Integrated Catchment Management

Assessment 2 – Report

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Introduction

The River South Esk Catchment

The River South Esk catchment is located in Angus on the East Coast of Scotland. Angus, with a population of 116,000, is one of the 32 local government council areas of Scotland.

The catchment consists of 14 baseline surface and 6 groundwater waterbodies over an area of 488 km^2. It is a diverse catchment area starting high in the eastern Cairngorms, before going south-east through Strathmore, consisting of agricultural and mixed-used recreational lands, and the small urban areas of Brechin and Forfar before at the Montrose Basin (SEPA, 2011).

The catchment area has a minimum altitude of 19 with a maximum of 1006 mAOD. The landcover of the catchment is: mountain/heath/bog (43%), grasslands (24%) with arable land (21%), woodland (11%), urban (0.5%). The underlying geology is very low (67%) and moderate (33%) permeability bedrock (NRFA, no date).

The River South Esk and its tributaries and the wider catchment area are vital to the region's economy, providing drinking water for humans and livestock, freshwater for crop irrigation and habitat for wildlife. It's also used for recreational activities such as hillwalking, fishing, and shooting (RSE Catchment Partnership, no date).

The report will discuss the main pressures on the catchment, any current and future mitigation measures before concluding the report.

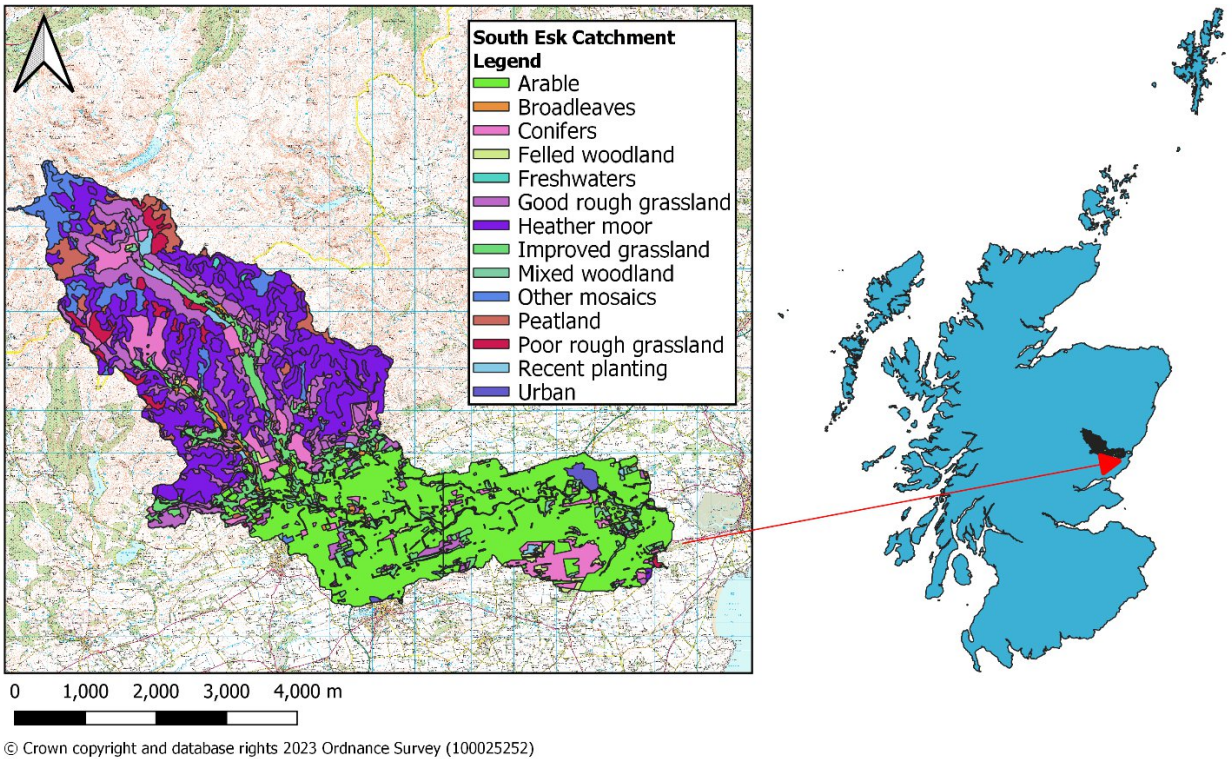

Figure 1 - South Esk Catchment shown within Scotland (Created by SB 2023)

