exposure to flooding.[3] These measures are regarded as potentially very effective as they are conceived as having no negative impact on the hydrological system. In addition to preventing flooding or reducing the consequences thereof, FRMs may also support the recovery of society after an extreme flood, thus helping to enhance the resilience of the local system.

According to SAWA the transition towards more resilience has to start with building the capacity of the human recourses. And capacity building from the perspective of SAWA is an integrated, complex and holistic approach taking all levels of society and the learning system into account. Implicit in the resilience

[3]The term resilience can be defined as the ability of a system/community/society to react and recover from the damaging effects of realized hazards.

concept is also thinking around education and pedagogy, and the importance to develop the most appropriate educational means for the situation in question.

The key issue in the SAWA capacity building approach is to increase flood risk awareness and ability to respond among the stakeholders. Capacity building in this sense surpasses simply awareness in that it should aim at developing the capability of stakeholder groups to understand and engage in all facets of the problem. In other words: It will not be sufficient to just inform people to be proactive in tackling flood risk, but to impart, teach or pass on the required knowledge and skills in a way that deliver responses. Interactive learning groups, learning alliances, collaborative platforms and life-long learning programmes may be suitable educational vehicles for this new approach.

Concerning the different levels of stakeholders involved in flood risk management, three levels should be considered: institutional, community and individual. For these three levels different knowledge and skills are required, as well as different pedagogical-educational-communicational approaches. Also within the different level different pedagogical-educational-communicational approaches may be required, like for example in Karasjok where the indigenous context of the Sami people requires a certain sensibility and way of communication from the national governance authorities.

1.5 Stakeholders Involvement

The Flood Directive demands an active involvement of interested parties in the whole planning process of the flood risk management plans. *Member States shall encourage active involvement of interested parties in the production, review and updating of the flood risk management plans referred to in Chapter IV (Article 10 of the Flood Directive).* However, little information is given about the strategy to develop and implement the flood risk management plans on a local level. To meet this challenge, one of SAWA's most important objectives has been to develop a good governance concept which is supporting the implementation process best and which will lead to acceptance and proper application of the new paradigm in flood risk management (Pasche, 2009). [4]

In a general way we can speak about two different ways of governance, a top-down and a bottom-up approach of decision making. In the first case the plan is developed by professionals. Public's opinion and input is only requested through public hearings and written objections at the end of the approval process. This approach does not necessarily fulfill the demand of the Flood Directive of encouraging active involvement of stakeholders in the whole planning process. The second method, the bottom up approach, will on the other hand involve all stakeholders, professionals and public from the very beginning, and together they develop the plan in a continuous collaborative process. This means that stakeholders on the lower levels are given more responsibility for the reduction of

[4] Governance is defined as the process of decision-making and the process by which decisions are implemented. It is more a general road map to progress rather than being a well-defined destination to reach.

flood than has usually been the practice. Especially in environments where many conflicting interests overlap (e.g. urban catchments or multiethnic/indigenous contexts) this broader involvement of stakeholders may be crucial for effective flood risk management planning.

The top down approach is however not about conflating the roles and responsibilities of the different levels of governance, but to give more attention to the communicative aspects of management and to enter into an ongoing developmental cooperation between the different levels in a society. One simple but effective way to think about capacity building of stakeholders is for example to speak about the new paradigm of flood risk management in all meetings whatsoever. This means one does not necessarily need to arrange specific workshops to educate the stakeholders; as professional authorities one can communicate, both explicitly and implicitly what the Flood Directive is about and why it is important to implement it in the area in question. This is what has been done related to Karasjok and Tana.

The main stakeholders of this project have been Karasjok municipality and the Sami Parliament. NVE has during the last ten years developed a very good relationship and cooperation with Karasjok municipality, which has been of great advantage in this project. A new development has been the process of working out a closer relationship with the Sami Parliament. Representatives of the Sami Parliament have provided us with important information about the Sami indigenous context in general and the local context of Karasjok and Tana in specific. As part of developing the governance approach into a more bottom up approach, we have in our stakeholder cooperation used a conscious cultural approach related to the Sami-Norwegian multicultural context of Tana. As a national authority we have seen the importance of knowing the history and the cultural landscape of the Sami, and the challenges related to for example local knowledge and communication issues[5].

1.5.1 Indigenous Context

As explained above the Flood Directive demands active involvement of interested parties in the development, review and updating of the flood risk management plans. This perspective opens up the possibility to take into account specific issues related to an ethnic or indigenous context in the flood risk management plans where appropriate. Based on this we have seen the necessity to add as an appendix a chapter on the indigenous Sami context of Norway, for four reasons: (1) the Tana River basin is situated in the midst of the Sami area of northern Norway and Finland; (2) the majority of the people living in the Tana area are of Sami heritage; (3) the indigenous context is complex and not easy to understand; (4) we see the development of cultural competence as one of the possible new measures in flood risk management.[6].

[5] The Sami culture is for instance still to a certain degree biased towards an oral way of communication.

[6] A development of cultural competence related to the Sami indigenous context is discussed at the end of appendix 1.

2 Description of the Tana River Basin District

The Tana River, with a catchment area of 16 380 km², drains from south to north in the midst of the Sami area of Northern Norway and Finland. The river, with a total length of 338 km is one of the largest rivers in Scandinavia and the fifth largest river in Norway, acting as a part of the official border between Norway and Finland for over 288 km. One third (31 %) of the river's catchment is found in Finland, while two thirds (69 %), including the mouth and the outlet of the river is situated in Norway. In Finland the Tana River basin is part of the Tana-Neiden-Pasvik river basin district and in Norway a part of Finnmark water region (Vannregion Finnmark). The main part of the Finnish catchment area is located in Utsjoki municipality, while smaller parts are to be found in the municipalities of Inari and Enontekio. On the Norwegian side the catchment area is divided between the municipalities of Karasjok, Tana, Kautokeino, Alta and Nesseby, with the major part located in Karasjok and Tana.

Figure 2: Catchment area of Tana.

2.1 Geography

The actual river Tana begins from the connection point of the river Anarjokha and the river Karasjokha downstream Karasjok Township. From the connection point to the national frontier there is approximately 109 meters fall and from the national frontier to the Arctic Ocean the fall is 15 meters. There are 15 tributaries

that flow to the main channel and 36 tributaries' tributaries, all with a catchment area of over 100 km². The lake percentage of the catchment area is only 3.1. Tana is also the river with the largest flood discharge (Q = 4800 m³/s) and the largest ice jam processes in Norway.

Tana River flows in many locations about 2-300 meters below surrounding highlands. The river has piled up within years huge sand layers, to which it has dug river terraces of different levels. These terraces act as good agricultural and living places. The median elevation within the river basin is 333 meters above sea level (masl) and approximately 80 % of the area is located between 200 and 450 masl. The highest mountain area in the basin is Gaissaene with its highest top Rasti Gaissa (1067 masl).

The vegetation of the Tana River Basin consists of extensive forests of mountain birch, broken up by large areas of peat bogs. There are also areas with pine forests, particularly in the Karasjok and Kautokeino municipalities. Tundra heaths dominate the landscape above forest level, whilst the highest peaks are mainly barren and rocky. Over 90 % of the river basin area in Finland is forest and marsh. The catchment area on the Norwegian side differs from the Finnish in containing much more mountain areas, with altitudes from 500 up to 1000 masl. Approximately 40 % of the Norwegian area contains a mixture of mountain and forest areas while10 % consists of bog and wetland areas. Developed and constructed areas constitute less than 0.5 %.

Tana is the largest and most productive salmon river in Finland and Norway that is still in its natural state; each tributary having a unique genetic salmon group specific to that river. There are also important natural values connected to the river banks with several eastbound endemic plants and insects. One of the most beautiful species to be found is the purple colored *Thymus Tanaensis* (Tanatimian) which can cover large areas of the flood banks during the summer season. The river delta of Tana is one of the largest virgin river deltas in Norway; rich in birdlife, with large numbers of ducks and waders, especially in the migration seasons. Various fish species and seals are commonly found in this area.

Picture 1: Thymus Tanaensis. Photo: Gunnar Kristiansen

2.2 Settled Areas and Land Use Management

The Tana River basin is *sparsely populated* with only about 10 462 inhabitants (2005) within the totality of the river basin. Constructed areas are mainly situated in the three villages of Utsjoki, Nuorgam and Karigasniemi on the Finnish side and the two villages of Karasjok (at the beginning of the river) and Tana Bru (at the outlet) on the Norwegian side. In Karasjok Township there live approximately 2768 (2011) people while Tana Bru has only 545 inhabitants. On the Finnish side the biggest population centre is the village of Utsjoki with about 300 inhabitants.

The Tana River basin is of extreme importance to the people that live here. The river not only offers opportunities for leisure activities, like fishing, hiking and hunting, it plays a crucial role in terms of a livelihood. Primary industries like reindeer herding, agriculture, forestry and fisheries has traditionally been the dominated occupations while the service industries have become more and more important during the last years. Despite this development a relatively large part of the population is still employed in agriculture and reindeer husbandry (15-17 %).

The municipalities of Tana and Karasjok are among the largest agricultural areas in Finnmark County, and the unique form of arctic river farming along the river are of specific importance to the Sámi identity formation. A unique type of river boat has been developed for the purpose of salmon and trout fishing in the river. These boats are often hand-made and tailored for a specific part of the river and are for the fishers in Tana just as important as the fishing rod and the fishing line.

The cultural identity of the Sami people in the areas of the Tana River also applies to the many cultural heritages situated along the river. Since the Sami is recognized as an indigenous people, the Norwegian nation state has to grant them specific rights. This may point to the necessity of giving special attention to the different monuments of antiquity along the river, and find a way, if necessary, to incorporate the protection of them into the flood risk management plan. From an indigenous perspective the cultural heritages along the Tana River are not only of local value, they have global significance as well.

2.2.1 Karasjok Township

Picture 2: Karasjok Township. Photo: Gunnar Kristiansen

Karasjok is a small township situated at the riverbanks of Karasjokha, 18 kilometers from the Finnish border. Today's Karasjok has grown from being the old Sami winter village Ávjovárri, situated about 40 kilometers from Karasjok centre, to a modern society. The municipality is considered to be multiethnic; in addition to the Sami, who represents over 80% of the population, there are also Norwegian and Kven settlements.[7] Sami and Norwegian language have today an equal status in the municipality.

Situated in the heart of the Sami area reindeer herding still has a central role in Karasjok, with about 18 % of the population involved. The others are involved in agriculture, the tourist industry, other service industries, state and municipal business, Sami institutions, Sami handicrafts and some industry. Agriculture in the Karasjok area can be traced back to the 16-17th Century, and was a result of the Sami transition from a semi-nomadic lifestyle to a more settled one, accompanied by the Norwegian colonization process. Agriculture has also played a significant role in the area around Karasjok in recent time and still does.

Many of the most important Sami institutions such as the Sami Parliament, The Sami Collections and the Sami Artists Centre are located here. The old church in Karasjok, dating from 1807, is the oldest Lutheran church in Finnmark, and the only building left after the Germans burnt down all the buildings in Karasjok Township at the end of World War II (see 4.3.2).

[7] Finnish descendants recognized as an ethnic minority in Norway.

