Witness Name: Prof. Andrew J. Millar
Statement No.: 1
Exhibits: AJM
Dated: 15 November 2023

UK COVID-19 INQUIRY

WITNESS STATEMENT OF ANDREW J. MILLAR

In relation to the issues raised by the Rule 9 request dated 20 June 2023 in connection with Module 2A, I, Andrew J. Millar, will say as follows: -

1. I am Professor Andrew J. Millar of the School of Biological Sciences, University of Edinburgh. I was seconded, part-time, to the Scottish Government from September 2018 to the end of December 2021, as the Chief Scientific Adviser for the Environment, Natural Resources and Agriculture. I will abbreviate this role as 'CSA ENRA' and Scottish Government as 'SG'. The CSA ENRA is one three, independent science advisers to SG, along with the CSA for Scotland (in the relevant interval, Prof. Sheila Rowan) and the Chief Scientist for Health (in the relevant interval, Prof. David Crossman). My remit included Waste, and therefore wastewater ('WW'; sewage) and therefore the monitoring of genetic material from the SARS-CoV-2 virus excreted by infected people into the wastewater system. I acted as the senior champion for the research and implementation of this monitoring programme within SG from 15th April 2020 until the end of my appointment and had ongoing involvement as a researcher until the summer of 2022. I will refer to the overall activity as 'the WW programme'.

2. I have prepared this statement myself from my recollection, from a page of contemporary notes [AJM/001-INQ000346149 and by reference to the Lessons Learned review of the programme that I commissioned from experienced, independent social scientists. The Lessons Learned review is provided as part 4 of the supporting exhibit [AJM/002-INQ000346150 and has been publicly available since November 2022 on the CREW website. I include a further, public example of the WW programme's results in

exhibit [AJM/003-INQ000346151 which is the final SG 'Modelling the Epidemic' report, number 115, published 22 December 2022). I no longer have access to the specific documents to verify other dates. I have updated this paragraph compared to the earlier draft provided, to summarise my response to the Inquiry's request regarding my OneNote notebooks:

a. Exhibit [AJM/001-INQ000346149 is one page from the OneNote notebook on Covid that I kept on my personal device. I noted to the Inquiry team by email [AJM/005 - INQ000273998, that this page was on that personal device because "*I was researching the new (to me) application of wastewater epidemiology on a personal device rather than my Scottish Government laptop, immediately after I became aware of this application*" [italics added]. I provided all the rest of this notebook by email, now included as [AJM/004-INQ000273997 These notes are "*mostly from research meetings of the SG-funded research project on WW screening. I previously shared the report of that project* [AJM/002-INQ000346150 *There is also a meeting hosted by Rockefeller Foundation. 13 out of 15 of these notes relate to the time after I left Scottish Government at the end of December 2021, because I no longer had a Scottish Government device after that point.*" Quoted from [AJM/005 - INQ000273998 italics added.
b. The OneNote notebooks regarding my work as CSA ENRA were accessible only from my SG laptop or other SG computers, as I noted in [AJM005 -INQ000273998 I was earlier advised by email [AJM/006 -INQ000273999 that they would not have been stored unless I had requested this when I ended my secondment, which I had not.

3. Unless stated otherwise, the facts stated in this witness statement are within my own knowledge and are true. Where they are not within my own knowledge, they are derived from sources to which I refer and are true to the best of my knowledge and belief.

4. References to exhibits in this statement are in the form [AJM/number-INQ000000].

Background, qualifications and role during the Covid-19 pandemic

5. I was trained as a geneticist. I led a research laboratory studying the 24-hour, biological clock in plants from 1996. My research was successful and recognised, for example by

my election as a Fellow of the Royal Society. My research group had routinely used the quantitative Reverse Transcriptase – Polymerase Chain Reaction ('qRT-PCR') method to test gene activity since 2003, along with mathematical analysis and modelling to understand changes in gene activity over time. Hence, I was very experienced in interpreting and using data from this method before I joined SG, and in leading research collaborations with experts in laboratory methods and in statistical analysis. These were the key methods used in the WW programme.

