REPORT 23

NATIONAL WASTEWATER DRUG MONITORING PROGRAM

AUSTRALIAN CRIMINAL INTELLIGENCE COMMISSION

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

University of South Australia

CONTENTS

CEO FOREWORD

I am pleased to present Report 23 of the Australian Criminal Intelligence Commission (ACIC)'s National Wastewater Drug Monitoring Program (the Program).

This report is based on data collected in April and June 2024. In April the Program covered 56% of the Australian population and in June it covered 48%. The findings are critical to inform the ACIC's insights on Australia's illicit drug markets, which are supplied by serious and organised crime (SOC) groups.

SOC remains an enduring threat to our security and safety. SOC actors exploit and take advantage of economic uncertainty, geopolitical and international instability and conflict, focusing firmly on maximising profit at the expense of the security and wellbeing of the Australian community.

Much of the harm Australians suffer at the hands of organised crime is due to illicit drugs. Groups engaged in illicit drug trafficking and production have no regard for our laws or the harms their trade causes. They are highly capable, well-resourced, resilient and increasingly transnational.

While this report specifically focuses on data collected in April and June 2024, longer term trends since August 2023 reveal a more nuanced picture of national drug consumption. While variable between capital city and regional locations, in some markets there was increased consumption (methylamphetamine and MDMA), while in other markets there was relative stability (cannabis, heroin and oxycodone). In some markets national consumption fell (fentanyl). Despite a fall in national cocaine consumption since December 2023, consumption of this drug remains higher than pre-COVID 19 pandemic levels, signalling possible longer-term expansion of the market. Current methylamphetamine consumption is above long-term average levels, but not at the levels observed prior to COVID. In April 2024 there was record high ketamine excretion in both capital cities and regional areas, underlining an escalation in use.

Wastewater data, combined with other drugs-related data and information, assist the ACIC and its partners to develop a comprehensive picture of illicit drug markets. Importantly, when considering the whole spectrum of market indicators (covering health indicator data including ambulance call-outs, emergency presentations, overdoses and coronial data, treatment services and mental health presentations, and law enforcement, survey and forensic data), the combined picture strongly indicates modest market growth only, not exponential growth, particularly in the markets for illicit stimulants.

A multi-dimensional approach to address drug-related threats and harms that targets supply, demand and harm reduction is critical to effectively responding to Australian drug markets. Wastewater analysis is one of the most cost-effective, least intrusive methods of measuring drug use at a population level. Wastewater data reveal drug market resilience, but also points of vulnerability that present opportunities for coordinated strategies that improve the safety of the Australian community.

The ACIC remains committed to working with a broad range of partners to increase understanding of illicit drug markets and contribute to government objectives in Australia and internationally. Wastewater analysis is also used, increasingly, as a component of drug 'early warning' programs. Layering data and intelligence allows for empirically-based, effective collective responses to drug markets and their harms.

ACKNOWLEDGEMENTS

I would like to acknowledge the valuable support and expertise of The University of Queensland and the University of South Australia, which undertook the data collection and analysis underpinning this report, and the ACIC officers who contributed to the project.

Heather Cook
Chief Executive Officer
AUSTRALIAN CRIMINAL INTELLIGENCE COMMISSION

SNAPSHOT

The April 2024 collection covers around **56 per cent** of Australia's population – about **14.2 million Australians**.

Capital city **cocaine, heroin, fentanyl** and **ketamine** average consumption exceeded regional consumption.

Regional **alcohol, nicotine, oxycodone, methylamphetamine, MDMA** and **cannabis** average consumption exceeded capital city consumption.

APRIL AND JUNE 2024 HIGHLIGHTS

RECORD HIGHS

KETAMINE
capital city and regional (April)

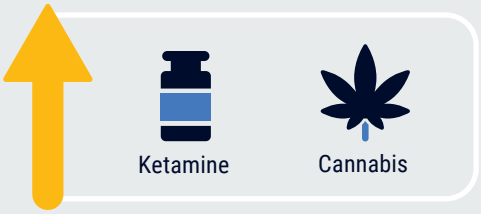
RECORD LOWS

FENTANYL
regional (April)

OXYCODONE
regional (April)

ALCOHOL
capital city (June)

Between December 2023 and April 2024, the population-weighted average **capital city** consumption of:



Between December 2023 and April 2024, the population-weighted average **regional** consumption of:

INTRODUCTION

This is the 23rd report of the National Wastewater Drug Monitoring Program (the Program) to be publicly released by the Australian Criminal Intelligence Commission (ACIC). Report 23 presents data on Australia's drug consumption for 12 substances and includes data for April (capital city and regional sites) and June 2024 (capital city sites only).

The Program is an Australian Government-funded initiative that assists in understanding drug use within populations, providing a measure of the demand for a range of drugs. Illicit drugs and licit drugs with abuse potential are inherently harmful. Reliable drug consumption data are a key indicator of levels of community harm.

Findings presented in ACIC wastewater reports provide law enforcement, policy, regulatory and health agencies with objective data on drug use. These data create opportunities to shape responses to the demand and supply sides of illicit drug markets, particularly in high-use areas, and can inform harm reduction strategies. They inform priority-setting that is responsive to constantly evolving drug markets domestically and internationally.

Longitudinal data captured by the Program increase our understanding of drug use nationally, in specific locations and over time. They provide valuable insight into trends and emerging issues in drug consumption across Australia and can identify new sources of risk.

IMPLEMENTATION

The ACIC contracted The University of Queensland, and through it the University of South Australia, to deliver the Program. Relationships have been built between the universities and the operators of wastewater facilities across Australia to permit collection and analysis of samples.

In this report, Program wastewater analysis measured the presence[1] of the following substances:

- methylamphetamine
- amphetamine
- cocaine
- 3,4-methylenedioxymethylamphetamine (MDMA)
- 3,4-methylenedioxyamphetamine (MDA)
- heroin
- cannabis
- oxycodone
- fentanyl
- nicotine
- alcohol
- ketamine.

The ACIC continues to review the range of monitored substances with its partners, stakeholders and universities.

1 The contract recognises that threshold levels are substance dependent and will vary accordingly. Refer to the research findings for further information on detection levels and whether it was possible to measure all substances.

Both contracted universities monitor wastewater across Australia, covering all state and territory capital cities and a range of regional cities and towns. In April 2024, 59 wastewater treatment plants participated nationally, covering 56% of the Australian population (Figure 1)[2]. Sites were selected to permit the ACIC to provide data on major population areas, to represent a cross-section of regional cities and towns and sites where treatment plant operators have established relationships with the universities.

Figure 1: The breakdown of sites by jurisdiction for April 2024.

Participation by all states and territories is vital to informing our understanding of the national picture of drug use and demand. Although the location of sites within and between states and territories may change over the life of the Program, the intention is to ensure site continuity.

