# Climate risks and actions in freshwater dependent industries: a Scotch Whisky example

Ronald Daalmans

Scottish Freshwater Group
Informing practical action to address the impacts of climate change on freshwaters in Scotland
Stirling, 21st April 2022

Chivas Brothers
Pernod Ricard

# The Scotch Whisky Industry

Annual exports of

**£4 bn**

**10,800** Scottish Jobs

**>7,000** in Rural Communities

**40,000** in UK

Direct exports to

**175 countries**

**1.5 mn**

distillery visits

scotch whisky

Chivas Brothers
Pernod Ricard

# Scotch Whisky Operations

- 117 malt distilleries, 250 mola (14 CBL)
- 7 grain distilleries, 300 mola (1 CBL)
- Warehouses (20m+ casks)
- 15 major bottling plants (2 CBL)
- Maltings, offices, research/technical centres
- By-products/dark grains processing
- Energy facilities
- Long-term business

Scotland is home to over 100 malt and grain distilleries, making it the greatest concentration in the world. Many of the Scotch Whisky distilleries featured on this map bottle some of their production for sale as Single Malt (ie, the product of one distillery) or Single Grain Whisky.

However, the majority of all Scotch Whisky is consumed as Blended Scotch Whisky. This means as many as 50 of the different Single Malt and Single Grain Whiskies are blended together, ensuring that the individual Scotch Whiskies harmonise with one another and the quality and flavour of each individual blend remains consistent down the years.

Malt whisky is usually classified in one of five main categories - Highland, Lowland, Speyside, Islay, and Campbeltown - according to the geographical location of the distillery in which it is made. In many ways, the geography and climate of each region influences the character of the whisky produced there.


## Islay Malt

Islay, a small island off the west coast of Scotland, may be only 25 miles long but is home to 8 distilleries.

Islay is frequently lashed by Atlantic storms. Sea spray blows across the island, impregnating the peat used in the malting of the barley and blows into the warehouses where casks of Scotch Whisky lie maturing, thus affecting the taste and aroma.

Some of the Islay whiskies are pungent and powerful, with a distinctive whiff of sea air in them. Other distilleries that are in a more sheltered location, and use less peat during malting have a gentler but still clearly identifiable character.

1. ARDBEG
   Glenmorangie Co Ltd
2. BOWMORE
   Beam Suntory
3. BRUICHLADDICH
   Bruichladdich Distillery Company
4. BUNNAHABHAIN
   Burn Stewart Distillers plc
5. CAOL ILA
   Diageo
6. KILCHOMAN
   Kilchoman Distillery Co Ltd
7. LAGAVULIN
   Diageo
8. LAPHROAIG
   Beam Suntory

# Environmental Sustainability Strategy

15 LIFE ON LAND

**Biodiversity & Agriculture**

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

**Environmental Governance**

17 PARTNERSHIPS FOR THE GOALS

**Water & Wastewater**

6 CLEAN WATER AND SANITATION

**Energy & Carbon**

7 AFFORDABLE AND CLEAN ENERGY

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

**Packaging & Materials**

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

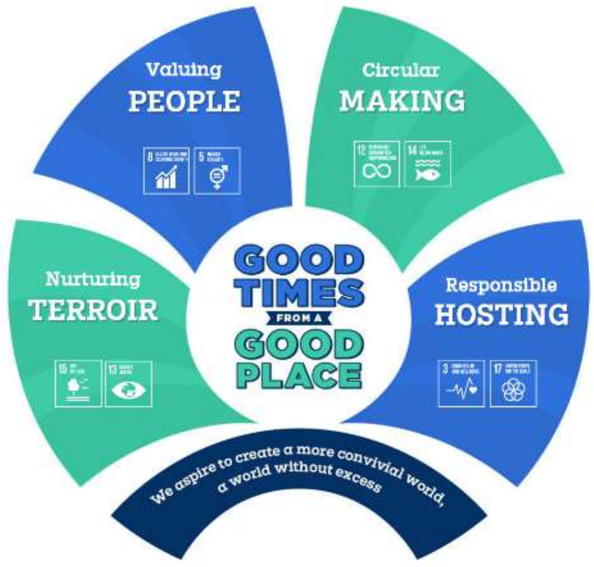
**Byproducts & Waste**

# Distillery Water Use

- **Process Water (10%)**
  - Mainly springs, some borehole, few surface
  - High quality
  - Steady temperature
  - Fixed consumption with over flows
- **Cooling Water (90%)**
  - Generally from rivers & burns
  - Lades, cooling ponds, intake pipes, pumped
  - Once-through vs Cooling Towers
  - Range of return distances (metres to miles)
  - Fixed, variable or on-demand
- **Location, location, location**
  - Remote upland tributaries
  - Major rivers (e.g. Spey)
  - Lowland agricultural
  - Single site to multi-user cascade