6. I was seconded, formally for three days per week, to SG from September 2018 to the end of December 2021, as the CSA ENRA.

7. I had no direct experience of epidemiological research, public health or WW analysis, and I had not previously assessed research methods or results from that area. However, CSAs expect to advise on evidence over a very broad remit, so I was used to learning about new areas quickly.

8. I attended a meeting of SAGE in late 2018 or early 2019 as the SG observer, standing in for the SG Chief Veterinary officer; international observers were also present. The meeting rehearsed the response to an outbreak of animal disease in the UK, arriving from overseas, and that might have spread to humans. I recall sending email feedback to the SAGE secretariat noting that the exercise had sought surprisingly little further input from their international counterparts, and noting verbally in a meeting with the CSA for Scotland, that we could prepare for such an event by identifying which institutions had large-scale PCR testing capacity.

9. Before 15th April 2020 I had no professional involvement in the Covid-19 response. I have no comment on the decision-making or evidence relating to the first national lock-down in March 2020.

10. My remit as CSA ENRA included Waste, and therefore wastewater (sewage) and therefore the monitoring of genetic material from the SARS-CoV-2 virus in wastewater ('WW'). I will refer to the overall activity as 'the WW programme'. I acted as the senior champion for the research and implementation of the WW programme within SG from 15th April 2020 until the end of my appointment, and had ongoing involvement as a researcher until the summer of 2022.

11. From 15th April 2020, I was involved in groups that researched and implemented WW monitoring in Scotland, the UK and to a limited extent, internationally. I commissioned laboratory and statistical research to develop the methods involved, and the 'Lessons Learned' review by social scientists. I provided information and documents that explained this WW programme and the evidence that it offered, to researchers developing similar WW monitoring in other UK nations, to CSAs and officials in SG and in UK Government, in their agencies, and in a handful of cases to Scottish Ministers up to and including the First Minister.

12. Some of these individuals were directly involved in the processes within SG that decided on the NPIs of interest to the inquiry. I was not involved in those processes. I therefore summarise my involvement briefly, in paragraphs 19-20, and summarise the WW programme in paragraphs 21-28.

Initial Understanding and response (January 2020 to March 2020)

13. I was not professionally involved in the Covid-19 response over that interval. I followed events in the mainstream media and from researchers on Twitter. As an indication of my response, I recall being surprised that the Councils of the UKRI Research Councils planned to meet in person, late in the week commencing 9 March 2020, but I still attended, including a busy social dinner. The last in-person event that I attended was a workshop on peatland restoration in central Edinburgh on Friday 13th March 2020. I then worked from home and recommended the same to my research group in the University.

14. At that time, the SAGE exercise that I observed was my only experience of epidemiology related to humans. Evidence on plant and animal health was within my remit as CSA ENRA but the Chief Plant Health Officer and the Chief Vet in SG normally lead on these areas.

15. Looking back, I find it extraordinary that I and other senior researchers in the UK were not personally taking greater precautions to avoid Covid-19 infection in early March 2020, even if we had no specific expertise in epidemiology or Public Health. It was also surprising that our colleagues in epidemiology had not effectively communicated the potential urgency of a novel respiratory virus. I accepted too lightly the initial reports that

most healthy adults had only mild symptoms and assumed that would apply to me and my immediate colleagues and family. I failed to appreciate that the entire population might be infected, so even a small fraction of serious symptoms could affect an overwhelming number of people. I also had no experience of the potentially extreme vulnerability of specific groups, such as the elderly.

(C) Role in relation to Non-Pharmaceutical Interventions (NPIs);
(E) Role in relation to scientific expertise, data and modelling.