REPORTING

Program reports are published 3 times a year. In accordance with current wastewater analysis conventions, the terms of the contract and to protect the integrity of the Program, the exact locations of wastewater treatment plants sampled are not publicly released by the ACIC. Stakeholders in law enforcement, health and other relevant policy agencies are provided with classified information identifying actual sampling locations to inform appropriate responses.

2 Sampling also occurred in June 2024 in capital city sites, with 20 participating wastewater sites nationally, covering approximately 48 per cent of the Australian population.

Reported results reflect per capita use in all locations and, with the exception of MDA and ketamine (for which reliable dose figures are unavailable), are expressed in terms of both the number of doses and the weight or volume consumed per capita of the respective substances, to facilitate comparison between substances.

EXPLOITATION OF PROGRAM DATA

The Program is based on a well-established, internationally recognised methodology. Program data provide an important basis for the development of empirically-informed government and private sector policy and decision making. The reports provide regular, timely, unambiguous and detailed measures of the level of demand for the listed substances in the Australian population, complementing other drug datasets published in Australia.

Wastewater data are also particularly useful for identifying differences in levels of drug consumption in capital cities and regional areas of Australia. The data reinforces different dynamics that apply to both capital city and regional markets and illustrate drug consumption variations that exist within and between states and territories. Understanding these preferences is important in the development and delivery of national responses and in tailoring responses to suit the specific needs of individual jurisdictions. Wastewater analysis also permits the ACIC to gain insight into the decision-making of serious and organised crime groups that supply illicit drug markets.

Regular wastewater reporting enables the ACIC and partners to detect and respond to increasing drug threats in a timely way. The number and diversity of regional sites that participate in the Program permit confident assessments to be made of drug trends outside of the capital cities that can be used to inform local responses. This is important because it allows wastewater data to complement a number of other Australian drug data collections that have limited regional coverage or are confined to capital cities. It also permits the ACIC and partners to speak with greater confidence about local drug threats.

Triangulated data show that domestic drug markets are complex and vary between jurisdictions, with external influences affecting markets in different ways at different time periods. Other Program data illustrate that consumption of the respective drugs also varies considerably at different sites within jurisdictions. It is important that Australian drug datasets are interpreted holistically. When considering the whole spectrum of market indicators (covering health indicator data including ambulance call-outs, emergency presentations, overdoses and coronial data, treatment services and mental health presentations and law enforcement, survey and forensic data), the combined picture indicates modest, rather than exponential market growth nationally, particularly in the markets for illicit stimulants.

For example, when coupled with seizure and detection data (onshore and offshore), wastewater data provide an important indicator of the collective capacity and intentions of serious and organised crime (SOC) groups. The economics of illicit drug markets are not substantially different to many other legitimate markets as they are governed to an extent by demand and supply. Despite this, there is no direct correlation between seizure/detection and consumption data because they measure relatively independent market dynamics. It is common for the total weight of drugs (such as cocaine) seized to exceed the total weight of drugs consumed because SOC groups continually seek to maintain or build markets through replacement loads as drugs that are detected/seized never make it to market.

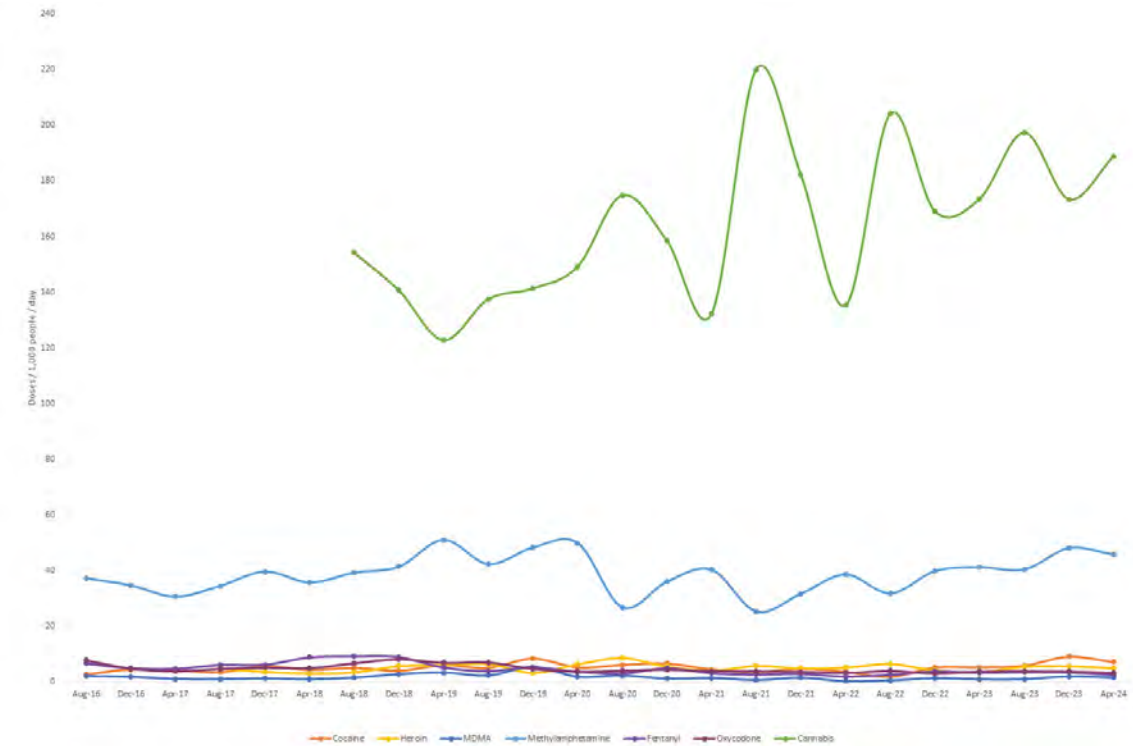
Demand is best understood at a population level and wastewater data lends itself to this. The level of drug consumption is the best and most reliable indicator of total illicit drug market size, noting that there may be short-term unmet demand, especially where drugs are largely (for example, methylamphetamine) or exclusively (cocaine and heroin) imported. As already noted, SOC groups constantly seek to replace detected/seized drugs to maintain or build those markets and so simply aggregating the total weight of all drug detections and seizures over time is not a robust measure of market size.

The ACIC engages with academic institutions, industry and public sector agencies to identify further data applications. Identified opportunities included informing responses in high-risk areas; measuring drug use in specific local areas; estimating the size of discrete illicit markets; and exploring options for monitoring the effectiveness of existing demand, supply and harm reduction initiatives. The Program is sufficiently flexible to allow for bespoke collection activity in different geographic locations and at varying intervals in response to identified needs and objectives.