# Sector Commitments

- **Scotch Whisky Association – Sustainability Strategy**
  - 2030 Responsible water use target:  All sites 12.5 – 25 ltr/ltr
  - Sector-specific water stewardship standard
- **Pernod Ricard – Sustainability & Responsibility Roadmap**
  - 2030 Water efficiency target:  20% reduction in unit water consumption
  - Water replenishment in high-stress geographies
- **Ongoing development**
  - Water re-use data collection
  - Quantifying energy & cooling consumption links
  - Opportunities to optimise water return



# Risk Assessment

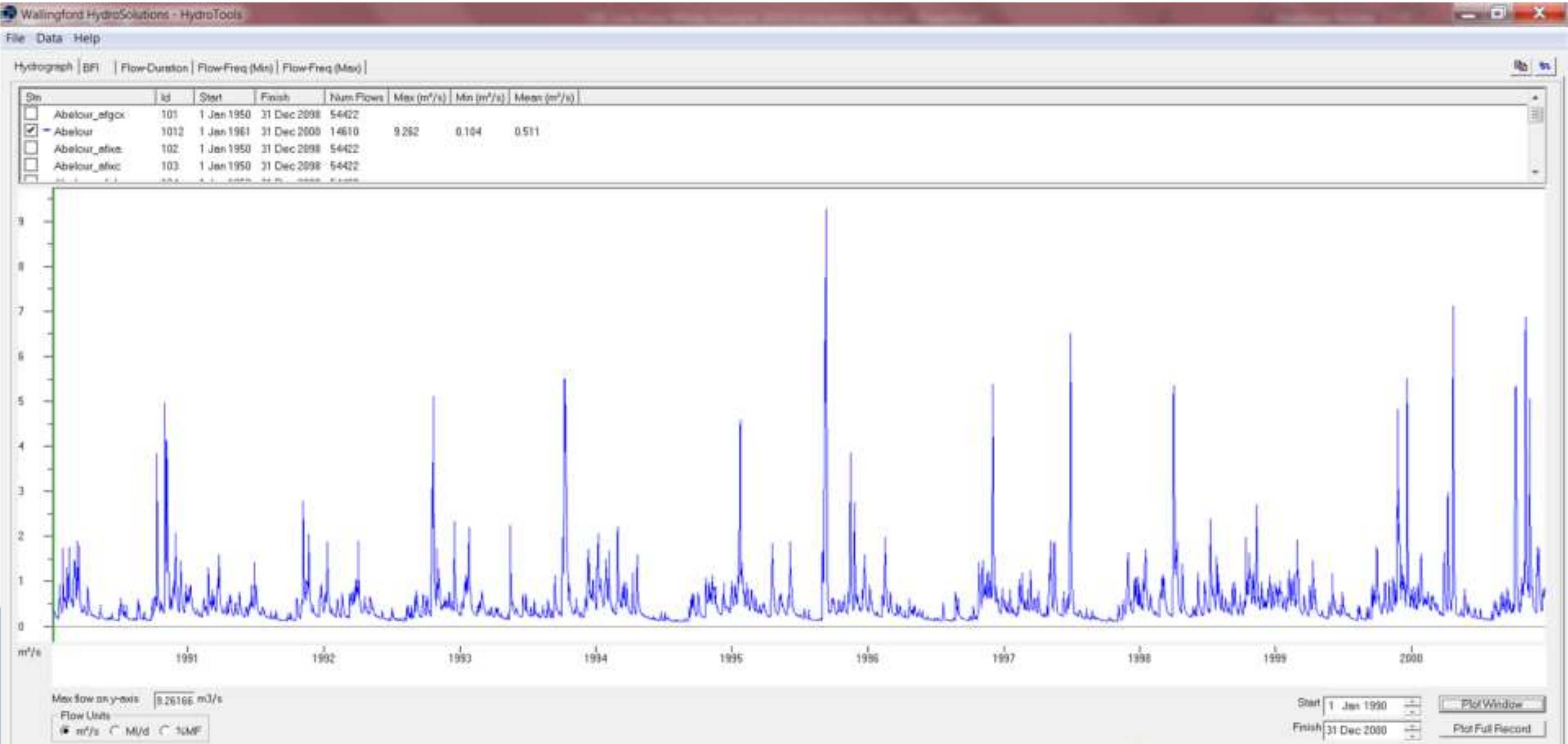
## Water Resilience Assessment

| Site | Water Use | | Regulatory Risk | | | Water Efficiency | | Water Availability | | | Expansion | Temp |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type | Source | RBMP | Q95 | Design | Reasonable | Planned | Current HR | Future HR | Return | Sources | Return |
| | Process | Springs | [green] | [green] | [yellow] | [yellow] | [green] | [blue] | [blue] | [blue] | [yellow] | [blue] |
| | Cooling | River | [green] | [green] | [red] | [grey] | [grey] | [green] | [green] | [green] | [yellow] | [blue] |
| | Process | Springs | [green] | [green] | [green] | [yellow] | [yellow] | [blue] | [blue] | [blue] | [green] | [blue] |
| | Cooling | River | [green] | [green] | [green] | [grey] | [grey] | [green] | [green] | [green] | [green] | [blue] |