16. I was not professionally involved in the SG Covid-19 response leading up to the national lockdown in March 2020.

17. I had close oversight of the data on viral genetic material in WW from June 2020. Because WW data matched the data from community testing, however, the WW data did not provide unique insights in the interval of interest, while there were substantial, ongoing community testing programmes. I became far more aware of all Covid-19 evidence in this interval, for example reading all papers to Covid-SAGE, but there were few or no different recommendations to offer based on the evidence from WW, except as summarised in paragraph 25. Hence my role remained in coordinating the provision of WW data and explaining the WW data and their potential uses, as outlined in paragraphs 21-28. I was not involved in the decision-making processes that the inquiry has asked about. From paragraph 29, I note specific points from the Lessons Learned review of the WW programme that might have broader relevance for the SG response to Covid-19. My role in NPIs was only to provide scientific expertise and data, so I address headings (C) and (E) together.

18. The WW programme contributed data from October 2020 that affected decision-making on NPIs, in two main ways: targeting a minority of local and mobile testing capacity and providing independent estimates of viral prevalence and transmission number (R) in Scotland to the SG Modelling and Analysis Hub, and to the UK Government Joint Biosecurity Centre (JBC; later the UKHSA). Further detail is provided from paragraph 23.

Details of the WW testing programme

19. On or just before 15th April 2020, I was contacted by Dr. David Pirie of the Scottish Environment Protection Agency (SEPA) regarding a rapid research project that had been funded on 31 March 2020 by the Centre for Research on Waters (CREW), a research organisation sponsored by the part of SG that I worked with, the Rural and Environment Scientific and Analysis Service (RESAS). The project aimed to develop a qRT-PCR test for genetic material of the SARS-CoV-2 in wastewater; if it was successful, Dr. Pirie suggested that SEPA might implement that test. My notes [AJM/001-INQ000346149 show I read some relevant publications, contacted my colleague in the University of Edinburgh with the closest expertise, the epidemiologist Professor Mark Woolhouse, found a contact in Public Health Scotland (Dr. Mary Black) *via* the Chief Scientist for Health, and discussed the potential with the Director of Environment and Forestry in Scottish Government, Ms. Bridget Campbell. I drafted an email confirming provisional support for the project to Dr. Pirie, to send on 16th April 2020. I also raised the potential for WW monitoring with the CSA for Defra in UK Government, Professor Gideon Henderson, in the next of our regular online meetings in April 2020. This was the start of my professional involvement with the WW programme, and hence with the SG Covid-19 response.

20. Subsequently, the WW programme was implemented by a new partnership led by Scottish Water (usually represented by Dr. George Ponton) and SEPA (Dr. Peter Singleton). The research phase was at first funded by RESAS within SG and coordinated by me, supported by my colleagues in RESAS, together with the Chief Scientist for Health. As we demonstrated national implementation, funding and coordination from about December 2020 was taken on by the SG Directorate of Health and Social Care.

21. From June 2020, Scottish Water and SEPA sampled a growing number of locations across Scotland, to test wastewater treatment works representing up to 80% of the Scottish population in 100-300 samples per week. From about December 2020, the programme added adaptive, local sampling in response to requests from Health Boards. In addition, the Scottish WW programme contributed data from 4 locations, 4 times per week, to the UK-wide WW monitoring programme initially coordinated by the Environment Agency for Defra.

22. The data were shared with all partner organisations including Public Health Scotland, via a password-protected data dashboard maintained by SEPA. From October 2020, the data have been shared publicly in a simpler dashboard that is still routinely updated at the time of writing, usually within a week of sampling. The dashboard can be located by searching for terms "SEPA.org.uk RNAmonitoring" using an internet search engine. I sent short, written briefings on the WW programme and its potential to Ministers including the First Minister, roughly in early May 2020, and on the operational programme in early October 2020, in addition to regular updates to officials and CSAs.

23. The WW data has mirrored community testing data (and until earlier in 2023, the Office for National Statistics Covid Infection Survey data for Scotland; see paragraph 31), making decisions taken on the basis of the combined data more robust. This was first apparent when the wastewater data detected an outbreak in samples from the Nigg treatment works, serving the City of Aberdeen, in August 2020, at the same time as community and clinical testing.