DRUG CONSUMPTION SNAPSHOT

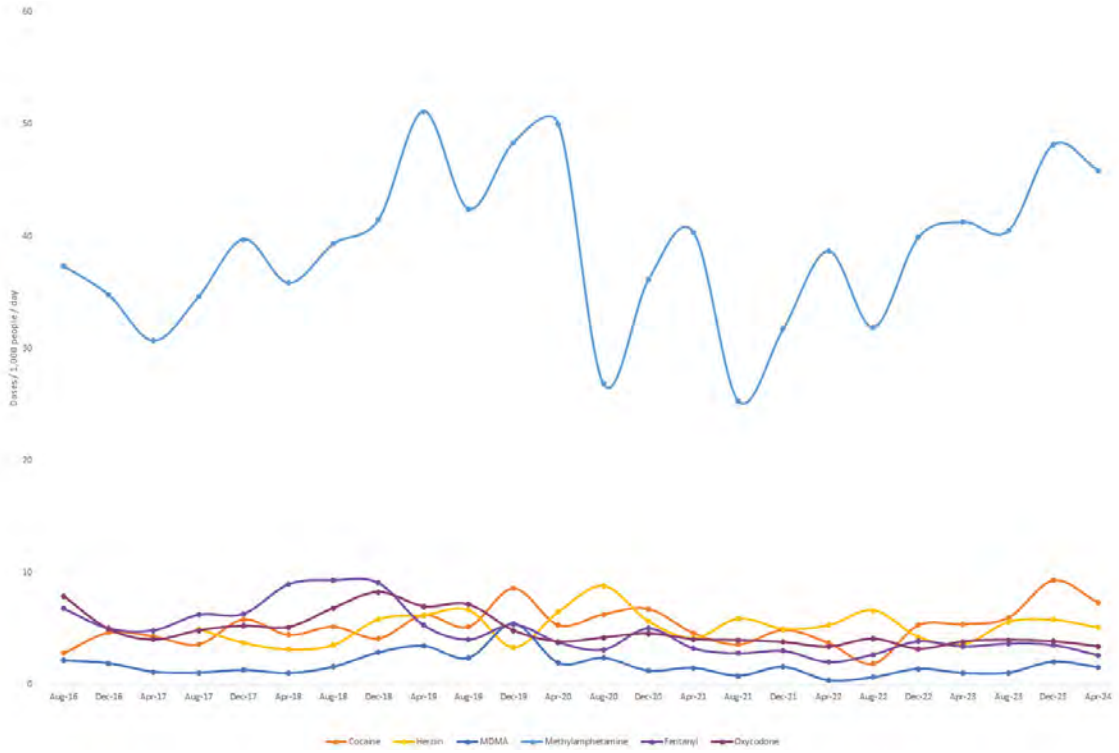
Nicotine and alcohol aside, cannabis is the most consumed drug by a large margin. In April 2024, cannabis consumption was 4 times higher than the consumption of methylamphetamine, 25 times higher than the consumption of cocaine and 36 times higher than the consumption of heroin (Figure 2). In addition, of the drugs in Figure 2, only cannabis had increased national consumption during the review period.

Figure 2: National average drug consumption of cannabis, methylamphetamine, cocaine, MDMA, heroin, oxycodone and fentanyl.



National consumption of fentanyl and oxycodone decreased to the second and third lowest levels recorded by the Program, respectively. Despite decreases in national methylamphetamine and cocaine consumption during the review period, methylamphetamine consumption remains at the fifth highest level recorded by the Program and cocaine consumption at the third highest level (Figure 3).

Figure 3: National average drug consumption of methylamphetamine, cocaine, MDMA, heroin, oxycodone and fentanyl.



RESEARCH FINDINGS

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LIST OF ABBREVIATIONS:

ABS	Australian Bureau of Statistics
ACIC	Australian Criminal Intelligence Commission
ACT	Australian Capital Territory (capital city is Canberra)
DASSA	Drug and Alcohol Services South Australia
LC-MS/MS	Liquid chromatography tandem mass spectrometry
LOD	Limit of detection
LOQ	Limit of quantification
MDA	3,4-methylenedioxyamphetamine
MDMA	3,4-methylenedioxymethylamphetamine
NSW	New South Wales (capital city is Sydney)
NT	Northern Territory (capital city is Darwin)
NWDMP	National Wastewater Drug Monitoring Program
Qld	Queensland (capital city is Brisbane)
SA	South Australia (capital city is Adelaide)
SPE	Solid phase extraction
Tas	Tasmania (capital city is Hobart)
THC	Tetrahydrocannabinol, active substance in cannabis
THC-COOH	11-nor-9-carboxy-tetrahydrocannabinol, metabolite of THC
Vic	Victoria (capital city is Melbourne)
WA	Western Australia (capital city is Perth)
WWTP	Wastewater treatment plant

TERMINOLOGY:

Methylamphetamine is also commonly known as methamphetamine. In this report methylamphetamine is used, consistent with the preferences of the ACIC.

MDMA is commonly known as ecstasy.

Alcohol consumption in this report refers to ethanol consumption, but the more general term 'alcohol' is used throughout.

Nicotine consumption has replaced tobacco consumption as the target metabolites may also be derived from nicotine replacement products, such as gums and patches.

THC and THC-COOH: Tetrahydrocannabinol is the main psychoactive compound in cannabis and is referred to as THC throughout this report. Cannabis consumption levels have been calculated from the THC metabolite, 11-nor-9-carboxy-tetrahydrocannabinol (THC-COOH).

1: EXECUTIVE SUMMARY

BACKGROUND

The Australian Criminal Intelligence Commission (ACIC) National Wastewater Drug Monitoring Program (NWDMP or the program) has reported on several substances of concern in Australia since August 2016. The NWDMP focuses on 12 licit and illicit drugs including nicotine, alcohol; the stimulants methylamphetamine, amphetamine, cocaine, MDMA and MDA; the opioids oxycodone, fentanyl and heroin; as well as cannabis and ketamine. Estimates of drug consumption in a population are determined from measured concentrations of drug metabolites in wastewater samples. Results are used to monitor trends in drug consumption over the life of the Program. Wastewater treatment plants (WWTPs) located across capital cities and regional Australia, covering all states and territories, have been invited to participate in the Program. Sites have been given a unique number which is used in every report. Site names and locations are not included in the report to maintain the confidentiality of participating treatment plants.

DATA IN THIS REPORT

Sampling for Report 23 included wastewater samples collected for up to 7 days in both April and June 2024. The April collection involved regional and capital city sites, while June included capital city sites only. A total of 59 sites participated in April, consisting of 20 capital city sites and a further 39 regional sites, covering a population of 14.2 million Australians. Data from this report equates to coverage of approximately 56 per cent of Australia's population for April and 48 per cent for June. A total of 531 new samples have been added to the 11,189 previously collected, bringing the total number since the beginning of the Program to 11,720. The samples provide national data on drug consumption and build on prior results to provide trends between locations and over time.

RESULTS

Alcohol and nicotine were the highest consumed drugs in all states and territories in April 2024, followed by cannabis and methylamphetamine. The scale of drug consumption for the remaining drugs varied by state and territory.