Main pressures on the South Esk Catchment

There are several pressures on the River South Esk and other tributaries within the South Esk catchment area which include, but are not limited to: water quality, water resources and species & habitat. Despite this, the catchment is generally in ok condition, with room for improvements as per SEPA's classification (Table 1)

Table 1 - South Esk Catchment SEPA classification from 2020

Water Body	Overall Status (2020)
River South Esk (Lower)	Good
River South Esk (Upper)	High
Pow Burn	Poor
Melgund Burn	Good*
Noran Water	Moderate
Lemno Burn	Moderate*
White Burn	Good
Quharity Burn	Good*
Prosen Water (Burn of Lednathie to South Esk Confluences)	Good
Prosen Water (to Burn of Lednathie Confluence)	Good
Burn of Glenmoye	Good
Burn of Heughs	Moderate
White Water	Moderate * *ecological potential*

Water Quality Pressures

Water quality issues within the South Esk Catchment can be attributed to pollution from agriculture, forestry and wastewater treatment (River South Esk Catchment Partnership, 2009).

Agriculture is a vitally important industry in Angus (Scottish Government, 2008), with a lot of this industry being within the South Esk Catchment. Forestry is another important industry, with Montreathmont Forest (1000ha commercial plantation) being within the catchment area. (Forest Commission Scotland, 2015).

Both these industries can put pressures on the quality of the catchments fresh water environments via diffuse pollution. To maximise tree growth and establishment and agricultural potato yields, fertilisers and pesticides are sprayed over these areas. Via run-off, these pollutants such as nitrates, phosphates and sediments can enter the tributaries within the catchment.

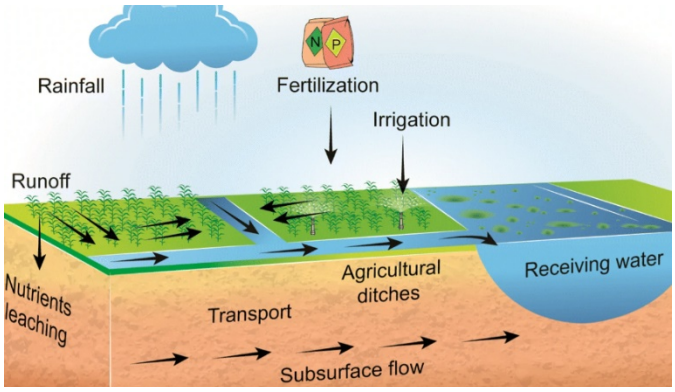

Figure 2 - Run-off diagram(© SpringerNature.com)

When there is too much nitrogen and phosphate entering the tributaries, this can cause harmful algal blooms within the water, and this is caused by the algae dying with the decomposition process consuming vast amounts of oxygen. Large blooms can eliminate oxygen supplies creating dead-zones killing most aquatic life including Salmonids *(Salmonidae)*. Harmful algal bloom toxins can also pollute drinking and irrigation water (John, 2014).

Water Resource Pressures

Water resource pressures in the South Esk Catchment can be caused by water abstraction, flood management and river engineering (River South Esk Catchment Partnership, 2009).

Abstraction of water along with climate change can drastically alter the flow of the River South Esk and other tributaries within the catchment. During drought periods, farmers and land mangers rely on the water bodies for crop irrigation and livestock drinking water.

Hotter, drier periods can affect the flow of the main tributaries effecting the ecology which Figure 3 demonstrates, with waterflow in the summer being considerably lower than "normal". Shallow waters mean *Salmonidae* can't get upstream and trapped in pools, and pollutants within the water as discussed above could have a greater effect with less water to dilute them (River South Esk Catchment Partnership, 2009).