Picture 3: The old church of Karasjok. Photo: Gunnar Kristiansen

2.3 Hydrology

The Sami name of Tana is Deatnu, meaning the Giant. The beautiful and dynamic river is characterized by large deposits of golden colored, organically formed sandbanks and shallow, quietly flowing river stretches alternating with rapid streams. The river course can change remarkably from season to season, catalyzed by the naturally occurring erosion processes that change and sculpt the riverbanks after periods of fluctuating rainfall and variations in flow. The riverbanks and sandy riverbeds represent huge sediment sources laid down during the end of the last ice age. These sediments can easily be eroded and transported downstream, thus changing the appearance of the river drastically.

Picture 4: Tana River. Photo: Gunnar Kristiansen

Flows in the Tana River vary greatly during a twelve months period. The watercourse has its naturally highest discharge during and after the annual spring flood, brought on by snow/ice melts and increased precipitation (usually around May turning to June). Most of the runoff takes place during this period. The lowest flow regime occurs naturally during the winter when precipitation falls only as snow. Some years floods may occur in the summer and fall due to heavy rain fall. Such annual changes in flow regimes can cause high erosion rates, particularly in areas with sand and gravel, and particularly with rapid increases in the volume of water in the river course.

The river basin has little possibility for tackling large flood event; because of the small lake percentage and the topography of the river basin there are almost none retention areas for flood water. Storage of floodwater in the water basin is therefore not an option and due to the few overflow recipients for increased runoff, flood events can occur rapidly in the main watercourse.

There are five water measuring stations and twelve ice measuring stations spread out in the Tana River basin[8]. The hydrographs below are from the water measuring station in Iesjokha, a river that converges with Karasjokha upstream Karasjok Township. Taken into consideration that the catchment area of Karasjokha is twice as big as Isejokha's, the two hydrographs give an indication of the discharge in Karasjokha

[8] Appendix 2

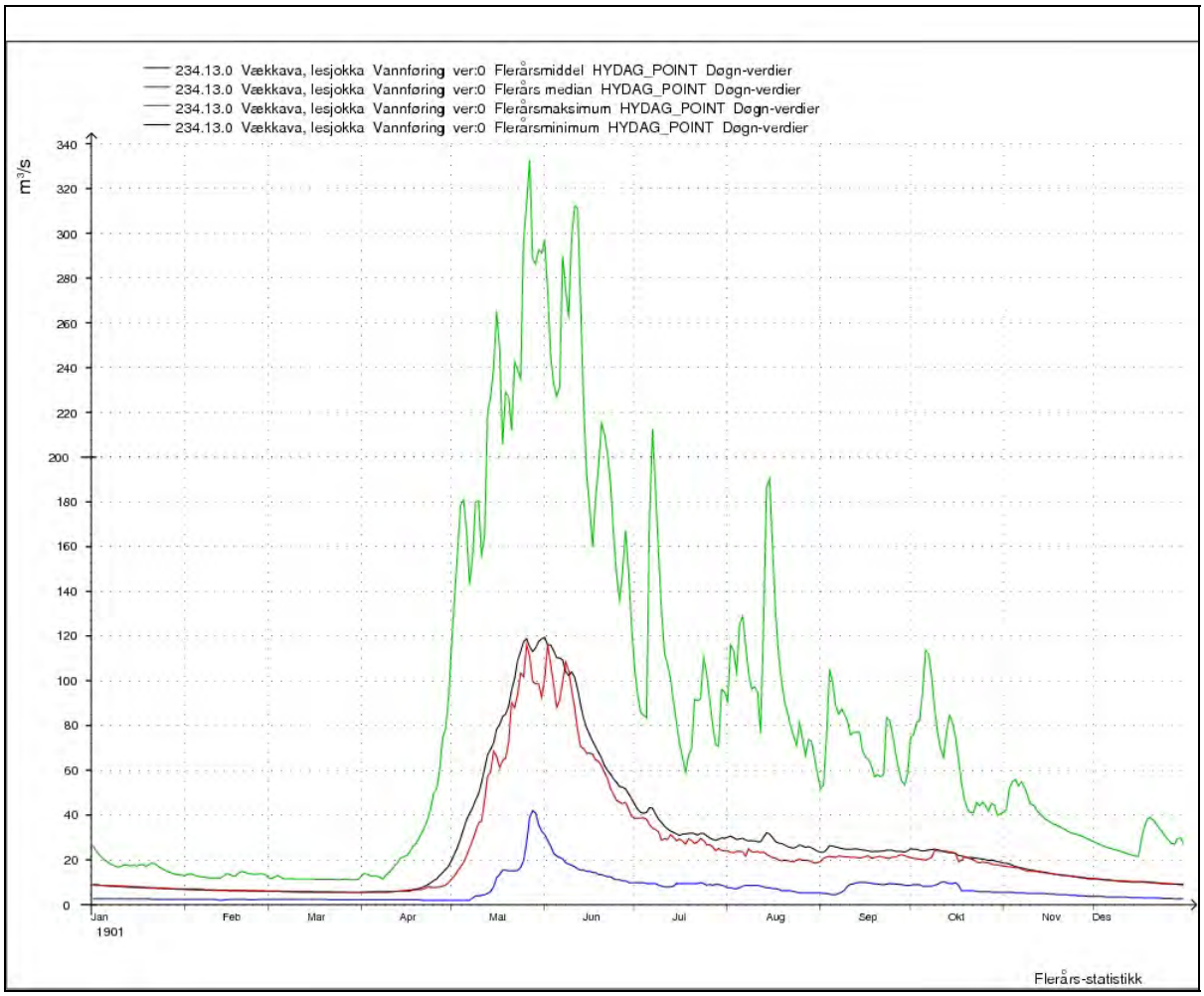

Figure 3: Annual change in discharge in Iesjokha.

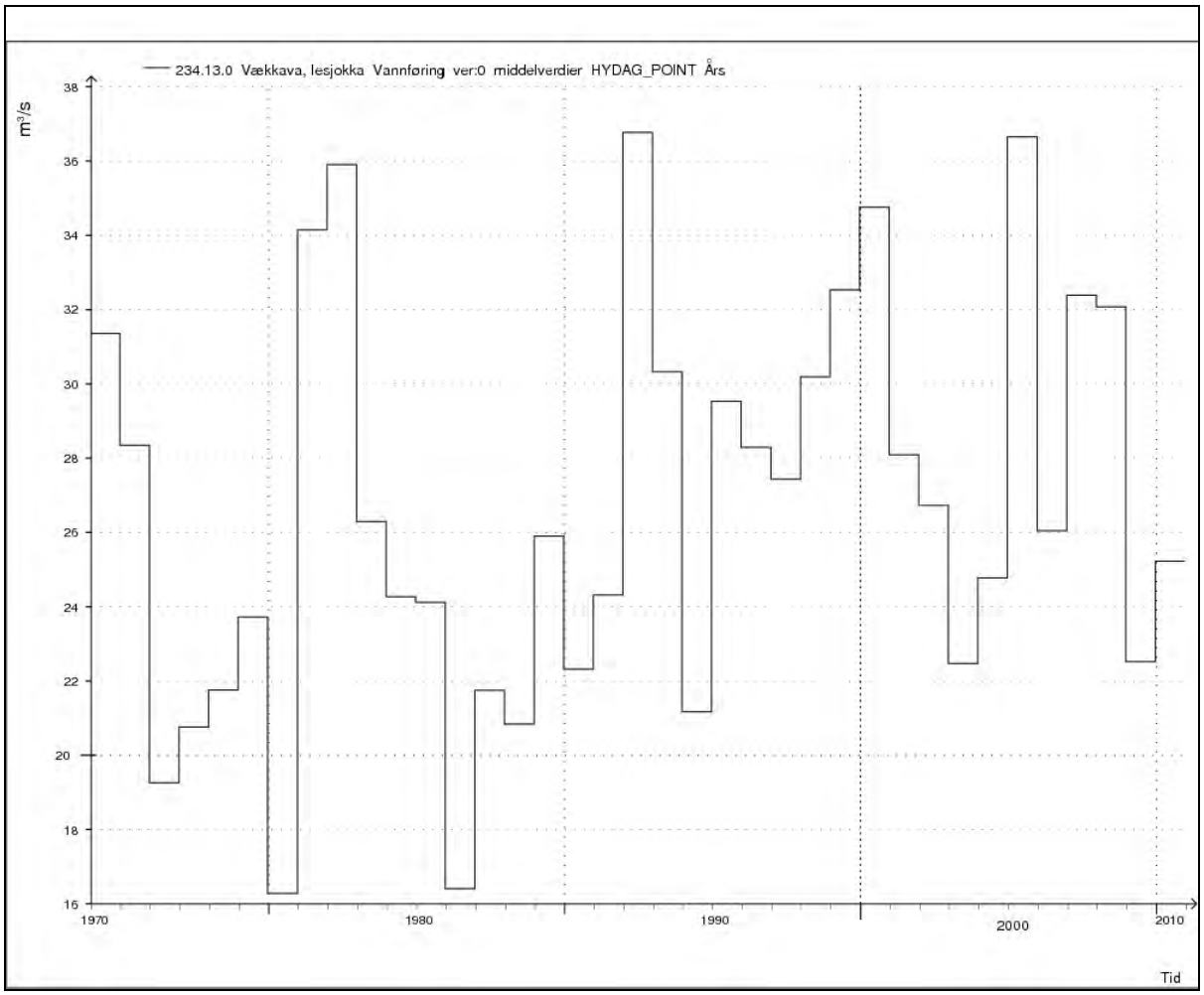

Figure 4: Maximum discharges in m³/s in Iesjokha.

2.4 Flood Problems and Relevant Flood Types

Tana is the river in Norway with the heaviest ice jam processes and is known for its large ice drift. The basin is located in a subarctic region where the winter provides long, stable periods of cold and relatively small amounts of snow. This means that when spring comes, the ice layer is often thick and minor layered. Since the river flows from the south to the north, from continental areas to the cost, with a much warmer climate in the south, the ice meltdown and thus the ice drift will often start at the beginning of the watercourse. So instead of a harmoniously meltdown from the sea level and backward, the breaking-up and transfer of the ice will regularly result in the formation of ice plugs and ice dams when the large amount of ice moves downstream and meets more stable ice at slow current areas, or stops at narrow/shallow areas of the river where the ice masses are blocked. Since the breakup process starts at the beginning of the river the whole river is affected by ice jam flooding when it happens.

Floods in the Tana River are usually caused by snow melt in combination with ice break-up during spring time (May-June). Ice break up in Karasjokha usually occurs in the period May (15-20), but has happened as early as late April (1990

and 2002) and as late as mid June (1867 and 1881). Ice jam processes occur in some way every year, but the effects differs quite a lot. There seems to be a connection between large discharge and heavy ice jam processes and the combination of these two factors seems to cause the biggest flooding in Tana. There also seems to be a connection between the point in time of the ice break up and the extent of flooding. Late ice jam processes at the end of May and beginning of June seems to cause the biggest problems. Studies to get a better understanding of the ice jam processes have been carried out since 1997, and SYKE (Finnish Environment Institute) has developed a forecast model for ice breakup in Tana that seems to works very well.