| | Process | Springs | [green] | [green] | [green] | [green] | [yellow] | [blue] | [blue] | [blue] | [green] | [blue] |
| | Cooling | River | [red] | [red] | [green] | [grey] | [grey] | [red] | [red] | [red] | [green] | [blue] |
| | Process | River | [green] | [green] | [green] | [red] | [green] | [green] | [green] | [green] | [yellow] | [blue] |
| | Process | Springs | [green] | [green] | [green] | [red] | [green] | [blue] | [blue] | [blue] | [yellow] | [blue] |
| | Cooling | River | [green] | [green] | [green] | [grey] | [grey] | [green] | [green] | [green] | [yellow] | [blue] |
| | Cooling | River | [green] | [green] | [green] | [grey] | [grey] | [green] | [green] | [green] | [red] | [blue] |
| | Process | Springs | [green] | [green] | [green] | [amber] | [red] | [blue] | [blue] | [blue] | [yellow] | [blue] |
| | Process | Springs | [green] | [green] | [green] | [amber] | [red] | [blue] | [blue] | [blue] | [yellow] | [blue] |
| | Cooling | River | [green] | [green] | [green] | [grey] | [grey] | [green] | [green] | [green] | [yellow] | [blue] |

# Water Availability - Headroom Analysis

## Aberlour Distillery (Lour Burn)

- Water Demand: Process = 0.006 $m^3/s$ , Cooling = 0.043 $m^3/s$
- Available Flow: 0.021 $m^3/s$
- Low Flow @ Q95 (1970s): 0.14 $m^3/s$
- Low Flow @ Q95 (2050s): 0.13 $m^3/s$ ↓ 6%



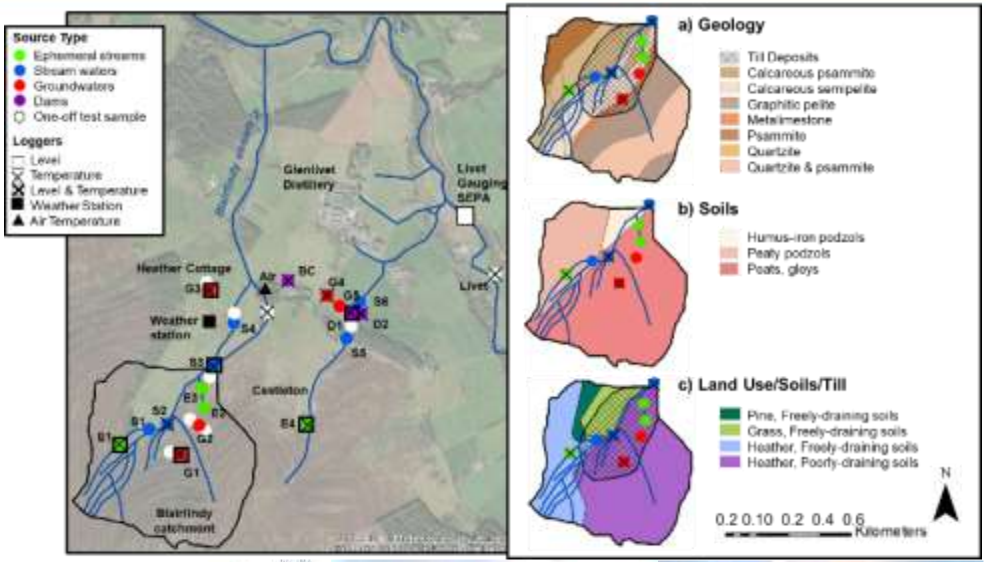
# Adaptation – Land Management Opportunities