NICOTINE

- Consumption is generally higher in regional areas.
- Nationally, consumption of nicotine has decreased from December 2023 to April 2024, although this was not necessarily the case at jurisdictional level.
- Over the life of the Program, average consumption of nicotine has increased in the capital cities and regional areas.

ALCOHOL

- Alcohol consumption is generally higher in regional areas.
- The amounts of alcohol consumed have been decreasing in some states and territories, and nationally, over the past 2 years.
- Higher average consumption of alcohol was recorded in the Northern Territory and Hobart in April and June 2024.

METHYLAMPHETAMINE

- Consumption is generally higher in regional areas than in the capital cities.
- An increasing consumption trend was apparent in many parts of the country.
- National estimates show methylamphetamine consumption in April 2024 was similar to or lower than in December 2023.

COCAINE

- Consumption is higher in the capital cities than in regional areas.
- Consumption remains at high levels despite a decrease from December 2023 to April 2024.

MDMA

- Consumption is generally higher in regional areas than in the capital cities.
- Regional consumption has been increasing from record low levels in April 2022.

MDA

- MDA excretion remains low nationally and average capital city and regional excretion decreased from December 2023 levels.

OXYCODONE

- Consumption is substantially higher in regional areas than in the capital cities.
- A decreasing trend in consumption is emerging in regional areas, while capital city consumption has been relatively steady for the past year.

FENTANYL

- Average fentanyl consumption decreased in regional areas from December 2023 to April 2024 and has been decreasing over the past year.
- For the first time ever, average capital city consumption exceeded average regional consumption.

HEROIN

- Consumption is higher in the capital cities than in regional areas.
- Many sites had consumption levels below the detection limits, particularly in regional areas where consumption remains very low at most sites.

CANNABIS

- Consumption is higher in regional areas than in the capital cities.
- Regional consumption remains approximately double average capital city consumption.

KETAMINE

- There were large differences in excretion between sites and within states in April 2024.
- Excretion is higher in the capital cities than in regional areas.
- An increasing trend has emerged over the past 2 years, with excretion in the capital cities and regional areas reaching record high levels in April 2024.

2: INTRODUCTION

2.1 PREAMBLE

Wastewater analysis is a technique for monitoring the population-scale consumption of substances. The University of Queensland and University of South Australia have provided wastewater data since 2016. Samples are collected at wastewater treatment plants for one week every 2 months for sites in capital cities and for one week every 4 months for regional sites. The aim is to provide consumption estimates for substances that cause potential harm, either through addiction, health risks or criminal and anti-social behaviour. This report compares consumption data from previous reports with results obtained from regional and capital city sites in April and capital cities in June 2024. The report presents patterns of substance consumption across Australia, showing differences in levels between capital cities and regional centres, within and between states and territories and nationally.

Substances included are nicotine (consumption of tobacco products, gums, patches, e-cigarettes/vapes), ethanol from alcohol consumption, pharmaceuticals with abuse potential such as oxycodone, fentanyl and ketamine, as well as illicit substances including methylamphetamine, MDMA, MDA, cocaine, cannabis and heroin.

3: METHODS

Wastewater-based monitoring of drug consumption is based on the principle that any substance that is consumed (irrespective of whether it is swallowed, inhaled/smoked or injected) is excreted in urine or faeces. This may be either in the chemical form it was consumed and/or in a chemically modified form that is referred to as a metabolite. Once the excreted substance or metabolite is flushed into the sewer network, it will arrive at a wastewater treatment plant, assuming the point of excretion forms part of a wastewater catchment (Figure 4).

Information on the current drug list and their metabolites of interest is contained in Appendix 1. The first NWDMP report (available at www.acic.gov.au) also provides an in-depth description of the methodologies and calculations used. Collectively, waste products in the sewer system arrive at a WWTP. There, samples can be collected over a defined sampling period, typically sub-sampled over the course of a day. First, the concentration of a target substance in the wastewater sample is measured. Next, information on the amount of wastewater entering the WWTP, the population serviced by the plant, as well as information about the substance metabolism are used to calculate consumption estimates. Estimates have units of mass (milligrams) per day per 1,000 people (mg/day/1,000 people) or doses per day per 1,000 people (doses/day/1,000 people). Sites of different land area can be compared directly when estimates are expressed per 1,000 population. As many thousands of people contribute to each sample, it is not possible to identify drug consumption from individuals. The method is considered non-invasive and privacy is ensured.

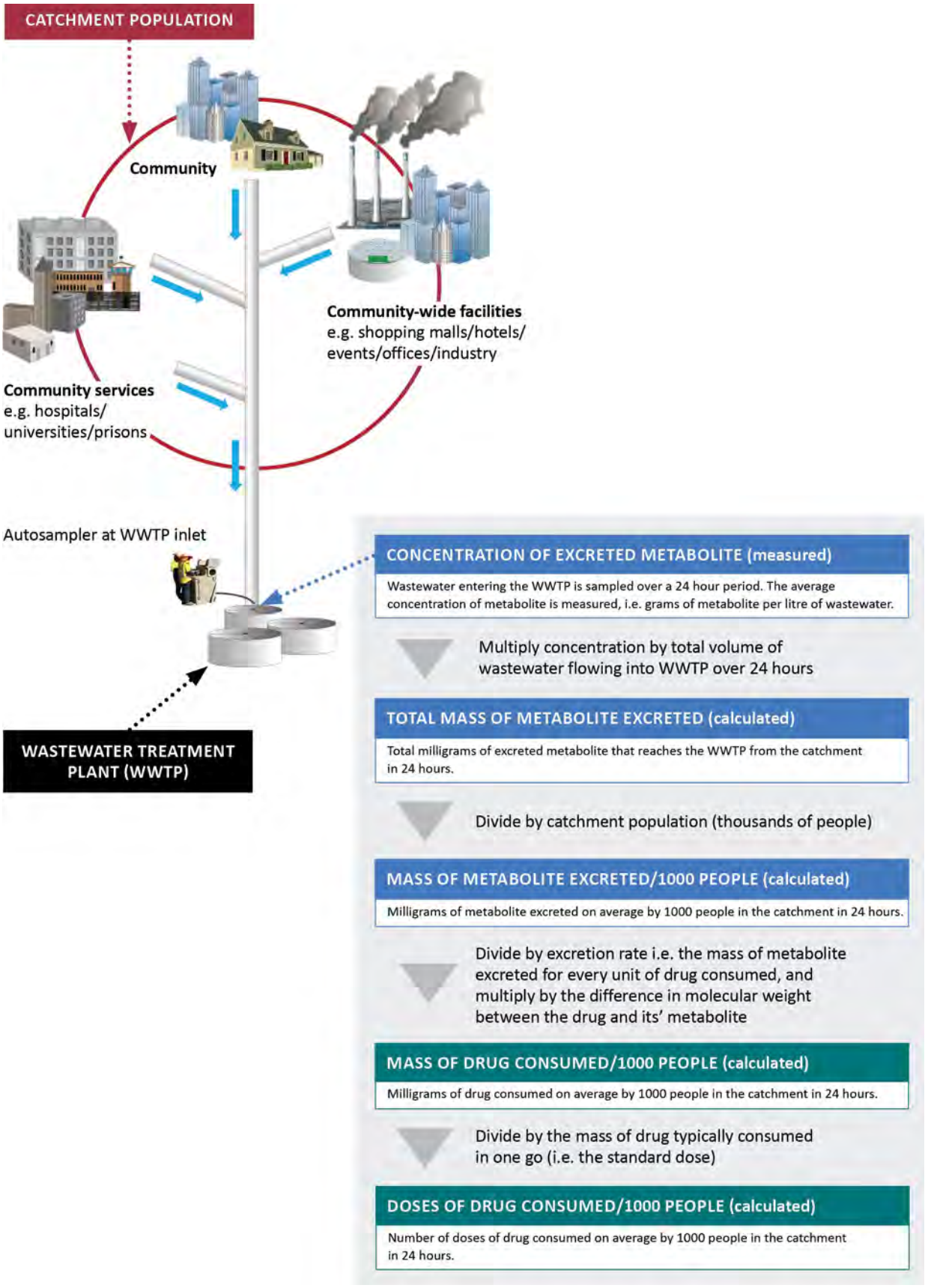
After their consumption, drugs can either pass through the body unchanged or get converted into metabolites. Methylamphetamine is partially metabolised and excreted as amphetamine, while part of a MDMA dose is converted to MDA. The relationships between these compounds have been well studied and have been accounted for in this report (Pizarro et al. 2002; Khan & Nicell 2011). MDA is a drug, but also a metabolite of MDMA. Since the proportion of MDA excreted after MDMA consumption is known, the proportion of MDA coming from MDMA metabolism was subtracted from