Because of the ice masses and the big ice rafts that floods into settled areas, ice jam floods often cause huge economic damages. An ice jam flooding also usually happens much faster than a regular rain/snowmelt flooding. While a regular flooding happens in a predictable way, an ice jam flooding occurs in the moment the ice dam breaks, resulting in a very fast inundation within half to one hour. And when an ice dam breaks it may cause harm in all directions. In addition to this, prognosis and localization of hazard areas are a challenge – even if the ice break up usually occurs some days before the maximum spring flood, and ice dams often are located at the same places, a flood caused by an ice dam at one point will for example cause a much bigger flood scenario than a flood caused by an ice dam at another point. This means that risk and danger related to ice jam flooding can be difficult to foresee (see 4.3). There is also a need for climate projections concerning ice jam flooding as this matter has not been included in the previous climate projections.

Picture 5: Ice jam in Tana. Photo: Sagat

3 Preliminary Flood Risk Assessment

According to the Flood directive, the firs step in flood risk management is a preliminary flood risk assessment in order to identify areas with potential significant flood risk. A preliminary flood risk assessment should be based on available or readily derivable information and include climate change impacts on flood occurrences. The assessment shall at least include the following:

- Maps of the river basin district at the appropriate scale including the borders of river basins, sub-basins and, where existing, coastal areas, showing topography and land use.
- A short description of the methods used to identify areas of potential flood risk.
- A description of the floods which have occurred in the past and which had significant adverse impacts on human health, the environment, cultural heritage and economic activity and for which the likelihood of similar future events is still relevant, including their flood extent and conveyance routes and an assessment of the adverse impacts they have entailed.
- A description of the significant floods which have occurred in the past, where significant adverse consequences of similar future events might be envisaged.
- For international basins, the necessary information should be exchanged between the countries.

3.1 Transboundary Cooperation

The transboundary cooperation between Northern Norway and Finland is well developed – both in terms of legacy and in terms of joint projects. NVE has together with the ELY-centre for Lapland[9] previously carried out three Interreg project related to the Tana River and are now in the process of a fourth one.[10] The three previous projects were mainly related to mapping of erosion sites and landscaping of erosion protection structures. The projects had as an overall goal to build good cooperation links between the Norwegian and Finnish authorities.

The present project is meant to follow up the previously intention of strengthening and developing the cross-border cooperation between the respectively authorities and to improve the networks between different actors in the planning area. The new project will for instance include cross-border internship between the two countries.

There has also been carried out a preliminary flood risk assessment for the Tana River Basin District as a joint project between NVE and the ELY-centre of

[9] Centre for Economic Development, Transportation and the Environment for Lapland

[10] Respectively 1999-2001, 2000-2004 and 2002-2005.

Finland.Because the preliminary flood risk assessment identified no areas as significant related to flood risk on the Finish side of the river, the further development of the flood risk management pilot plan for Tana has been taken care of by the Norwegian authority. The Finish partner has contributed with valuable information related to ice jam flooding and ideas on how to solve the issue of flooding in sparsely populated areas. Part of the ongoing Interreg project is for example to develop flood hazard maps for the Nourgam area on the Finish side of the river – a sparsely populated area that didn't meet the requirements of significant flood risk on a national level.

3.2 Description of Methods

For the preliminary flood risk assessment work it was decided to use a 1000-year flood (1000 years return period) as a base flood. More frequent flood can be derived from the 1000-year flood later on by decreasing the flood level with a certain amount. By choosing the biggest possible scenario of once a thousand years flood, the effect of ice jams has been taken into account. In addition, when the discharge is big enough, all possible areas possibly threatened by flood are taken into account.

The Finish PFRA approach was based on the recognition of a substantial lack of spatial information on major floods, resulting in the development of a procedure for identifying potential flood risk areas by extensively use of existing GIS (geographic information system) date. The basic idea for how to identify potential flood risk areas in Norway has been to develop a simplified GIS based method for flood susceptibility mapping. The idea was to first develop a simple method to calculate the potential maximum rise of water levels in various kinds of rivers. Then to use these maximum water levels rises to determine the flood water level and interpolating these to a flood plane. Combining this flood plane with the Digital Terrain Model (DTM) should make it possible to find the potentially inundated areas.

Flood prone areas have been compared with population and housing data as well as the national database system of properties and buildings and thus given an estimate of the number of people who can be affected by flood, together with the economical loss (buildings, roads and railways). The results from the GIS analyses have then been evaluated with respect to historical floods. In the preliminary flood risk assessment cultural heritage or environmental issues is not decisive on a national level, but will be taken into consideration in the flood hazard mapping and in the flood risk management plan.

Based on the GIS analysis no significant flood risk areas were suggested to the Finnish side of the Tana River basin, while Karasjok Township, situated at the river bank of Karasjokha River, was pointed out at the Norwegian side. So even if there are other areas of flood risk, both on the Finnish and on the Norwegian side of the watercourse, they are not taken into consideration because of the sparsely settlement pattern and the low amount of heavy infrastructure along the river. Even Karasjok Township is considered to be a marginal case, but was selected as a pilot area due to the special case of ice jam flooding.

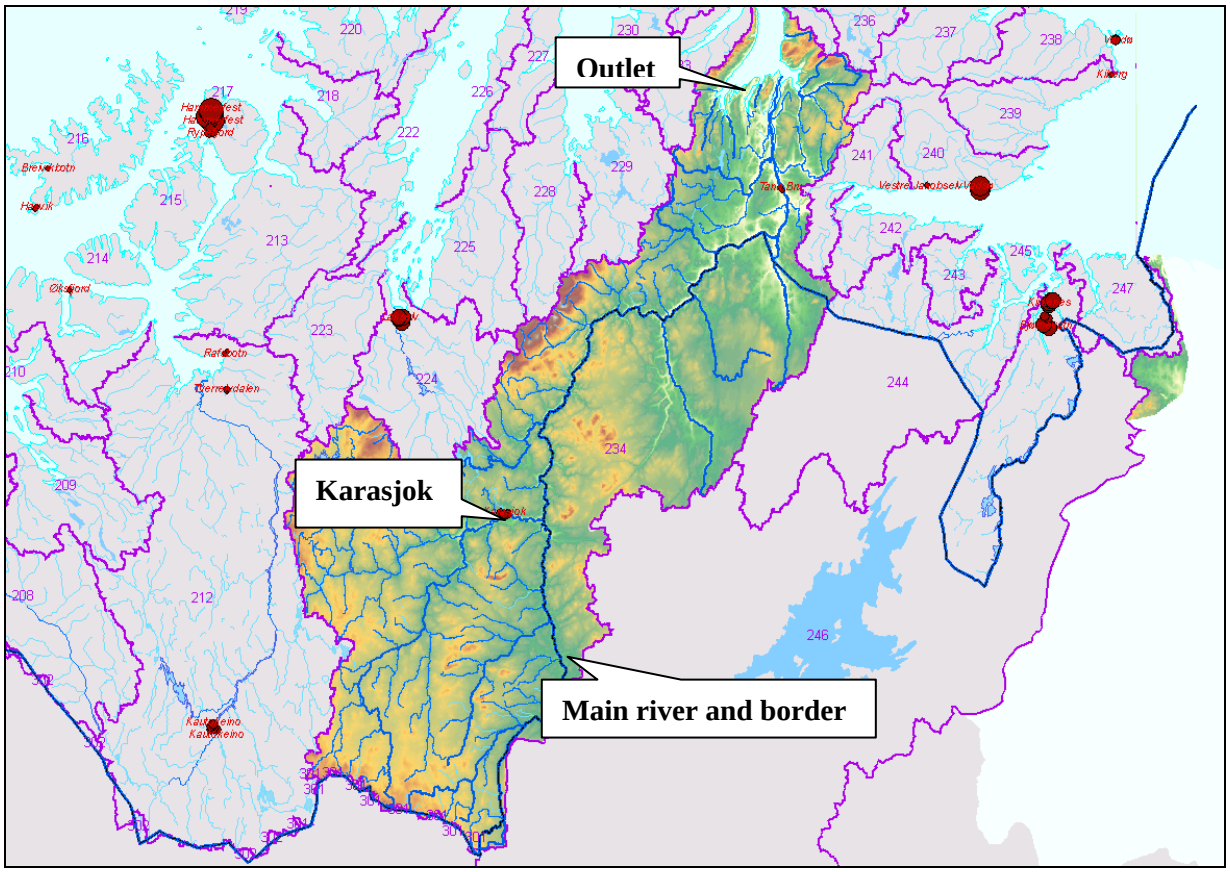

Figure 4: Tana River Basin District

3.3 Historical Flood Information

There have been several big floods in Karasjok Township during the last century that seriously affected big areas of settlement, important infrastructures and buildings. The most serious floods have occurred as a result of ice jam processes and the formation of ice dams downstream the community. The worst floods seem to have happened in 1917, 1938, 1959 and 1968, and these floods also caused damages further down the Tana River.

Quite little data describing the conditions of the historical flood events are available until the latest years. The reasons for this may be the indigenous influence with a focus on the oral tradition, the original semi-nomadic life style of the people living there, and the peripheral location of the watercourse in relation to the national authority. Local knowledge of the historical floods is also in the process of disappearing, since it depends on the people old enough to have experienced the floods. Due to this it is difficult to get an exact picture of the historical flood events in Tana. NVE has however managed to interview some of the older local people living nearby the river that still had some degree of local knowledge intact, and because of this been able to set up historical data for the time of the ice break up from 1858 until today. After 1917 documentation of the actual water level at the most serious floods in Karasjok Township has been undertaken.

Another available source of information related to the historical floods in Karasjokha and Tana are old newspapers. From the old newspapers we were able to understand some of the conditions and incidents happening around the flood events in Karasjok Township in 1959 and 1968. The description below is mainly a summary of the different newspaper articles covering the two incidents.

3.3.1 The 1959 and 1968 Flood in Karasjok

The flood in 1959 was mainly caused by a big ice dam at Ajunjarg (isdam 1 in figure 7) and involved a combination of several factors. Due to the continental climate of the area the cold and stable winter had built up a strong and thick ice cover. At the end of April, when the winter still prevailed in the area, a weather change appeared with sunshine, rain and warm southerly winds. This caused a very rapid ice and snow meltdown and a break up of a very thick and solid ice. The result was a very heavy ice jam process and a flood that came very quickly.

The ice started to drift Monday night, and Tuesday morning, May 5, due to an ice dam downstream the township people had to flee from several farms at the river banks. Within two hours the river rose 1.5 meters, throwing ice rafts and water masses into the developed areas.

The ice dam loosened temporarily but the water level remained constant during that day. A new ice dam was formed 5 km downstream Karasjok Township and a three to four kilometers long belt made of packed ice blocked the river course. The army tried to blast a hole in the ice Tuesday night and Wednesday morning, but in vain. It was like pin holes which new ice immediately corked again. People had to stay up all the night to move domestic animals, livestock and themselves to places above the flooding. More than 700 people had to evacuate their homes.

Wednesday afternoon the ice loosened and the water could run free again. Wednesday night, people could begin to return to their homes.

The flood had caused significant damages to buildings, roads, yards, cropland and pastures. High-voltage masts were torn to the ground and telephone poles were broken like matches. When the river retired huge amounts of mud and debris covered the yards, fields and pastures. Large ice blocks were also left on roads and fields. Some sheep drowned, but no human lives were lost.