24. The first key advantage of WW monitoring is that it does not depend on testing individuals. The process has biases, for example missing rural populations that are not served by main wastewater treatment works, but it was unaffected by the major changes in community testing programmes or the testing behaviour of individuals.

25. In a half-dozen cases in late 2020 and early 2021, high viral levels in WW data relative to community testing data were followed up with mobile community testing units, which then identified cases that had not previously detected, allowing those individuals to self-isolate. However, the fact that WW data otherwise matched the community and clinical testing data meant that the WW data did not suggest different responses. Rather, the independently-generated WW data offered greater confidence that both data sets were accurately representing the numbers of infected people in different parts of Scotland.

26. The independent WW data was also used by the SG Covid Modelling and Analysis Hub to estimate the prevalence of the virus in Scottish populations, and the transmission number (R) in the population. These estimates were statistically combined by JBC (later, UKHSA) with multiple estimates from other data sources, in order to calculate the

consensus values of viral prevalence and transmission for the UK. Independent data are often combined in this way in order to give more reliable, consensus estimates.

(H) Responses and Lessons Learned

27. The WW data showed the very low prevalence of the virus in the summer of 2020, with levels below the detection threshold in almost all wastewater treatment works tested. The outbreaks in the late summer and autumn of 2020, which grew progressively across Scotland, were also detected by the WW data. Again, the WW data were broadly consistent with the data from community and clinical testing data.

28. Though I was not involved in making decisions on NPIs, I was increasingly concerned over September and October 2020. I monitored the WW data closely as part of my oversight of the WW programme. I recall a moment close to despair when viral material was detected on 12th October 2020, in the small town of Nairn in the Highland Health Board region that had had undetectable viral levels in WW until then. This was just one example of many such "first-detections" in the WW data as that wave of the epidemic unrolled. To me at the time, these data indicated that Scotland needed additional NPIs up to and including a national lockdown to control the infections in the autumn of 2020, though I was not privy to the counterbalancing social and economic data at the time. I still hold that view. Without knowing these aspects of the evidence in detail, I also have the impression that some aspects of the lockdown might usefully have been relaxed: school attendance in person and access to the outdoors, including socialising, might have been beneficial.

29. The results of the CREW Lessons Learned review (part 4 of the 2022 report attached, [AJM/002-INQ000346150 which was conducted by independent researchers in late 2021 to early 2022, are consistent with my views on the WW programme. To summarise, among other points, the WW programme grew from an existing network of loose connections, fostered by SG-sponsored groups and organisations such as CREW. The research emerging on the WW test method was quickly brought into practice, albeit in an ad hoc manner where many individuals increased their workloads. New partnerships were developed between organisations in the programme but it also revealed "a lack of collaboration across environment and health research and policy that appears to exist

within Scottish Government". More strategic, over-arching management of the programme would have been beneficial.

30. In the summer and autumn of 2020, access to data was an early, though temporary, obstacle. Any effect on the SG response overall was probably very minor. There was an urgent need to compare the WW data to community and clinical testing data, in as much detail as possible. This comparison was a key step in validating the relationship between WW data and testing data in Scotland, which had previously been shown internationally. The comparison was delayed due to the requirement for Public Health Scotland to approve the use of these detailed testing data. The review notes (p.26, italics added): *"Interviews revealed more fundamental concerns regarding privacy and sharing health data. PHS were seen as unwilling to share to their data below the neighbourhood level due to concerns about potentially identifying individuals and stigmatising communities, even with bio-informatics colleagues who are used to working with confidential data and have the facilities to do so securely. The system governing Scottish health data was also described by one interviewee as "deeply flawed" and "fragmented" to the point where "nobody controls [health data] in its entirety" (Interview 17, Researcher).".* The comparisons were made from around December 2020 and regular updates for specific locations, or for Scotland as a whole, were published in the series of SG 'Modelling the Epidemic' reports, starting from number 34, of 14 January 2021.