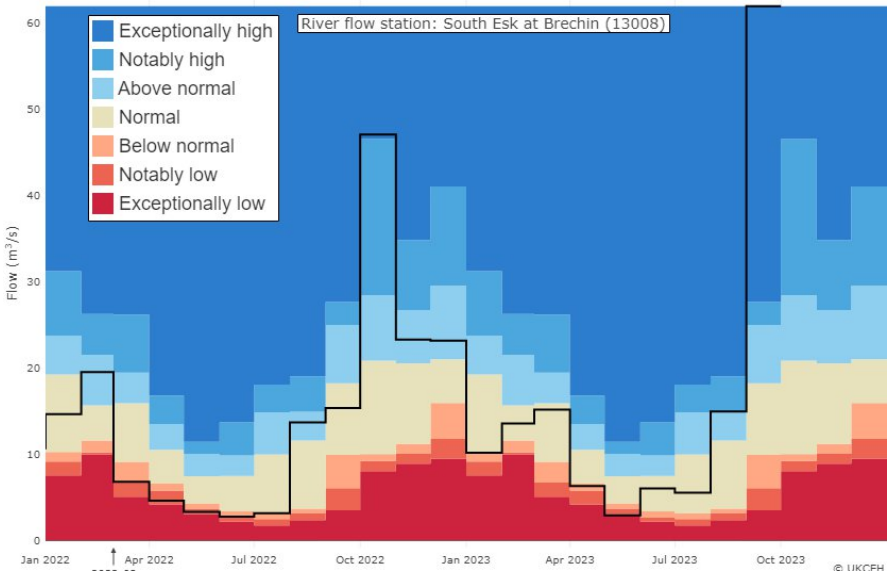

Figure 3 - River South Esk flow data from Jan 2022 to Nov 2023 UKCEH

At the opposite end of the spectrum, South Esk catchment also suffers from too much water which Figure 3 also demonstrates, with the flow of water (m^3/s) for October this year being triple the normal value. When there is too much water, which moves to fast, this can cause severe flooding as seen in Brechin in 2002 (BBC, 2002) and again in October 2023 (BBC, 2023).

Species & Habitat

Pressures on natural habitat and native species such as Salmon *(Salmo salar)* , Brown sea-trout *(Salmo trutta trutta)* and Freshwater pearl mussel *(Margaritifera margaritifera)*, which can be attributed to the pressures discussed above as well as non-native invasive species within the catchment. (River South Esk Catchment Partnership, 2009).

In 2005, *Salmo salar* and *Salmo trutta trutta* were deemed to be "doing well", however their condition in the 2009 catchment plan was deemed "Unfavourable". *Margaritifera margaritifera* populations are also not as healthy as they should be. The condition of these species is largely down to increased levels of soluble reaction phosphorus via run-off, illegal fishing/poaching and barriers to fish migration. Lower *Salmonidae* results in reduced freshwater mussel populations as they act as hosts for the *Margaritifera margaritifera* when they are larva (River South Esk Catchment Partnership, 2009).

Aswell as the above, sediments from run off from agriculture and forestry can also increase turbidity of water making it harder to find food, and destroy spawning beds (O'Geen *et al.*, 2010). Introduction of signal-cray fish *(Pacifastacus leniusculus)* can also harm salmonoid populations due to their very quick reproduction cycle, an appetite for almost any food source and sharing similar hiding and feeding places as young fish (Peay et all, 2010).

Mitigation Measures Implemented

To help overcome these pressures, the first "River South Esk Catchment Management Plan" was released in 2009. The 10-year plan is a very important step, as it identifies the pressures felt, sets out a plan to help ease some of the pressures for the benefit of all, while bringing together all the stakeholders within the catchment, such as national government and bodies/organisations, local council, residents, recreational users and businesses. In 2017, a review of the management plan was released which will be used to discuss mitigation measures in place.

Water Quality Mitigation

Working in conjunction with SEPA, Scottish Government (agri-environmental schemes), NFUS, James Hutton Institute and land managers, improvements have been made to water quality by reducing agricultural run-off into the main tributaries.