The 1968 flood was like the flooding in 1959 caused by a sudden weather change in combination with a thick and solid ice cover. In this case the flooding happened unusual late, in the beginning of June, and was a result of rapid ice/snow melt in combination with heavy rain. Even if this was not an ice dam flooding and the economic losses were less than in 1959, the river went 4 meters above its summer level and caused significant damages to cropland, pastures, houses and roads. In the nearby area of Kautokeino the flooding was however catastrophic.

Picture 6: Karasjok Township at the 1968 flood. Photo: Harald M. Alstad

3.3.2 An estimation of damages caused by floods in the past nowadays

In Tana damages caused by floods in the past are assumed to be at the same level nowadays or even smaller, because the numbers of new buildings are relatively low and are in general not allowed to be placed in flood prone areas. In addition, the population has in general decreased along the Tana River during the last decades and is expected to decrease in the future. The population in Karasjok Township has however remained stable during the last years, due to the establishment of the Sami Parliament and other service institutions. These institutions provide working places and also cultural development that may attract people to the area.

3.4 Effects of Climate Change

Climate change directly affects how we may manage urban and other settled areas, society and water resources. To ensure that water recourses are managed appropriately it is important to understand how a changing climate is going to affect the environment we live in, how it can affect water in our regions and how urban and other settlement planning needs to change with regards to water and water bodies. The Flood Directive therefore states that the likely impacts of climate change on the occurrence of floods have to be an integrated part of flood risk management plans. We also need to bear in mind that there will always be a

varying degree of uncertainty related to climate projections due to the fact that we lack information about future emissions of greenhouse gasses and particles, and because climate models are incomplete or simplified. Uncertainty is greater on a local than on a global scale.

Even if there is a certain degree of uncertainty related to climate projection, the general climate change projections for Norway indicate changes in both temperature and precipitation regimes in the future (Lawrence & Hisdal, 2011). According to this picture the average annual temperature is expected to increase in all seasons throughout the country, and the average annual temperature is expected to increase between 2.3 and 4.6 °C by the end of the century. Further on the average annual precipitation is expected to increase by 5 to 30 %, although there are large differences between seasons and between regions in Norway. The largest increases in precipitation are expected during the autumn and winter months at most locations. The changes in temperature and precipitation will, in turn, impact the magnitude and, in some cases, the seasonality of peak runoff and floods throughout the country. It is also generally concluded that large snowmelt floods will be less common under a future climate, and that annual snowmelt floods will occur earlier in the year. It is also proposed that intensive local rainfall floods will become more frequent – there will be more days with heavy precipitation, and the average precipitation level during these days will be higher.

The Tana River basin is characterised by peak flow regimes dominated by spring to early summer snowmelt and ice jam. This is expected to continue in the future, although the increase in temperature and precipitation, together with a decrease in snow cover, is expected to lead to earlier peak flows of reduced magnitude (Lawrence & Hisdal, 2011). This conclusion is in accordance with a recent Finnish research, where it was concluded that for the next century spring floods are expected to diminish whereas autumn and winter floods will become more frequent in the Tana River region. In addition the spring flood is expected to occur earlier (Lotsari et al. 2010). According to these researches one may conclude that the possibilities of significant floods are going to decrease in the Tana River basin in the future. Another factor that strengthened this conclusion is that a warmer climate will result in a thinner ice lid, which will also contribute to a decrease of ice jam formation. There is however some uncertainties to this picture one needs to take into consideration.

A warmer climate may result in a scenario of *alternating freezing and melt down periods* during the time of ice built up. If this is happening, minor ice jam processes may occur during late fall and early winter resulting in ice dam formations at specific locations. The ice will then build on top of the ice dams resulting in a several meters thick and layered ice cover. Large amount of frazil ice under the ice cover in these locations do also contribute. Another factor that may increase the flood risk is that a warmer climate may results in a *rapid temperature shift* and weather change in the transition from winter to spring/summer, which historically have seemed to be an important factor for ice jam flooding in Tana.

Floods caused by heavy rainfall events have been rare in the Tana River area. However, due to the above climate change picture one also needs to bear in mind the probability of more extreme local precipitation events over shorter periods, resulting in pluvial floods and surface water flooding. In the summer of 2010 there was for example a heavy rainfall event in Karasjok Township, that according to the local people no one had experienced in living memory. Within two hours the surface water system collapsed.

4 Flood Hazard Maps and Flood Risk Maps

According to the Flood Directive the second step in the flood risk management planning is to prepare flood hazard- and flood risk maps at the most appropriate scale for the areas identified in the preliminary flood risk assessment. The purpose of the flood hazard maps is to provide a rough picture of which areas will be covered by water under different hydrological conditions, while the flood risk maps have to estimate the respectively impacts related to the different hydrological conditions.

4.1 Flood Hazard Maps

The flood hazard maps produced in Norway are the results of combining simulated water levels with a digital terrain model. Flood hazard maps shall cover the geographical areas which could be flooded according to three different flood scenarios:

- Floods with a low probability, or extreme event scenarios. In Norway a 1000 years flood is chosen.
- Floods with a medium probability. Likely return period in Norway is 200 years.
- Floods with a high probability, where appropriate. In Norway 10 years.

In the flood affected areas, the flood extent, the water depths/water level and the water velocity should be made clear where appropriate.

The aim of the mapping is to improve the basis for the assessment of flood risk for use in land use planning and building management. The mapping is also important in connection with emergency response to flooding, as well as a better basis for flood warning, evacuation and planning of flood control measures. In Norway, the flood inundation maps meet the requirements of the flood hazard maps in the Flood Directive.

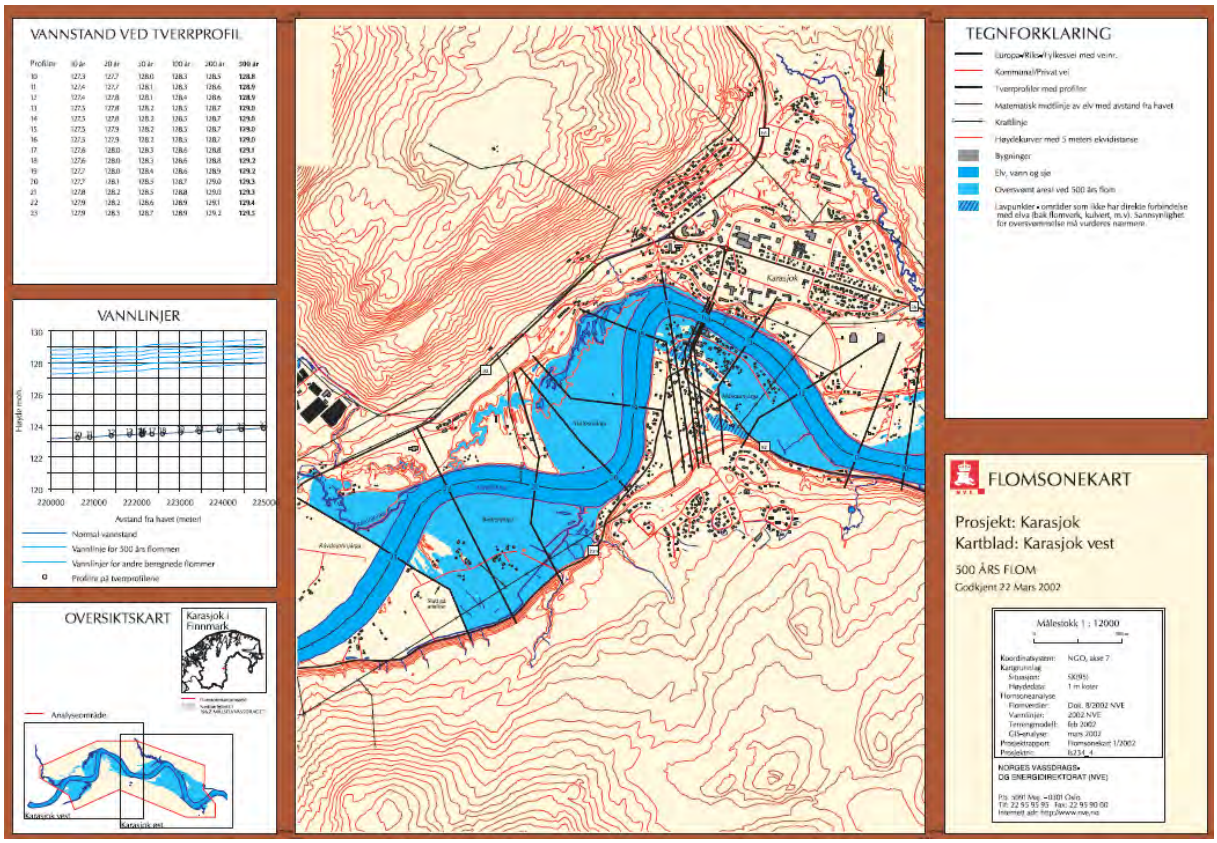

Figure 5: Inundated areas of Karasjok Township by a flood with a return period of 500 years.

4.2 Flood Risk Maps

Flood risk maps describes the potential adverse consequences associated with the flood scenarios referred to in the previous section, expressed in terms of the following categories:

- The indicative number of inhabitants potentially affected (loss or damages to human health and life).
- Type of economic activity of the area potentially affected (loss or damages to properties, buildings or infrastructure and the disruption of activities that have economic values).
- Installations which might cause accidental pollution in case of flooding and potentially affected protected areas.
- Other information which is considered as useful, such as the indication of areas where floods with a high content of transported sediments and debris floods can occur and information on other significant sources of pollution.

The flood risk maps aim to provide a rough picture of the social, economic and environmental impacts that can be foreseen as a result of flooding within an area. The maps should be able to identify problematic areas where in-depth analysis needs to be carried out and where action needs to be taken. The flood risk maps

should reflect the impact on the population in two ways: (1) how many people will need a temporary home during a flooding, (2) the indirect effects on people, in terms of work places, schools, health care centers, important infrastructure etc., which functions are crucial for the society.

Another purpose of the flood risk maps should be to get a rough estimate of how many people will be directly affected in the different flood scenarios. A scenario where a large hydro power dam or a dyke break mean a high number of deaths, since the event will happen so fast that there will not be enough time for evacuation. For normal flooding occasions due to high precipitation the effect will mainly lead to people having to leave their homes for a longer or shorter period of time. An exception here is ice jam flooding, which may happen so fast that there is a danger for loss of lives.

In Norway the flood risk maps show the number of people as population density. The amount of people is shown for 250 m x 250 m cells within the inundated areas. This can still differentiate between scattered settlements and more rural areas within the inundated area. Economic activity is defined by the number of offices and shops, industry buildings and tourism buildings within an area. Community infrastructure is defined by schools, day care centers, power supply buildings, communication buildings and buildings in use by organizations involved in emergency preparedness. All the different elements are shown by different symbols. Roads and railways are shown in different colors. Cultural heritages will also be showed in the risk map.