the total measured amount of MDA. Similar calculations are conducted for methylamphetamine and amphetamine, where amphetamine coming from methylamphetamine consumption is subtracted from the total amount of amphetamine. Due to the lack of information on MDA elimination following MDA ingestion, consumption estimates cannot be calculated, so MDA is reported as excretion. Similar to MDA, ketamine results are also reported as the amount (mg) of drug excreted per day per 1,000 people as no suitable scientific information is available to convert amounts excreted to amounts consumed in wastewater.

After wastewater containing the drugs and their metabolites transits the sewer, samples are collected at the inlet of a wastewater treatment plant over 24 hours using autosamplers that collect time or flow proportional samples. Wastewater treatment plant operators aid with collecting the samples from the influent autosampler. Each sample is then preserved using 2 different preservatives to prevent decay of the drugs or their metabolites and kept frozen until analysis. A few sites in regional Western Australia are not able to collect the preservative used for the detection of the cannabis metabolite and so no data for the drug is reported for those sites.

Wastewater samples are then sent frozen via overnight courier to analytical laboratories at the University of South Australia and The University of Queensland where they are analysed. The steps include filtration of the samples followed by an enrichment or concentration step. Sample extracts are then injected into the analytical instruments to determine the concentration of each of the specific drugs or metabolites. Some drugs are at high enough concentrations where the concentration step is not necessary and are directly injected into the instrumentation. The instrumental analysis consists of chromatographic separation and compound specific detection by liquid chromatography mass spectrometry (LC-MS/MS). A summary of the extraction and analytical methods is given in Report 1. Methods to extract and analyse the cannabis metabolite are outlined in Tscharke et al. (2016). The excretion and dose information used in the calculations can be found in Appendix 1. Drug consumption estimates for each catchment population were calculated from these measured concentrations using daily flow volumes provided by the wastewater treatment plants and estimates of the catchment population size by evaluating census data vs. catchment maps, together with excretion and dose data on the drugs of interest obtained from the scientific literature.

Figure 4: Schematic of the population catchment area and methodology used to convert concentrations of substances in wastewater to consumption estimates.



3.1 PARTICIPATING WASTEWATER TREATMENT PLANTS (WWTPs)

Fifty-nine WWTPs across Australia participated in the NWDMP for the April 2024 collection period (Figure 5). Of these, 20 sites were in capital cities and a further 39 in regional areas, covering a wide range of catchment population sizes. Sites were selected in consultation with the ACIC. The number of participating sites for this report and a complete list of participating sites, number of samples and relative catchment sizes are listed in Table 1 and Appendix 2. To maintain the confidentiality of the participating sites, all sites were allocated a unique code to de-identify their results for the course of the Program. Only site codes are presented in the results.

Figure 5: Participating WWTPs in April 2024 showing the number of capital city and regional sites by state and territory. Each state or territory is assigned a colour which is used to identify them in figures.