## Research Partnership (PhD)

- The Glenlivet water gathering lands
- Nature based solutions – test & model
- Increase water storage & infiltration
- Increase base flow level
- Limit maximum water temperatures

- Leaky dams (timber, earth, stone)
- Test size & number of features
- Assess impact of substrate

- Positive model outcomes
- Long-term site monitoring plans
- Development of site selection tool




NERC SCIENCE OF THE ENVIRONMENT | UNIVERSITY OF ABERDEEN | The James Hutton Institute | Chivas Brothers Pernod Ricard | THE GLENLIVET

Chivas Brothers Pernod Ricard

# Efficiency - Responsible Consumption (Process Water)

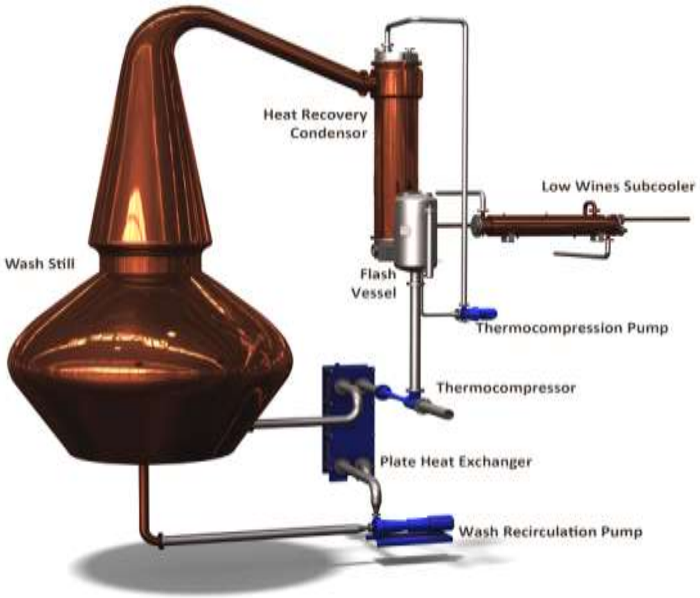
- **In vs Out**
  - All material flows containing water, plus external factors (e.g. rainfall) & meter error
  - Investigate significant differences
- **Actual vs Theoretical**
  - Design basis for water use per activity
  - Investigate omissions & cross-overs
- **Benchmarking**
  - Context Important
  - Whisky Average = $20m^3/kl$
  - CBL Average = $18m^3/kl$
  - CBL Best = $14m^3/kl$
  - Sector reports
  - Identify local buddies
  - Target $<15m^3/kl$

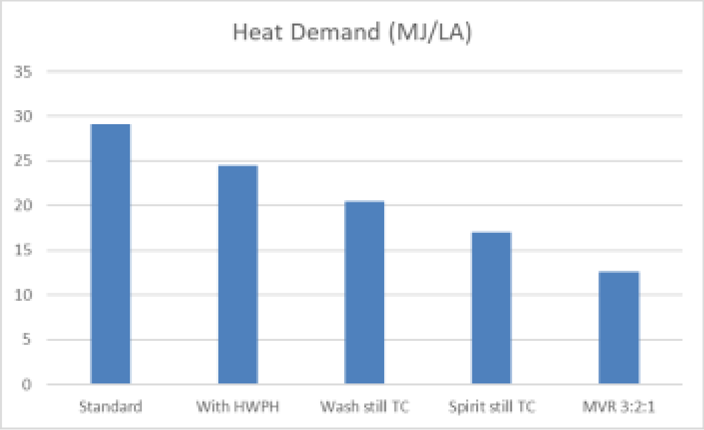

| Distillery | Priority | Site Balance | Process Theoretical |
|---|---|---|---|
| GA | Y | In = Out | Act > The |
| GK-SI | N | In = Out | Act > The |
| BV | Y | In < Out | Act > The |
| LM | Y | In > Out | Act > The |
| GB | Y | In < Out | Act > The |
| GT | Y | In < Out | Act = The |
| AL | Y | In < Out | Act > The |
| TM | Y | In < Out | Act < The |
| TGL | N | In < Out | Act > The |
| MD | N | In > Out | Act > The |
| AAB | N | In > Out | Act < The |
| SP | N | In = Out | Act > The |
| DM | | | |