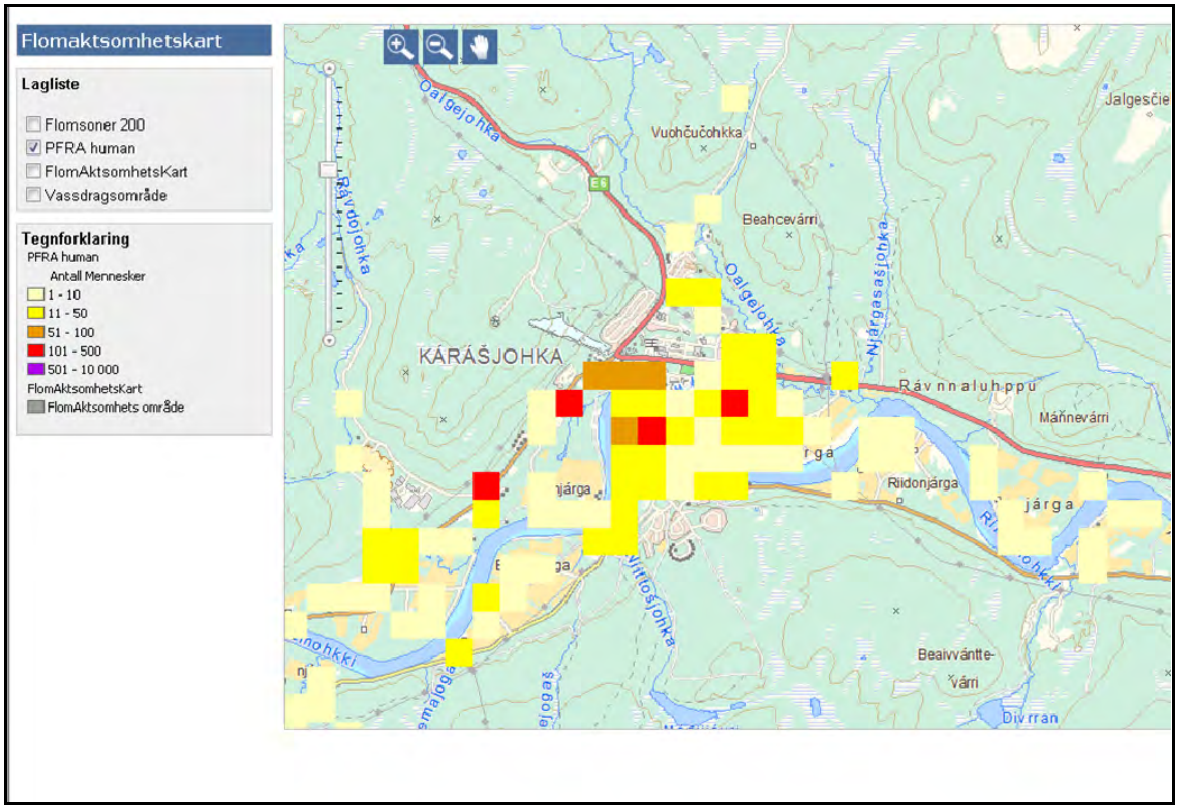

Figure 6: Flood risk map for Karasjok Township. Each square correspond to an area of 250 m x 250 m.

4.3 Significant Flood Risk Area – Karasjok Township

NVE has developed flood inundation maps for Karasjok Township with return periods of respectively 10, 20, 50, 100, 200 and 500 years. A total of 8 km of the river is mapped out. In addition to the flood inundation maps there has also been carried out a study related to ice dam flooding in Karasjokha. The ice dam report attempts to determine the extent and risk of ice dam flooding in Karasjok Township by examining three ice dam scenarios in Karasjokha (Lier, 2001).

The results from the flood inundation maps show that Karasjok Township is prone to flooding on all headlands downstream the river. Based on the 500 years flood approximately 131 people (47 households) live in areas that will be directly affected by flooding.[11] The result also shows that ice jam floods will have a bigger damaging potential than a regular water flooding based on high discharge of water in the river. The damaging potential is related to the areas inundated, but also to the fact that an ice dam flood happens much faster than a regular water flood. The ice dam report also indicates (as already mentioning in 2.4) that there seems to be a connection between large discharge of water in the river and heavy ice jam processes, and that the combination of these two is what seems to have caused the biggest flooding in Tana. These factors indicate that the specific challenges of ice jam flooding should be at the centre when discussing flood risk related to Tana in general and to Karasjok Township in specific.

4.3.1 Ice Dam Flooding

Karasjok Township is prone to flooding caused by ice dams at three possible locations downstream the township. A flood caused by an ice dam at point 3 will cause a much bigger flood scenario than a flood caused by an ice dam at point 1 and 2, while an ice dam at point 2 will cause a bigger flood scenario than 1. Ice dam 1 is the most probable, being the location where the known historical ice dams have occurred, but due to the unpredictability related to ice jam flooding and the lack of historical data, one also has to take into account the other two scenarios. Specifically since an ice dam at point 3 will cause a catastrophic flood situation.

[11] One could assume that an ice dam flooding at point 1 would affect approximately 200 people.

Figure 7: Possible ice dam locations downstream Karasjok Township.

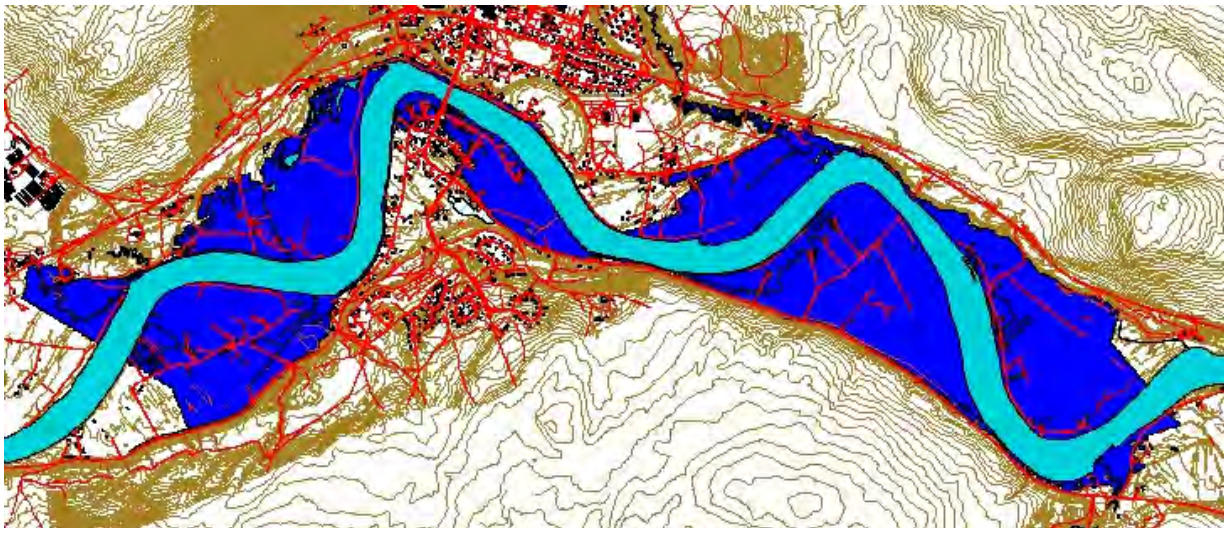

Figure 8: Inundated areas by a 500 years flooding.

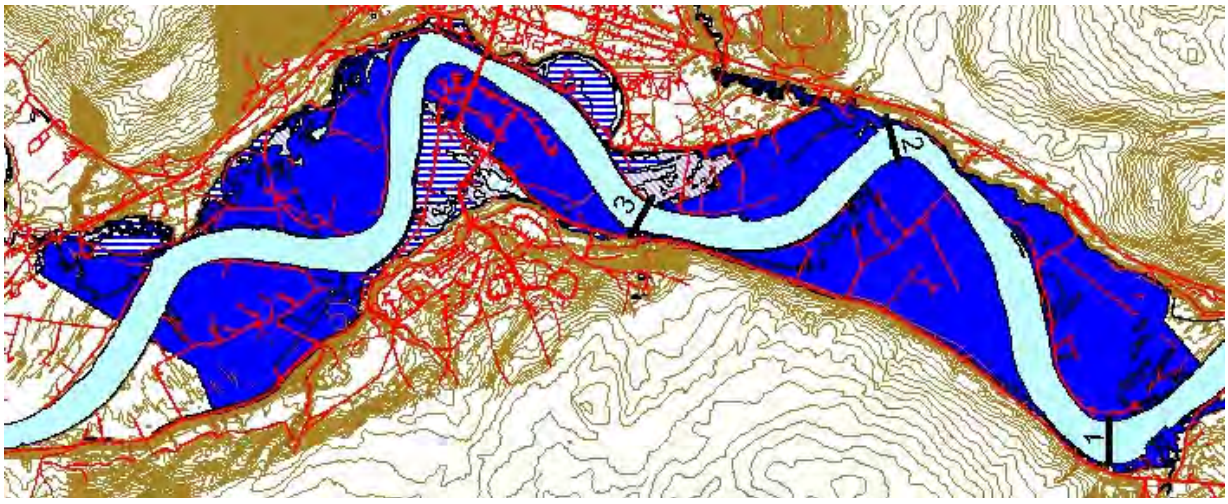

Figure 9: Inundated areas as a result of ice dam flooding. Ice dam 1 is dark blue, 2 is violet and 3 is light blue.

4.3.2 Assessment of Risk

In addition to private households and roads, other infrastructures, like different commercial buildings, a shopping mall, the old community center, water supply systems, electricity supply, fire valves and the sewage treatment plant will be affected by a 500 years flood in Karasjokha. The old houses and commercial buildings in the area still have a basement, and will therefore suffer economically damages. One should also pay attention to the old church which is situated in the border area of the 500 years flood, and in the inundated area of an ice dam flooding.

In addition to the three headlands downstream Karasjok Township, Tana is prone to ice dam and/or water flooding at ten other locations in the river. Private houses, farms, holiday cottages, a camping site and an agricultural college will be affected by flooding at these places. One of these places, Sirma, was inundated (1.5-2.0 meters) for nine days in 1932 due to a big ice dam flooding. A private house, several storehouses and barns were destroyed and several sheep (50) and cows were killed.

The specific challenges related to ice jam flooding indicates that a certain degree of unpredictability and uncertainty has to be part of the flood risk assessment. Early experiences also show that if an ice jam flooding occurs there is little to do in terms of reducing it. This means that flood forecasting and early warning, as well as emergency preparedness have to play a crucial role in the area, and in cases of serious ice dam flooding one may also have to consider the possibility of technical measures like explosives. The municipality of Karasjok has developed a local plan for crises management, including a well organized evacuation plan in cases of flooding. The plan is very well structured and detailed in scope, but may consider including a specific section on ice dam flooding where the rapid inundation pattern is made explicit (see 5.2.3).

There is also another factor related to ice jam flooding – the necessity of local knowledge. Understanding the dynamics of an ice jam flooding depend on local knowledge about the unpredictability and uncertainties described in 2.4, but one also needs experience about how temperature and precipitation influences the ice build up process and the ice break up process in the river. According to some of the local people of Karasjok one has to live by and with the river to be able to know its flood dynamics.