Along with the physical changes, a key part of this improvement came from education to raise awareness of the legal requirements by land managers, as well as share and demonstrate best-practice methods for improving water quality by reducing run-off. Best practices can include investments that may have to made but also sharing knowledge such as, ensuring that the correct amounts of chemical sprays are used, that chemicals aren't sprayed on windy days, or over frozen compacted soils, or before heavy rain fall is predicted (Ozkan, 2020).

Figure 4 - Riparian buffer strip example (Source: angus.gov.uk)

Physical changes were also made to agricultural areas within the catchment. In total, between 2009 and 2017 6km of fencing and buffer strips were created alongside 3000 newly planted trees along the riparian zone. Buffer strips slow down run-off and trap chemicals and sediment. In an EPA report, buffer strips, depending on the width, vegetation type and soil condition have a trapping efficiency of between 27-96% for phosphorous and 7-100% for nitrogen (EPA, 2008).

Further investments were made by installing pasture water pumps and troughs in some farms (RSE Partnership, 2017). Fencing stops poaching, pasture water pumps and troughs stops livestock from eroding river banks (Dunn RM *et al.*, 2022).

Together these implemented measures have had a positive impact within the catchment area on water quality. Prior to the plan, Lemno and Melgund Burns were both classified as having poor water quality, however as of 2020, SEPA classify both these burns of having "Good" water quality (SEPA, 2020).

Water Resources Mitigation

Working in conjunction with SEPA and the Scottish Government, South Esk Catchment has seen improvements in hydrology in its water courses, most of which has come from the creation and implementation of flood management systems and river engineering.

After the 2002 floods in Brechin, flood management was included in the original 2009 Catchment Partnership plan with this project being marked as completed in the 2017 review.

Upstream, in Glen Cova and Glen Doll, large scale forests have been planted with the aim of reducing peak flows in the upper parts of the South Esk Catchment. Woodlands play a vital role in flood management as the trees absorb and also slow down the flow of rainwater. Furthermore, trees help stop soil erosion, which also means more rainwater being absorbed. All of this slows down rainwater entering the tributaries largely contributing to natural flood management systems (UK Government, 2022).

As well as this, further improvements have also been made with regards to flood management via river engineering. In a section of the Rottal Burn, a 650m stretch of canalised channel was removed and replaced with a new 1250m section of meanders. Large pieces of deadwood and rootballs were placed in the burn with the final part of this was project reconnecting the burn to a floodplain. Channel straightening increases stream power, so by removing straightened sections and introducing deadwood, it reduces the water's energy, slowing it downstream, while also increasing the volume of water the river can hold (Heritage et al., 2020).

These changes within the catchment have seen improvements which Table 2 demonstrates.

Table 2 - Overall hydrology improvements (SEPA's Classification Hub)

Water Body	Overall hydrology (2007)	Overall hydrology (2019)
Noran Water	Poor	Moderate
Lemno Burn	Poor	Moderate
Pow Burn	Poor	Moderate

Species & Habitat Mitigation

Above we have outlined some of the mitigation measures for Water Quality and Water Resources. While those measures help with those things, some of them also have the added benefit of being beneficial to local ecology and biodiversity.

Figure 5 - Riparian woodland plantation example (Source: Eden Rivers Trust)

To help reduce pollutants getting into the waterbodies and as part of flood management, large areas of riparian woodland have been planted. As these areas become established, not only will they help with those things, but they also provide invaluable habitat for native species that are in decline.

Riparian woodland helps cool water bodies by providing shade, which will be required due to more prolonged periods of intense heat. This will be beneficial to *Salmonidae* who are weakened by increased water temperatures and become susceptible to disease (Irle, 2000).

Deadwood in the tributaries can also provide habitat and food sources for certain fish species which can potentially increase fish populations too (Maday *et al.*, 2023). In the upper catchment, many sites surveyed between 2012-14 were deemed to be more productive than the national average for *Salmo salar* which suggests mitigation measures are working.