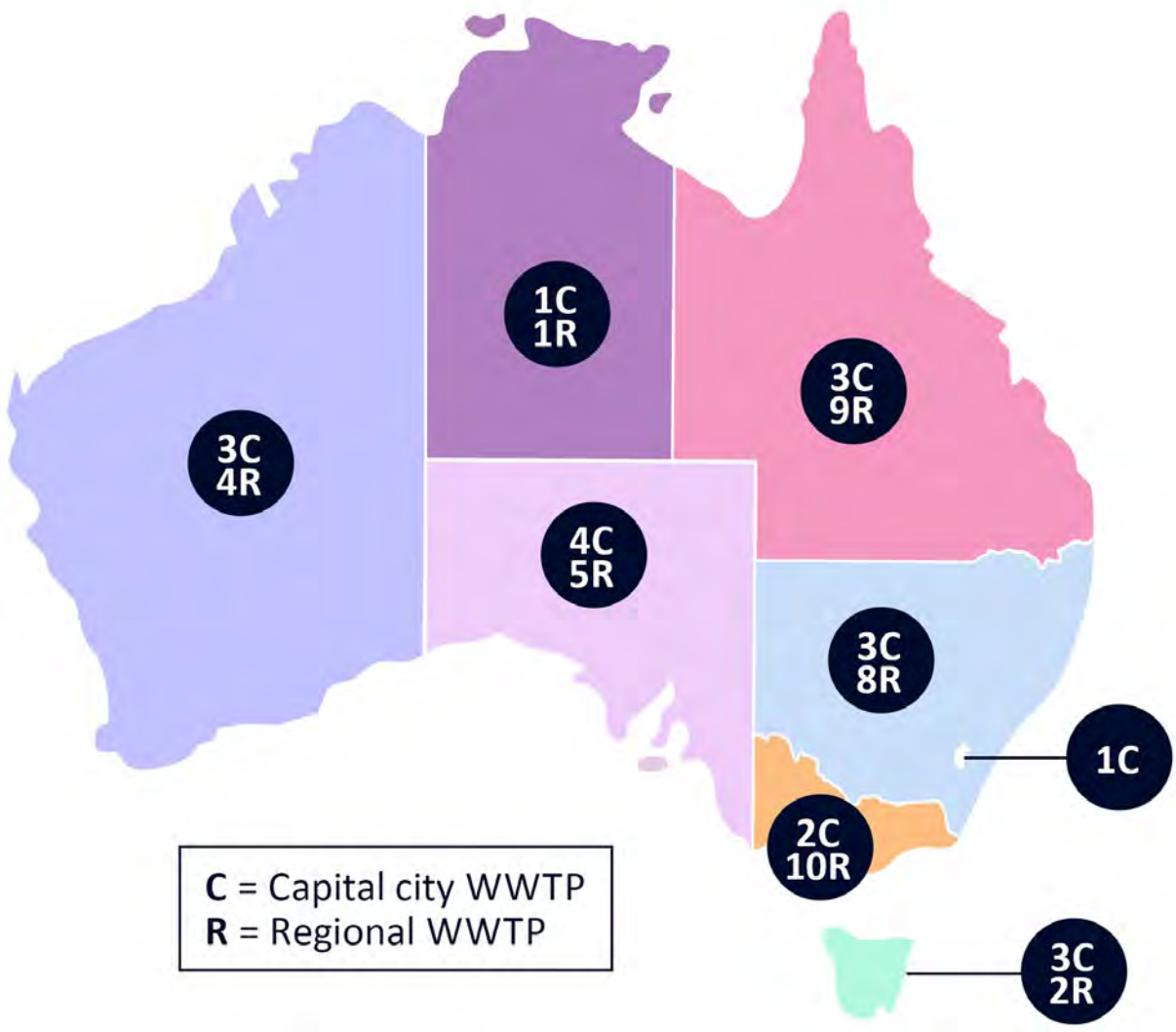


Table 1: Number of participating WWTPs for the periods covered in this report. One collection period aims to collect data from both capital city (C) and regional (R) sites, while the other collection period aims to collect data from capital city sites only.

State/territory	Apr 2024 Capital	Apr 2024 Regional	Jun 2024 Capital
ACT	1	–	1
NSW	3	8	3
NT	1	1	1
Qld	3	9	3
SA	4	5	4
Tas	3	2	3
Vic	2	10	2
WA	3	4	3
Sites	**20**	**39**	**20**
Population (millions) C & R	**12.1**	**2.1**	**12.1**
% of Australian population	**47.6**	**8.1**	**47.6**
Total population (millions)		**14.2**	**12.1**
% of Australian population		**55.7**	**47.6**

Estimates have been rounded to the nearest 0.1 million. Census 2021 population used (25,422,788) for population percentage estimates.

3.2 SAMPLE COLLECTION AND PREPARATION

Daily composite samples were collected by treatment plant staff on 7 consecutive days, or where 7 days was not possible, across as many consecutive days as possible. Weekend samples in many of the Tasmanian sites were not available. Samples were stored at 4°C or were frozen prior to transport to South Australia or Queensland. Further details of the sampling protocol and relevant quality controls are included in Irvine et al. (2011), Lai et al. (2011), Lai et al. (2015), Tscharke et al. (2016) and Bade et al. (2019). All other descriptions of calculations, extractions and analytical methods are outlined in Report 1 (available at www.acic.gov.au). Methods to detect and analyse THC-COOH are outlined in Tscharke et al. (2016). Small revisions may be made to historical data when more accurate data become available, for example, when updated flow measurements supplied by wastewater utilities or population estimates become available.

3.3 PRESENTATION OF DATA AND INTERPRETATION OF GRAPHS

Reported averages: All consumption averages for state/territory or Australia-wide are presented throughout this report as population weighted averages. The number of people in the catchment population is used as the weighting for the respective drug consumption data for that population. For example, to calculate the population weighted average of capital city consumption, the consumption data for each WWTP was multiplied by the respective population, all data were then summed and divided by the total population across all capital city sites. Reported average values are therefore not skewed towards usage data from small, non-representative populations.

Per capita consumption: The per capita consumption estimates presented in this report are calculated using the total estimated catchment population (which includes children). Per capita alcohol consumption has previously been reported by the Australian Bureau of Statistics (ABS) based on population numbers for people aged 15 and over. The consumption values presented in this report will underestimate consumption determined for an adult-only population. For consistency, data from other studies were recalculated where necessary using the estimated total population.

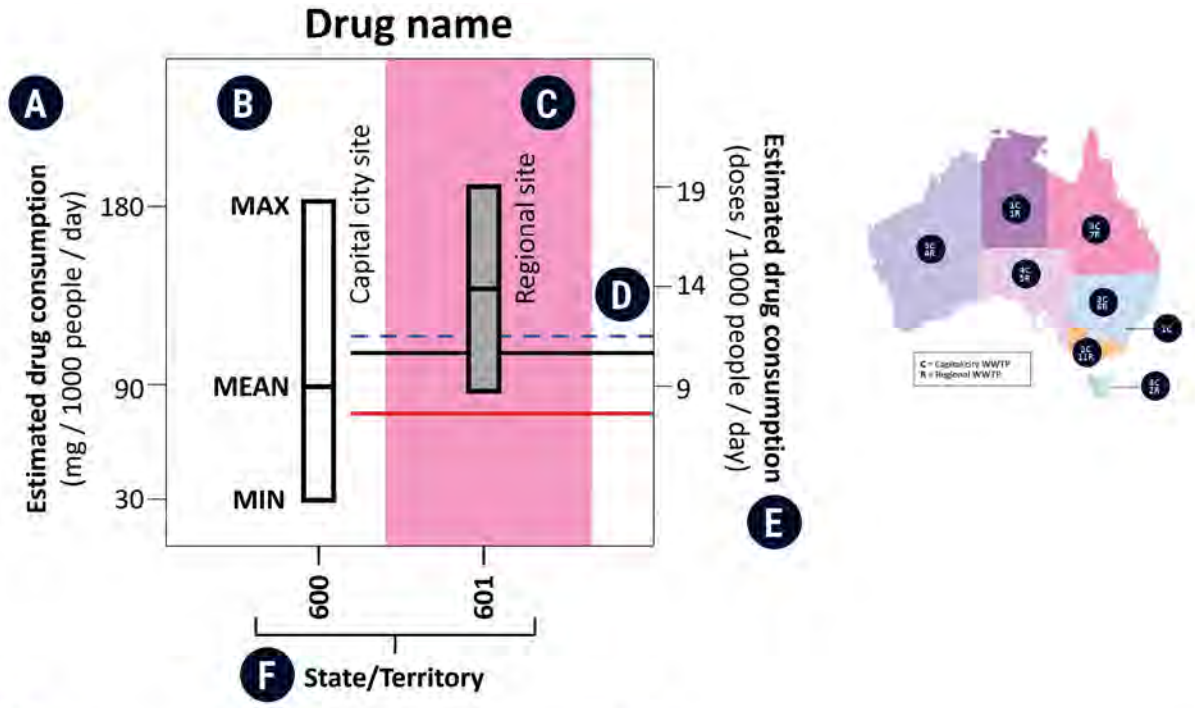
Graphical presentation of data: An overview of how the data is presented in the graphs for the individual sites is given in Figure 6. This includes information on interpreting the consumption data presented on the vertical axes in all graphs in this report. To improve readability of graphs with higher results in one site, we have reduced the graph height and labelled the higher value on the bar (values obtained from the left axis). In some graphs, the values plotted in the graph can be read as either mass of drug consumed (left axis) or doses of drug consumed (right axis). For the specific cases of MDA and ketamine, the amount of MDA and ketamine excreted following their consumption is not known, and therefore the drugs can only be expressed as how much drug was excreted into the sewer network, e.g., the mg excreted per 1,000 people per day. From Report 19, cannabis results were also presented as doses per day per 1,000 people, similar to other drugs. This has to be considered when referring to historical reports where results were shown only as mg consumed per day per 1,000 people. In addition, the calculation of cannabis used a different excretion rate prior to Report 19. From Report 19 all current and historical data have been revised and are comparable within the report.