5 Objectives and Measures

According to the Flood Directive preparing the flood risk management plans involves the establishment of appropriate objectives for the management of flood risks for the areas identified, focusing on the reduction of potential adverse consequences of flooding for human health, the environment, cultural heritages and economic activities. If considered appropriate, the focus should also be on non-structural initiatives and/or on the reduction of the likelihood of flooding. Flood risk management plans shall include the necessary measures for achieving the objectives. The measures shall be worked out by addressing all aspects of flood risk management; prevention, protection and preparedness. The plan is supposed to be carried out in close association with local and regional authorities and under participation of the public. The first flood risk management plans should include:

- A description of the appropriate objectives of flood risk management (the appropriate level of protection).
- A summary of the measures and their prioritisation aiming to achieve the appropriate objectives of flood risk management.
- When available, for shared river basins or sub-basins, a description of the methodology of cost-benefit analysis used to assess measures with transnational effects.
- A description of the prioritisation and the way in which progress in implementing the plan will be monitored.
- A summary of the public information and consultation measures/actions taken.
- A list of component authorities and, as appropriate, a description of the coordination process within any international river basin district and of the coordination process with the EU Water Framework Directive.

5.1 Objectives for the Management of Flood Risk

The overall objectives of flood risk management in Norway are zero loss of lives and the prevention of damages to properties and society. In this pilot project the following objectives are suggested:

1. Zero loss of human lives.
2. Reduction of economical damages to an acceptable level for the municipality.
3. Implementation of the new paradigm underlying the Flood Directive at different levels of the community. What does it actually mean to live with flood?
4. Enhanced cultural and psychological resilience related to future flooding and a future climate. This means to develop a society and a population less

vulnerable and with a higher ability to cope with stress and crises. This means both to learn to think preventive and to know what to do when the flood is happening.

5. Integrate local knowledge about flooding and the Sami indigenous context into the flood risk management plan.

6. Identification of already existing measures and the evaluation of the different aspect of the flood circle. Propose improvement where appropriate.

7. Start to think about risk-reducing measures that will make Karasjok greener and bluer. This is win-win measures that in addition to preventing flood add elements of beauty and creative landscaping to the township, and may also be an important measure related to a future climate.

8. Start to look into the possible future scenario of increased pluvial flooding and surface water flooding in Karasjok Township.

5.2 Measures for the Management of Flood Risk

Norway has since the widespread and damaging flood in 1995 improved its national action plan on measures against floods, including the strengthening of the flood forecasting system and the development of flood inundation maps. The existing measures related to flood risk management in Norway can be divided into the following categories:

- Flood mapping
- Land use planning
- Flood forecasting and emergency preparedness
- Physical flood defenses
- Recovery and evaluation

The different measures must be adjusted to local conditions and the characteristics of the flood events that cause damages in the various watercourses. The measures that are implemented must, to the greatest extent possible, be consistent with the Water Framework Directive. The measures also have to take into consideration other relevant plans for the region, such as protection plans, municipality and county plans.

In working with the example plan for Tana the existing measures for the management of flood risk in Norway have been collected and new ones have been suggested. Some of the new measures will sort under a suggested new category related to flood risk management called cultural and philosophical measures.[12]

[12] For more possible measures see *Flomrisikoplan for Gaula ved Melhus, NVErapport 8- 2012*

5.2.1 Flood Mapping

1. NVE has since 1998 developed flood inundation maps for most cities and villages with potential flood risk. The flood inundation maps show the extent of the inundated area with different return periods.

   The overall objective of the flood inundation mapping in Norway is to reduce flood damage through improved land use planning and emergency preparedness. A sensible use of flood prone areas is in Norway regarded as the best way of keeping the damage potential at a reasonable level. Improvement in land use planning with respect to flood risk is among the most important measures to achieve this goal.

   The maps will also be useful in emergency planning and action connected to flood situations. Flood inundation maps can be generated related to the forecasted flood levels, allowing quick assessment of the potential impacts of a given flood. The maps will simplify rescue operations such as evacuation, and give background information when setting priorities to other actions.

   The maps are produced digitally to enable users to make their own presentations. The main target groups are municipalities and county officials, who are responsible for land use planning and emergency planning at local and respectively county level.

   NVE has produced flood inundation maps for 4 different areas of Tana; altogether 43 km of the river Tana is mapped out.

2. The flood inundation maps may serve as a foundation for the development of flood risk maps as described in 4.2. The identification of the flood prone structures should at least include electricity supply, water supply and sewer systems, telephone and internet systems, road and railway network and infrastructures that produce or handle environmentally dangerous substances. In the Tana River Basin District the identification and mapping of the Sami cultural heritages should play a central part of the flood mapping activity.

3. Hydrological climate projections should be included in flood mapping activities and made available to land use and emergency preparedness planning.

5.2.2 Land use planning

1. Consideration of flood risk is incorporated in the different land use plans. Local municipalities have the main responsibility for ensuring that areas are not utilized in an unacceptable way related to flood risk. The risk of flood, erosion, mass deposition and ice flows must be evaluated for all development areas.

   NVE offers guidance to local municipalities in the form of flood inundation maps and maps showing areas at risk of quick clay landslides, and give expert advices to municipal land use plans. NVE has also

developed a national guideline defining acceptable safety levels with respect to floods and other hazards related to rivers. The safety levels are differentiated related to hazard type and type of asset. A stepwise procedure for assessing the hazards has been designed to fit with the planning process and levels typical for a local municipality. The following procedure is recommended:

- Municipal plan: potential hazard should be identified.
- Zoning plan: the actual hazard should be described and risk quantified.
- Building case: a satisfactory level of safety must be documented.

This procedure ensures that areas with a potential hazard are identified at an early stage in the planning process, resulting in more reliable and predictable land use plans. NVE can raise an objection to a land use plan if due consideration to flood or landslide hazards have not been taken into account. Areas that are especially exposed to danger of flooding, erosion, landslides and ice jams may be held on trust for further regulation as a danger zone.

2. There could also be an increased focus on safety zones in land use planning. This means for example that buildings should not be place in flood prone areas and that further urbanisation has to be restricted if this contributes to an increase in damage potential. This may in the long run result in the settlement being pulled away from the river so that the river, with its flood zone, has the possibility to flow freely in the landscape. Along Karasjokha and Tana depopulation of private houses and farms has already been used as an appropriate flood risk measure.

3. If flood-prone areas are going to be developed, special restrictions/inventions for construction in flood prone areas have to be introduces, such as houses without a basement or the development of water surface systems on the property could be required. Resilience of buildings may be improved by preventing floodwater entering the building or by applying waterproof materials and elevating the services and inventory above the expected flood level. In case of the necessity of evacuation of the buildings it may be important to consider special requirements, such as for example shielding measures or alarm systems.

4. Another thing related to land use planning is that insurance companies are no longer willing to compensate for damages caused by poor land use planning. Since the municipalities are responsible for approval of construction and development, one may claim that making municipalities economically liable increases risk awareness and promote better practice in land use planning.

5. Is it possible to give more responsibility to the private house keeper? In the same way as one think that risk awareness and better practise in land use

planning may be a result of making the municipalities economically liable, one could think in the same way related to the house owner.

5.2.3 Flood forecasting and emergency preparedness

1. NVE has carried out flood forecasting in Norway since 1967 and has had a 24 hour flood forecasting services for the entire country since 1989. The prognosis are based on local observation of discharge, snow measurements, precipitation accumulation maps, satellite photos and meteorological prognosis. There is a comprehensive network of hydrological observation stations and the forecasts are published online, as teletext and distributed by fax to the County governor, the Directorate of Public Roads, the Norwegian Meteorological Institute, NVE's regional offices, hydropower companies and media. The County governor evaluates the needs for forwarding the warning to the municipalities. NVE's responsibility is to distribute flood warnings in time so that efforts can be made by the local emergency service to reduce the risk for damage. The responsibility of the local emergency service is to consider whether a flood will cause damage in their region, and if so, to make precautionary efforts such as informing the public and distributing the flood warning to other flood exposed units.

2. As described in chapter 2 the biggest flood problems in the Tana River is related to ice jam processes. Norway and Finland work together on flood forecasting and ice characteristic measuring in Tana. Ice characteristics have been measured since 1997 from the outlet and up to the lower part of Karasjokha River (about 250 km upstream the outlet). There are 12 ice measuring stations in the watercourse.

3. Related to the future climate change scenario of increased pluvial flooding one may consider, in due time, to establish a measuring station for short term (minute based) precipitation measurement in Karasjok Township. *NOU 2010:10 "Tilpasning til eit klima i endring"* suggests more short term measuring stations when meeting the ongoing climate change.

4. In a flood situation NVE's role is primarily to act as a technical advisor to the local crisis management team, but can also contribute with technical and material assistance. Responsible authority for crises management is in Norway delegated to the political and administrative leadership of the municipality. The municipality of Karasjok has developed a local plan for crisis management, including the handling of all major accidents, disasters and crises that may arise in the municipality. The plan is built around a general management of different types of crises, but does also include specific action plans for the most probable events, including floods. The plan is very clear, comprehensive and detailed in terms of who are in charged of the co-ordination and communication, and who has the responsibility for what and how during the management of a disaster. The plan is controlled once a year and includes realistic exercises. The crisis management plan includes the following:

- a plan for the establishment of crisis management in the municipality
- a plan for information management
- a plan for evacuation / accommodation
- establishment of support services for people in crisis
- action plans for the most probable events
- warning lists

5. It is developed a County plan for risk and vulnerability associated with major natural and social accidents. The plan acts as an overall and coordinating instrument between the national authorities and the municipalities in the assessment of risk and consequences of various accidents. The goal is to provide an overview of the important challenges in the County and to create awareness around the different roles and responsibilities to the different actors involved. Karasjok Township is considered as one of the most exposed areas in the County with a high vulnerability related to flood.

6. Improving the county and municipality emergency plans by including a chapter on ice jam flooding where the rapid inundation pattern is made explicit and therefore also the need for a very rapid evacuation procedure (see 4.3.2).

7. Coordinated emergency planning related to flooding between Norway and Finland and between the different municipalities affected on the Norwegian side. When flooding happens in Tana, and specifically when heavy ice jam processes occur, more places than Karasjok Township are at risk. So even if the flood risk plan for Tana has a specific focus on Karasjok Township coordination or harmonization between Karasjok municipality and the other municipalities in the water basin would be useful and even important.

8. Rising risk awareness and resilience in people, so that people living in an area of significant flood risk: (1) always bear that in mind; (2) know what to do when a significant flood occurs; and (3) start to think creatively and take responsibility about what to do to become less vulnerable to floods in the future. This could be done either by a popular meeting once a year and/or by a more extended educational seminar or workshop. This will also involve education in the new perspective underlying the Flood Directive and may, if the local flood awareness is revitalized and improved, result in a local supplement to the governmental flood warning and ice jam prognosis.

5.2.4 Physical measures

1. NVE is responsible for the allocation of the state funding for flood and erosion defenses and do also assist in the planning and implementation of

the different defenses. An integrated approach is used in the evaluation of the need for flood and erosion defenses, taking into account environmental consequences as well as cost/benefit analysis. A flood protection wall is in the process of being constructed in the most vulnerable area of Karasjok Township. The wall will be built as a semi-square construction; the first half of it along the river bank, the second half across land. The total length of the wall is 1000 m and it range 129,5 m above sea level. The height will vary between 2.5 m to 0,7 m depending on the terrain.[13] The paths from the properties down to the river are taken care of by constructing new ones outside the flood wall.