With regards to INNS such as *Pacifastacus leniusculus*, little has been done to eradicate or even control populations within the catchment, however a "River Watch" programme has been created for members of the public to report any sightings of INNS (RSE Partnership, 2017).

Further Potential Mitigation

Despite improvements made, there are still various pressures on some of the tributaries. Looking at data from SEPA's Water Environment Hub, diffuse pollution from agriculture is still affecting water quality within the Pow Burn. A further mitigation step, which hasn't been included in the catchment's Management Plan or Review, is cover crops for arable lands.

Cover crops can stop soil erosion and run-off, which directly reduces nitrogen into the water bodies. Indirectly, less nitrogen fertiliser would need to be used on the next crop. On top of this, Ohio State University found cover crops uptake 57-296 kg N/ha, and return 50% of this to the soil during decomposition, further reducing the need for nitrogen to be sprayed/injected (Hoorman, 2017).

Abstraction is another pressure within the catchment, for example, the Lemno Burn during drought periods, farmers rely on more freshwater for crop irrigation which affects the overall hydrology of the waterbody by reducing flow (SEPA, 2021). One way to mitigate against this could be water abstraction pricing by meter, this would promote efficient water use by land managers such as installing drip irrigation and harvesting and storing water from peak flows. This saw a reduction of 20,000 million m^3 surface water abstraction by agriculture across the EU between 2000-2010 (EEA, 2022).

INNS such as *Pacifastacus leniusculus* was recognised as a problem in 2009 (Catchment Management Plan) and is still a huge problem today in many of the catchment's tributaries with nothing being done to eradicate them (SEPA, 2021). A team in Switzerland successfully completely eradicated *Pacifastacus leniusculus* from ponds and reservoirs by draining them and treating the area with calcium hydroxide before filling them back up 6-12 months later. The same report also states trapping, in conjunction with a predatory fish also seen a reduction of 75% of the INNS (Krieg, King and Zenker, 2020).

Conclusion

In conclusion, since the creation for the River South Esk Management plan in 2009, and review in 2017, the creation of the plan, the bringing together of all different stakeholders, identifying pressures and actioning the mitigation's, there has been some very good progress on the overall status of the surface water tributaries in the catchment which Table 3 demonstrates.

However, some pressures still remain such as water quality issues from agricultural run-off, hydrology issues such as too little or as we seen recently, too much water leading to severe flooding, and the persistent problem of INNS such as the *Pacifastacus leniusculus*.

In 2020 the Scottish Government, through its The River Basin Management Plans, committed to 81% of waterbodies to reach good status by 2027. Despite the progress being made, further investment from local and national governments, and work from the various stakeholders, needs to be done in the South Esk catchment to help achieve that goal (Scottish Government, 2020).

Table 3 - Overall Status (SEPA Water Environment)

Name	2020	2017	2013	2010	2007
River South Esk (White Burn Confluence to Estuary)	Good	Good	Moderate	Moderate	Good
River South Esk (White Water to White Burn Confluences)	Good	Good	Moderate	Poor	Good
River South Esk (Source to White Water Confluence)	High	High	Moderate	Moderate	Good
Pow Burn	Poor *	Bad	Moderate	Bad	Good
Melgund Burn	Good *	Good *	Bad *	Bad	Poor
Noran Water	Moderate	Moderate	Poor *	Good *	Moderate
Lemno Burn	Moderate *	Bad	Moderate	Bad *	Poor
White Burn	Good	Good	Bad *	Good	Poor
Quharity Burn	Good *	Good	Good	Good	Good
Prosen Water (Burn of Lednathie to South Esk Confluences)	Good	Good	Good	High	Good
Prosen Water (Source(s) to Burn of Lednathie Confluence)	Good	Good	Good	Good	Good
West Burn of Glenmoye/Burn of Glenmoye	Good	Good	Moderate	Good	Good
Burn of Heughs	Moderate	Poor	Good	Bad	Good
White Water	Good	Moderate	Moderate	Good	Moderate

*ecological potential

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