Instrumental method limits of detection and limits of quantification: Since the wastewater samples contain very low quantities of particular drugs, the limit of detection (LOD) was determined analytically as the lowest concentration of that drug that could be determined in the sample (using the methods described in Report 1). A drug may be present at a concentration below the LOD. However, trace quantities may be present at undetectable levels. The limit of quantification (LOQ)[3] is a concentration (higher than the LOD), above which we have high confidence that the concentration measured on the analytical instrument is accurate. Above the LOD but below the LOQ there may be some uncertainty as to the actual concentration. To be conservative (a drug may be present but there is uncertainty as to its concentration) and in line with current practice, for back calculations to estimate per capita consumption, a concentration below the LOD was included as a value of LOD/√2. A concentration above the LOD but below LOQ is included at the midpoint between the LOD and LOQ (i.e. (LOD + LOQ)/2). The frequency of detection is included in Appendix 3.

Weekly pattern of drug use: The pattern of drug consumption over the sampling week for the sites in this report cannot be elucidated from the data included. We present the maximum, minimum and average (for individual sites as illustrated in Figure 6) and only population-weighted average values for all other graphs. Consistent patterns of drug consumption in Australia from previous wastewater studies indicate that some substances such as cocaine, MDMA and alcohol have significantly higher consumption on weekends. Other drugs such as methylamphetamine, oxycodone and fentanyl tend to have smaller differences between days of the week (Lai et al. 2015, Tscharke et al. 2016).

3 LOQ is the lowest level that can be accurately measured.

Figure 6: Explanation of the graphs used for individual sites. General concepts relevant to all graphs in the report are also outlined (unique site codes, explanation of vertical axes, colour coding).



A

The **LEFT HAND AXIS** shows the estimated total mass consumed (in milligrams, mg) of a drug which is calculated by measuring the concentration of the drug's metabolite in a 24 hour wastewater composite sample, multiplying by the flow volume in the 24 hours, dividing by the population size and applying an excretion factor for the metabolite (see Equation 1, Report 1 for details).

To convert the mass consumed (left axis) to the estimated doses consumed (right axis), we divide the estimated mass consumed by the standard dose amount. Dose amount and excretion factors are given in Appendix 1 of Report 4. In this example, at Site 600, the minimum consumption was 30 mg in one day, the maximum was 180 mg and average was 90 mg per day over the sampling period (for every 1,000 people).

B

We collect wastewater data for up to 7 days and estimate the amount of drug consumed for each day of sampling. We plot the maximum **(MAX)** day's consumption, the minimum **(MIN)** day's consumption and the average **(MEAN)** across the 7 days. If the box is long, there is a large difference in consumption patterns over the week, for example, if the drugs are used excessively at weekends but not often during the week. Alternatively, a short box suggests a similar drug usage every day of the week. See also main text.

C

COLOURS help identify the State or Territory that the data related to (colours are consistent between figures).

D

These lines represent the **POPULATION WEIGHTED AVERAGES** for drug consumption for all capital city sites (blue dotted line), all regional sites (red line) and for all sites combined (black line). The method to calculate weighted population averages is given in the main text. In this example, the average consumption for regional Site 601 (horizontal bar with red checked box) is above both the average for regional sites and all sites nationally. In contrast, the average consumption for capital city Site 600 is below the national average.

E

The **RIGHT HAND AXIS** shows the estimated number of doses of a drug consumed by 1,000 people in the catchment in a 24 hour period: e.g., one dose would be 1 cigarette, 1 standard drink or 1 injected amount of drug. In this example, at Site 601, the minimum consumption was 9 doses in 1 day, the maximum was 19 and average was 14 per day over the sampling period (for every 1,000 people).

F

UNIQUE NUMBER allocated to each WWTP to maintain confidentiality. WWTP names will not be disclosed publicly.

4: RESULTS

Estimated drug consumption data are presented differently in the following sections. Results are compared at the individual site level for April 2024 (section 4.1), and averaged to state or territory to compare longer term trends for the past 2 years (section 4.2). Trends are also presented nationally in section 4.3 and within each state and territory (section 4.4).

April 2024 data were used to compare individual sites as it included the latest set of results for the full suite of regional and capital city sites. We recommend exercising caution when comparing results between sites, as some sites provided samples for fewer days than others. The number of collection days can vary from 5 to 7. For example, sites in Tasmania are not always able to collect samples over the weekend. It is not always possible to coordinate collection of the same week of the month at all sites, so sampling weeks may not correspond in all instances. A list of the detection frequency for each drug can be found in Appendix 3. The uncertainties in individual population estimates have less impact when data are averaged, for example at the state/territory or national level. The uncertainties in population estimates are likely to be higher for smaller sites (e.g. regional communities), or where large short-term population changes occur due to employment opportunities, tourism or festival events.