2. Ensuring that the physical flood defenses are constructed with regard to a changing climate.

5.2.5 Recovery and evaluation

1. Inspection of erosion protection sites and physical flood defense structures after the floods to detect damages that must be repaired.
2. Revise land-use restrictions and flood frequency analysis.
3. Evaluate the possibility to change relevant infrastructure related to the water system.
4. Relocation of people or buildings if possible and necessary.
5. Evaluation and improvement of emergency plans.
6. Increase awareness and responsibility related to flooding and climate change.
7. Encourage new thinking about how to live with floods.

5.2.6 Cultural and Philosophical Measures

Water management is not a fixed structure but an evolving process. The Flood Directive thus takes into account elements that previously haven't been part of flood risk management, neither in EU nor in Norway. By the new paradigm it is also possible to start to work out a more social scientific and philosophical foundation in flood risk management, which is an area that traditionally has been based on the natural and technological sciences. The development of what is called cultural and philosophical measures has been an essential part of this pilot plan and can be described in the following way:

1. Implementation of the paradigm and the way of thinking underlying the Flood Directive. The most important points to take into consideration related to the new paradigm are mentioned in 1.2. According to these principles management is not only about objectives and measures – it also reflects a specific way of thinking in terms of nature, culture and society. One key objective should therefore be an educational approach towards the implementation of the new paradigm or underlying thinking of the

[13] See appendix 2 for a map of the flood wall.

Flood Directive. We therefore see the necessity of what can be called a paradigmatic education wherein different levels of stakeholders, from the government to the local people, learn the new principles in flood risk management. This can be done by simple presentations to more extended seminars and workshops. It could also involve interviews or writing of articles in the local newspapers.

2. Flood marketing stone: A concrete measure related to risk awareness could be to set up one or more flood marketing stones, where the historical as well as the possible future floods are marked.

3. Integrate the Sami indigenous context into the plan. As a national authority one is obliged to consult the Norwegian Sami Parliament in all cases where Sami interests are affected. In addition to the more formal requirement, incorporating an indigenous perspective in flood risk management means on the one hand that the National authority needs to develop cultural competence, and on the other hand that both parties needs to engage in creative dialogues and active involvement with each other. The practice of cultural competence is necessary both in cases where Sami interests are directly affected, but also in cases where the people living in the area are of Sami heritage.[14] In writing this report we have both studied written literatures about the topic and engaged in dialogues with representatives from the Sami Parliament.

4. Cultural heritage: Sami cultural heritages are directly related to the formation of the Sami identity, and needs to be given special attention. What does it mean to protect a culture and not only nature?

Picture 7: Sandbanks in the Tana River. Photo: Gunnar Kristiansen

[14] See 1.5.1 and appendix.

6 Summary

6.1 A Work in Progress

Flood risk management is an evolving process – an ongoing work in progress. This means there will always be problems to solve, issues to improve and questions to ask. Some of the questions and issues to engage with in the further flood risk management work in Tana may be as follow:

1. The necessity and importance of an increased focus and interest in the new paradigm underlying the Flood Directive.
2. The Sami context has to be integrated through dialogue and with a shared focus on the Sami local knowledge of the river and flood events, and also with a shared knowledge about the historical colonisation process.
3. The Sami issue seems to concern more and more areas of culture and society. Related to climate change there is for instance a discussion if the Sami people will be more affected than the Norwegian, since a future climate may degrade or destroy the natural recourses vital for the Sami way of life.
4. Involvement, communication and process: What is the best way to carry on processes and dialogues with local authorities and the Sami indigenous culture? A conscious strategy of cultural competence from the national authority seems to be important.
5. How to raise flood hazard and flood risk awareness?
6. Increased focus on unexpected events, for instance early ice jam processes and pluvial floods due to climate change.
7. The problem of scattered settlement: For an area in Norway to qualify as a significant flood risk area it has to constitute a geographically continuously area of more than ten squares (250 m x 250 m) with more than ten people in each. Related to Norway this is problematic. Since most of the country has a dispersed settlement, many areas that qualify as significant related to flood risk will not be taken into consideration because of the population picture. This goes specifically for the Northern part of Norway having an ever lower population density than the south. Concerning the Tana River there are only two townships of approximately 500 and 3000 inhabitants, respectively. The rest of the population is scattered in small settlements throughout the watercourse. One could therefore ask if one actually need another way of measuring vulnerability related to people in Norway. With dispersed settlement one also needs to give specific attention to non-structural measures, like for example flood forecasting and emergency preparedness.

6.2 Experiences

Three factors have mainly influenced the process and outcome of this pilot plan: low population density, a focus on cultural and philosophical issues and flood problems caused by ice jam processes.

- The Tana River basin is sparsely populated. Consequences of floods in Tana will therefore be assumed to be much smaller than the consequences of flooding in many other places in the country, not to say the densely populated area of central Europe. This reflects a quantitative perspective that we have questioned in this plan, and asked if not human life and a local perspective is of equal importance.

- Our focus on cultural and philosophical issues is probably what has influence this plan mostly. Incorporating a philosophical foundation and cultural issues not only adds something to the already existing management; it also has the potential of developing our very understanding and practice of it. This is a complex issue and this plan is only a beginning of a possible process in this direction.

- Tana is the river in Norway with the heaviest ice jam processes, and since ice jam flooding has some unique characteristics, this has been an important focus in the plan. Knowledge about ice jam flooding seems to be important in relation to a changing climate but also as a general international knowledge about flooding.

6.3 Recommendations

The development of flood risk management plans will, most probably, reflect both general and unique issues related to flood risk management. We consider both to be important in the further flood risk management work, suggesting that the different plans can draw on each other and form a think-tank in flood risk management. The two Norwegian pilot plans of Gaula and Tana is a good example of this, having different focus and strength that supplement each other. The Gaula plan has its strength in functioning as a think-tank related to measures while the Tana plan has incorporated a cultural perspective and a philosophical understanding related to flood risk management. The two plans are recommended to be seen as one integrated project. The recommendations from the Tana pilot project are summarized as follow:

1. It is recommended to start the development of the flood risk management plans with an educational approach related to the cultural and philosophical issues. This means that the stakeholders involved in the project has to understand the paradigm and philosophical perspective underlying the Flood Directive. Since the paradigm involves new understanding about resilience, communication, cooperation, capacity building and governance, education in the new perspective may reduce the conflict potential between stakeholders at the different stages of the process. The new paradigm also has the potential to push our way of thinking about management into a more complex and holistic way.

2. It is also recommended in the initial phase of the project to develop cultural competence related to the relevant area. This means to incorporate a cultural understanding of the place and the people concerned, but also to develop this understanding into a fruitful way of communication and cooperation with the relevant stakeholders.
3. Related to the previous points it is also important to be clear about roles and responsibility and to realize that a bottom up approach doesn't mean that all parties are on the same level but gives specific and complementary contributions to the process.
4. It could be useful to prepare an appendix document including all different types of measures, also philosophical, cultural and awareness raising measures.
5. It could also be useful to prepare a document explaining and describing the new perspective underlying the Flood Directive and *how* to develop cultural and philosophical competence.

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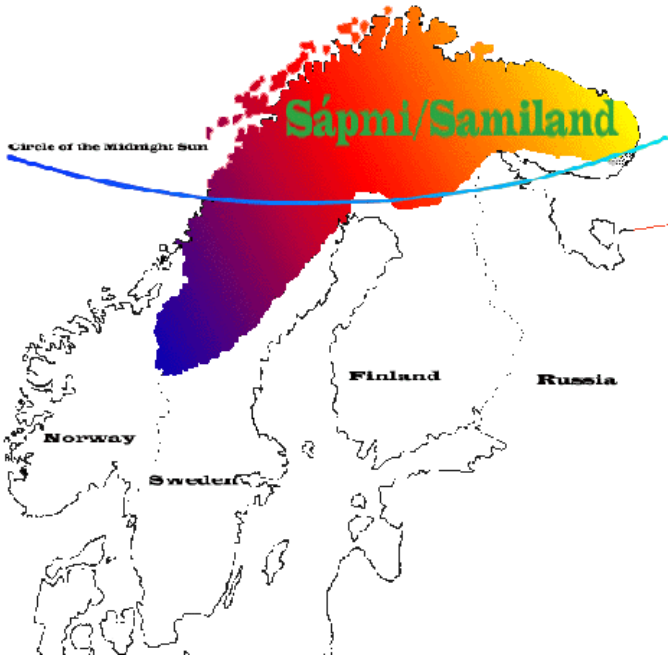
Appendix

1 The Sami – One People in Four Countries

The Sami is the only ethnic group in the European Union to be recognized as an indigenous people. They are an ethnic minority residing across the borders of four countries, Norway, Sweden, Finland and Russia, constituting one people with a distinct language culture, livelihood and history. It is estimated that the number of Sami is between 60 000 and 100 000, depending on how they are counted. The largest population of Sami, 40 – 50 000 lives in Norway, half of these in the province of Finnmark; 15 – 25 000 in Sweden; at least 7000 in Finland and about 2000 in Russia. In the interior of Finnmark County in Norway and Utsjoki Municipality in Finland, the Sami are in the majority.



The Sami language belongs to the Finno-Ugrian language family. This means that Sami is related to Finnish, but not to the Scandinavian languages and not to Russian or any Indo-European language. Even if the Sami linguistic area constitutes a unit, there are a number of Sami languages, some so distinct from each other that they are mutually incomprehensible. In the Sami area as a whole we find three main languages: Southern Sami; Central Sami (Northern Sami and Luli Sami) and Eastern Sami. The division between languages is not cross-border but rather north-south. Northern Sami is the most widespread language, since most Sami live in the Northern Sami area.

The Past – Emergence of a Unique Culture

The Sami culture has evolved from earlier Stone Age cultures over a period of several thousands of years. The earliest ancestors of the Sami people migrated northwards at the end of the last ice age (around 11.000 – 10.000 B.C.), attracted by the large herds of reindeer that trekked north as the ice-cap slowly retreated.

During this period of about ten thousand years the unique character of the Sami culture started to emerge, not as a result of isolation but through lively interaction with, and influences from many different cultures in the region. At the beginning of our era the Sami had aroused as a distinct group with a unique culture that has characterized the Sami people up until today.

The basic pattern of the society was a community of forest Sami, organized into what is called the Sami siida system. The traditional Forest Sami siida was a village unit or social system that provided for community activities, and it was the territory wherein the members of the society had usage rights.[15] Throughout the year the different families and kin groups migrated within their own areas from one settlement site to another according to their fishing and hunting needs. They had a multi-based livelihood and a sensitive usage of renewable natural resources: freshwater fishing, hunting wild reindeer and sea animals, snaring birds, sea fishing, picking berries and gathering of wild vegetables. At the height of the winter the whole community gathered in the winter village, where merchants, tax collectors and ministers also knew to come.

In the second millennium AD the Sami's capacity for active adaption and assimilation met a diversity of challenges, both from within and from without their own culture. From about the thirteenth century Sami areas became the object of increasingly territorial demands. To secure control over the valuable recourses Denmark-Norway, Sweden-Finland and Russia each tried to increase their taxable areas, and thereby create a basis for their territorial demands. In some areas the Sami people had to pay taxes to all three states. Trade monopolies, evangelical mission, church-building and agricultural colonization were other important ways to gain control over Sami land and recourses.