# Deep Demand Reduction & Heat Recovery

- **Effluent Re-use**
  - Water for cleaning ~20% of process consumption
  - Improved bioplant reliability & efficiency
  - Hot condensate effluent from evaporation plant
  - Lab testing of impact on caustic CIP operations

- **Eliminating Evaporation Losses**
  - Long-standing focus on heat recovery
  - Low-grade waste heat discharged to rivers
  - Cooling tower needed for smaller watercourses
  - Dalmunach distillery TVRs achieve 19MJ/LA
  - Next generation heat recovery pilot – heat pump
  - Expected to:
    - Eliminate needed for cooling towers (4% loss)
    - Reduce thermal load on rivers by further 30%



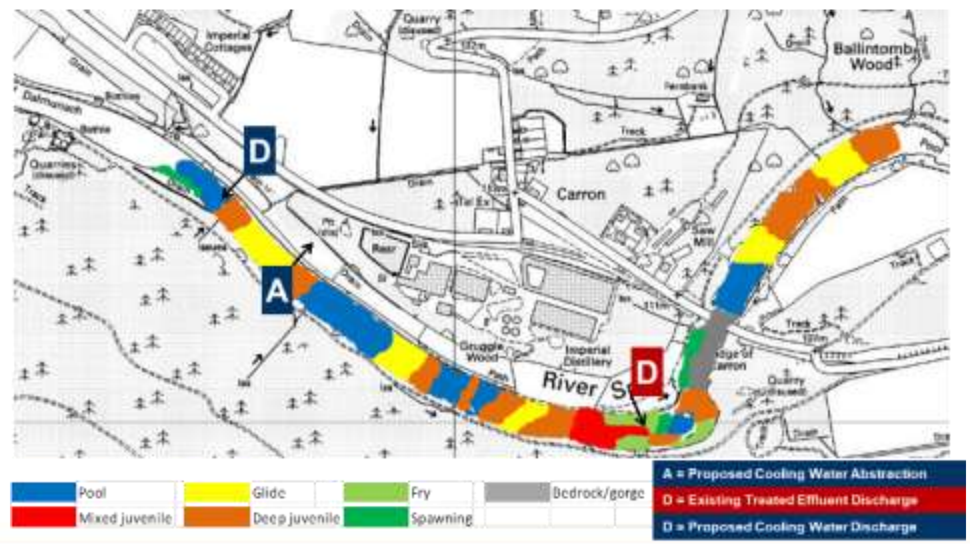




Chivas Brothers
Pernod Ricard

# Replenishment & Net Zero Abstraction

- **Effluent Treatment**
  - 1974 Control of Pollution Act:  EQS & discharge limits for Copper
  - Bioplant closures & road tanker removal
  - Review in light of revised Copper “availability” EQS
  - Opportunities to return additional 3-6% of water abstracted

- **Major Upgrade or Expansion Plans**
  - Review cooling water systems
  - Model thermal load & T uplift
  - Return upstream of abstraction
  - Dalmunach return rate = 96%



# Research Needs – Water Temperature Risks

## Water Temperature Network

- $1^{o}$C rise = +30% cooling water demand
- Understand source variability
- Establish air/water relationship
- Potential risk assessment or warning system

- Strong air/water relationship
- Significant variability between locations
- Temperature uplifts during silent season

## Smart Cooling Water Decision Tools

- Simple regulatory approach – mass balance
- Thermal models - estuaries / coastal waters
- Scotland River Temperature Network – prediction inconsistencies (groundwater)

- Better understand sub-surface interactions
- Map local variability in water temperatures
- Understand effect of temperature profile on behaviour of indicator species
- Develop location selection criteria / tool

# Summary

- Location & water dependent sector

- Future flow predict low flow reductions 6% - 11%
- Process efficiency potential <15%
- Land management opportunities for mitigation
- Deep demand reductions ~7%

- Water temperature = strategic risk (summer air temp $+2^{o}C$)
- Heat recovery essential to reduce thermal load (30% - 50%)
- Research partnership essential

Dr. Ronald Daalmans
Environmental Sustainability
Chivas Brothers Ltd
ronald.daalmans@pernod-ricard.com

Chivas Brothers
Pernod Ricard