31. The final report of this series (number 115, published 22 December 2022) is included [AJM/003-**INQ000346151** This report notes "*a continued increase in wastewater Covid-19 levels over five consecutive weeks from low levels previously seen in November* [2022].". That increase in WW up to 14 December 2022 had not yet been detected by the UK Office for National Statistics Covid Infection Survey (ONS CIS) data that is plotted for comparison, in figure 10 of the report. These WW data represented a wave of infection that subsequent data show had peaked around 22 December, corresponding to a wave of Covid-19 hospital admissions that peaked at the end of December 2022. This figure 10 illustrates that these comparisons, which were delayed by access to testing data in 2020, were important to validate the WW data.

32. Separately, I note that only the timeseries of WW data continues to the time of writing in Scotland, because all community testing and the ONS CIS have ended, as has the

national WW monitoring in England. This underlines the point I make in paragraphs 17 and 27, that WW data reinforced community testing data during the inquiry's interval of interest when community testing was ongoing. At the time of writing, however, WW monitoring data provides the continuous timeseries, as the Chief Scientist for Health and I anticipated in our earliest briefings on WW monitoring in 2020.

33. Participants in the WW programme had difficulty in engaging PHS more generally, until 2022. The review notes (p.25), "many interviewees experienced difficulties in trying to get members of the public health community to engage with the WW testing research".

34. I did not provide evidence directly to either UK or Scottish Parliaments.

Relationship of the Scottish WW programme to other UK nations

35. There was good communication and exchange of research materials amongst researchers in Scotland, England and Wales, from the inception of the WW programme, supported by multi-partner research funding notably from UKRI-NERC. Several working groups met regularly (sometimes weekly) to discuss laboratory methods and data analysis. The groups involved scientists or science advisors from the governments and their agencies, such as SEPA and JBC, and some university researchers.

36. The Scottish WW programme had initially developed different lab testing and data analysis methods, compared to those used in the English and Welsh programmes. The Scottish programme kept with their approaches over time, as they worked well, adopting some minor practices from the other groups. This was an example of parallel developments in Scotland and England, rather than divergence from a common starting point.

37. I joined a strategic coordination group led by the Defra CSA's office, which met throughout 2020. For example, we coordinated two, joint press releases announcing the WW monitoring programmes, with both UK and Scottish Government participation. This strategic coordination was significantly reduced after the management of the WW programme in England passed from Defra to DHSC in December 2020/January 2021.

The lack of coordination was most evident in March 2022, when WW monitoring was significantly reduced in England but maintained in Scotland and Wales.

38. The English and Scottish WW programmes also took different approaches to sharing data. The Lessons Learned review notes, "*A final comparison between Scotland and England highlighted by many interviewees was different approaches to data sharing in the two countries. The underlying narrative was one of Scottish willingness to share the WW testing data (which has been in the public domain since October 2020) compared to the unwillingness of the equivalent English institutions to release their data.".* However it also notes *"that the situation is more complex that [sic] this account allows*". The Scottish WW programme provided WW data for four Scottish locations to JBC from the earliest stages of the programme, together with access to the protected version of the SEPA data dashboard. I had no access to English data in return, until the development of new reporting tools that were shared in the summer 2021, and reports on Covid-19 variants from sequence analysis that were shared later that year. This probably had little effect on the SG response overall.

(F) Roles in Covid-19 Public Health Communications, and (G) in public health and coronavirus legislation and regulations.

39. I had no role in those areas.

(I) Informal communications and documents.

40. I used WhatsApp and text messages to arrange real-time meetings, for example to coordinate online meeting times and platforms with participants, and to follow up requests that had previously been sent by email. As outlined above, I was not involved in the decision-making processes that the inquiry's request refers to. The messages were on my personal device and no steps were taken to preserve them.

Statement of Truth

I believe that the facts stated in this witness statement are true. I understand that proceedings may be brought against anyone who makes, or causes to be made, a false statement in a document verified by a statement of truth without an honest belief of its truth.

Signed: Personal Data

Dated: _____ 15 November 2023 _____