During the 1500s the most valuable animal of the Sami, the wild reindeer became heavily depleted. The European market's endless need for large quantities of furs led to a change from sustainable hunting to over hunting and extinction of the wild reindeer. Pits and corrals for hunting constantly became bigger and the entire herd would be driven into the corral and killed. The result was that the old way of hunting and gathering had to be given up. Some Sami became small-holders, combining hunting and fishing with keeping a few domestic animals while others developed reindeer husbandry. The small-holding became a major feature of the Sami economy, while the reindeer husbandry became the primary livelihood for the inland Sami. The emergence of nomadic reindeer herding had many consequences for the Sami way of life. The expansionist nature of this life form caused competition for pastures among siidas as well as among other Sami

[15] The siidas communal lands and waters were divided into usage areas that were exclusively for kin groups or families (around 25-130 persons).

groups, for instance the Sea Sami. The emphasis on private ownership led to the emergence a capitalistic attitude following the principle of constant and unlimited growth. Problems stemming from this change still prevail among the Sami of today.

The Sami religious culture underwent violent changes in connection with Christian missionizing in the 1600s and 1700s. The intention of the missionaries seems to have been the destruction of the old Sami world view which they consider to be nothing more than a collection of underdeveloped beliefs and superstitions. Even if they succeeded in eradicating the great religious leaders (noaidis or shamans) of the Sami culture and with them much of the symbolic understanding, the Sami worldview has partially survived until present days.

Until the end of the 1600s Sami property rights were comparable to the Nordic law of ownership. The land and waters of the Sami area belonged by law to the members of the siidas and could not be colonized by people from outside. In the 1700s this situation changed dramatically. The rights of the Sami siidas was no longer honored – the old border between the Sami area and the south was gradually forgotten and foreign settlement started to spread vigorously northward. The Sami people became a minority in their own homeland.

After the mid-1800s a harsh Norwegianisation policy began, lasting nearly a century and with impacts until today.[16] The goal was to assimilate the Sami people and culture into the national majority and to shape a Sami people who, as far as possible, spoke and lived as Norwegians. The policy was motivated by nationalistic ideas and later by race theories, and was a continuation of the political goal to secure the national borders and the Norwegian jurisdiction throughout the country. Several laws relating property ownership to language competence in Norwegian was passed, as well as laws forbidding the use of Sami language in schools. The process of Norwegianisation wasn't officially ended until the Amendment to the Constitution in 1988 and the Sami Act of 1989.

The Present – We and the Others

The increasing strengthening of the ruling population's grip and the weakening of the Sami way of life eventually started to awaken the Sami people to a common fight against the narrowing circumstances of existence. During the 20. Century, the family and village based local identity was transformed into a growing feeling of solidarity among the Sami, and an awakening consciousness that all Sami once again formed a community, Sapmi, which the national borders and other historical events had partly destroyed. This new identity came in waves and climaxed when Sami from the different countries joined in the demonstration against the damming of the Alta River in 1980-1981.

[16] Its strongest period was from 1870 to 1914.

Together with the revitalisation and the creation of a pan-Nordic identity from within the Sami community, a re-examination of the majority population's public opinion of the Sami was also taking place. After World War II it was impossible to carry on with the accustomed nationalistic attitudes. Ideas about the value of individuals and the rights of minorities improved, so that the United Nations added an important section to its Charter that secured the priority of indigenous peoples' rights. As a result the racially prejudiced images of Sami that had been widely presented and publicised before the war eventually started to be overturned.

In a relatively short time the situation has changed from the Sami being an ethnic minority exploited and oppressed by the majority to a situation where the Sami is recognized as an indigenous people. Getting status as an indigenous people the Norwegian national authority has certain obligations to the Sami as an indigenous pursuant to international law. There is today an ongoing process of cooperation and collaboration among the Nordic governments, the Sami people and the United Nation system to advance the rights of indigenous people.

Today the Sami in Norway, Sweden and Finland have their own representative (political) body – the Sami Parliament. The Sami Parliament of the different countries doesn't have decision-making powers in matters concerning Sami, but serve as an advisory capacity. Despite of this, the Norwegian Sami Parliament has from the very beginning been able to have a great influence on the different Sami issues. One of the resent developments is that the Norwegian authority is obliged to consult the Sami Parliament in all cases where Sami interests are affected. The main administrative office of the Norwegian Sami Parliament is located in Karasjok Township in Norway and has played a crucial role as a significant stakeholder in the development of the pilot plan of Tana.

The Future – From Ethnicity to Authenticity

Even if there has been cultural contact between the Nordic people and the Sami at least since the early time of the Vikings, the cultures seems to have been so different that people could not simply understand each others way of life. These differences range from languages and religion, settlement patterns, livelihood and social structures, to the utilization of natural recourses and ecological understanding. In general, while the Sami people developed a semi-nomadic lifestyle based on hunting and gathering, living *in*, *from* and *with* nature, the Nordic people developed a lifestyle based on intensive utilization of land, living in permanent farming communities. The agricultural communities demanded a lifestyle based on private ownership of land, while the hunting and gathering communities where based on common ownership of land organized into different units or siidas. Within the siida there were no social stratification, the form of

government was a stateless local democracy, with a leader, the first among equals. While the different siiddats moved from place to place within large, but defined areas throughout the year, never developing large permanent settlement, the agricultural lifestyle created the conditions for social stratification, urbanization and the development of towns and cities with their need for advanced economic and political infrastructures.

Since the World War II both the Sami and the Norwegian people have been thrust into a modern consumer society where new technologies were applied in traditional livelihood. Access to permanent settlement, formal education, improved standard of living and new technologies is now an equal part of both cultures. One could then assume that the cultural differences between the two people would diminish or disappear altogether? This is not the case.

The new Sami identity that started to emerge at the beginning of the 20. Century still thrives, and has to be taken into consideration in all matters of affair. So even if the way of life is no longer so different as it once was between the Sami and the other Norwegian people, and the Norwegian authorities has changed their attitude and policy towards the Sami to the positive, there are still two different people living in the same national area. How can his be taken into consideration in management in general and in flood risk management in specific?

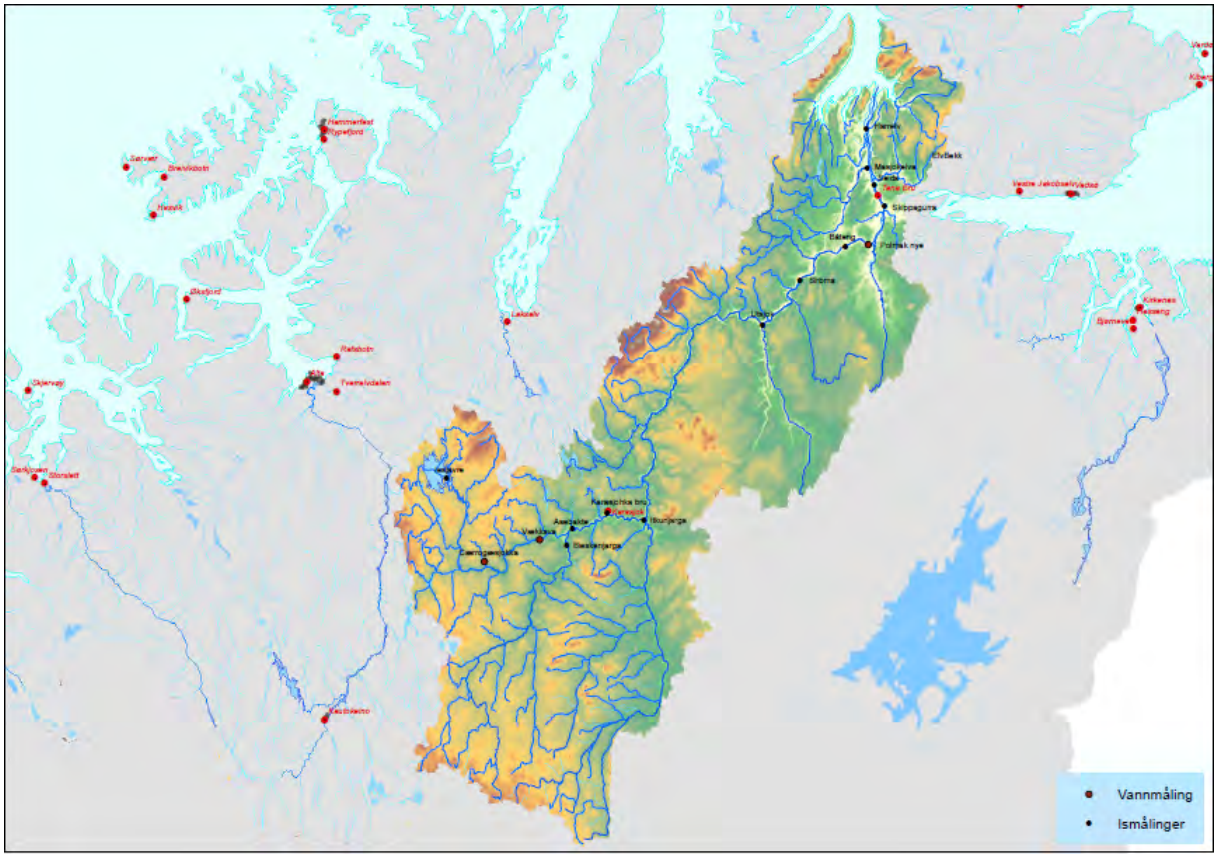
First we believe one needs to take the historical context into consideration and be aware of that these two people have lived separate from each other in terms of culture and ways of living for hundreds, even thousands of years. It is only in resent time that the Sami and the Norwegian has started to share the same social context. This means there are still real and clear differences going on between the two cultures, and the national authorities has a responsibility for being aware of this and acting from a position of cultural sensitivity in relation to the indigenous people. Secondly one also needs to take into consideration the history of suppression and alienation imposed by the Norwegians upon the Sami. One has to understand that this has caused huge wounds and left deep traces in the collective Sámi population. The recognition of the Sami as an indigenous people and the constitution of the Sami Parliament has thus been part of a restorative justice to heal the wounds caused by the Norwegians upon the Sámi.

However, time may now have come where the two cultures may be able to transcend the old conditionings? What are now needed are a stronger unity and a move towards a mutual responsibility, not only for each other but for the common destiny of humankind. After all, we are today faced with problems that go far beyond an ethnic level of interaction – problems, as for instance climate change and environmental degradation, which will require a much higher level of togetherness and cooperation than what is in general prevailing today. The Sámi people could use their experiences as a suppressed people to create a society that will ensure that this could not be repeated and the valuable traditional knowledge could be included in a higher context of universal unity and serve humanity as such. It is a fact that the Sámi culture has brought with it a valuable relationship to nature based on respect, sensitivity and spirituality. Even if many of today’s Sami

are alienated from their cultural heritage it is still available if one choose to focus on it.

Photo 8: Inside the Sami Parliament of Karasjok. Photo: Gunnar Kristiansen

2 Water and Ice Measuring Stations in Tana



3 Flood Protection Wall in Karasjok Township

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Nr. 14 Capacity building in Hydrological Services Course in Water Level recording and Data Processing at Ministry of Water and Energy 13th – 16th February 2012. Documentation (23 s.)

Nr. 15 Landsomfattende mark- og grunnvannsnett. Drift og formidling 2011.
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