4.1 INDIVIDUAL SITE COMPARISON OF DRUG CONSUMPTION IN APRIL 2024

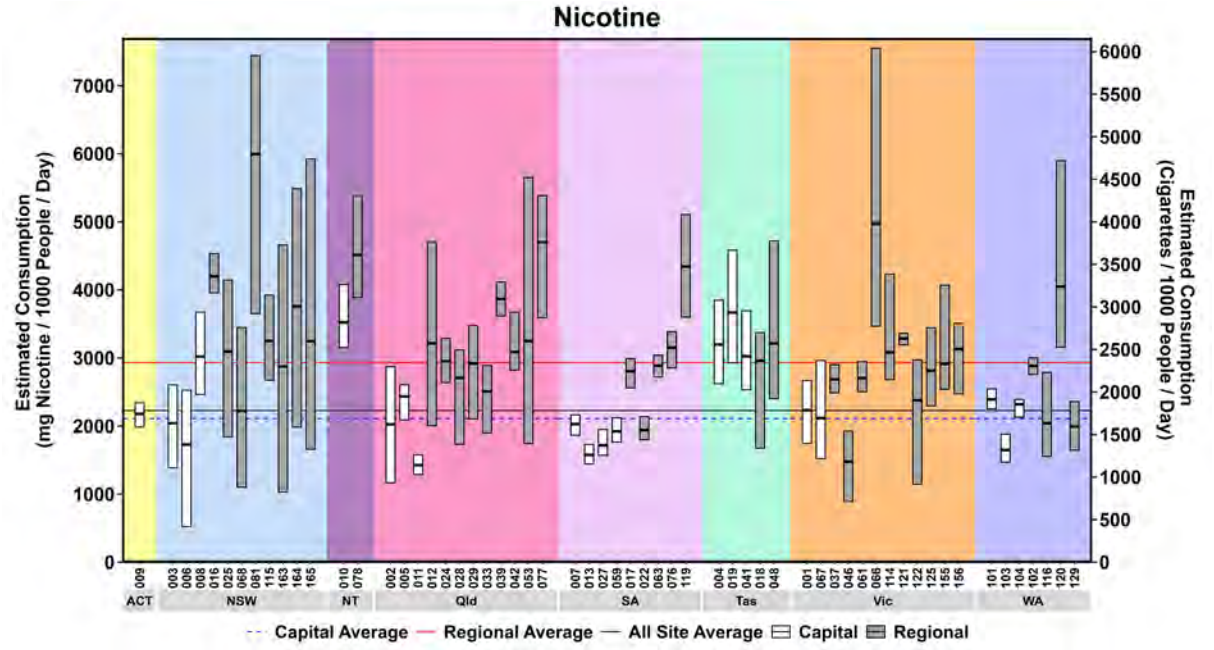
4.1.1 NICOTINE AND ALCOHOL

Nicotine is the main psychoactive substance present in tobacco leaves, some vaping products and nicotine replacement therapies used to facilitate cessation of smoking. Two nicotine metabolites, cotinine and hydroxycotinine, were used to estimate the consumption of nicotine. The estimate is expressed as nicotine in this report as the method cannot distinguish between nicotine from tobacco, e-cigarettes or nicotine replacement therapies such as patches and gums.

On a national level, Figure 7 shows the average nicotine consumption was higher in regional areas compared to capital cities in April 2024 (red horizontal and blue dotted lines, respectively). Tasmania was the only jurisdiction where all capital and regional sites had similar consumption within a narrow range. Most jurisdictions had some regional sites with a relatively high mean consumption and some capital city sites with lower consumption.

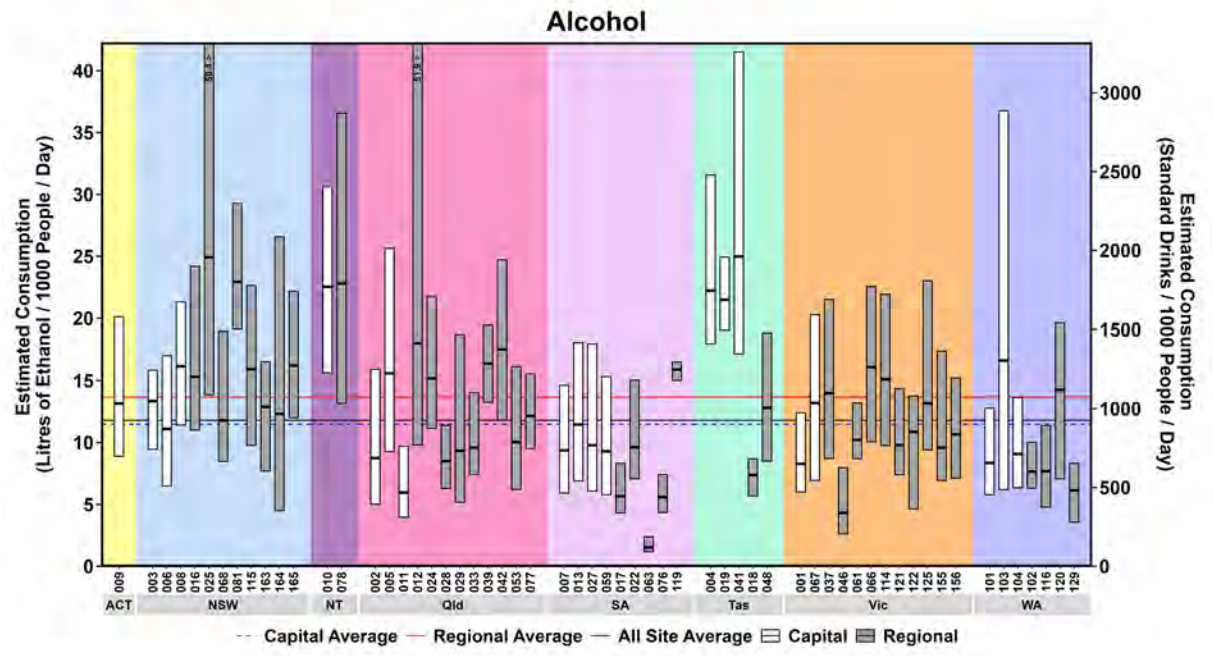
The specific marker of ethanol consumption, ethyl sulphate, was used to determine the scale of alcohol consumption across the country. The regional average consumption of alcohol was higher than the capital city average in April 2024 (Figure 8). Higher mean alcohol consumption was found in Hobart and the Northern Territory sites and several regional sites across jurisdictions.

Figure 7: Estimated nicotine consumption for April 2024 in mass of nicotine consumed per day (left axis) and number of cigarettes per day (right axis) per thousand people. The number of collection days can vary from 5 to 7.



- Higher consumption in regional areas
- Large difference between sites

Figure 8: Estimated alcohol consumption for April 2024 in litres consumed per day (left axis) and standard drinks per day (right axis) per thousand people. Text describing the extreme values shown above the graph are based on the left y axis. The number of collection days can vary from 5 to 7.



- Higher consumption in regional areas
- Very large weekly spread in some sites

4.1.2 STIMULANTS

4.1.2.1 METHYLAMPHETAMINE

National average methylamphetamine consumption was higher in regional areas (Figure 9). Regional sites in South Australia and Western Australia and one site in Victoria had well-above average consumption. There was considerable variation in methylamphetamine consumption within and between jurisdictions in April 2024.

4.1.2.2 AMPHETAMINE

The measured concentration of amphetamine in April 2024 mostly fell within a range which is consistent with the reported excretion rates following methylamphetamine consumption (Gracia-Lor et al. 2016). The results broadly matched our previous findings (see Appendix 4 of Report 1). The levels of amphetamine in wastewater samples can be mostly attributed to the metabolism of methylamphetamine. However, it is also excreted following consumption of prescribed drugs lisdexamfetamine and dexamfetamine and the method cannot differentiate between this medical consumption and illicit consumption. The high levels of methylamphetamine in most parts of the country means a firm conclusion is not possible.

4.1.2.3 COCAINE

Benzoylecgonine is a specific metabolite of cocaine and was used to estimate cocaine consumption. The average consumption of cocaine was higher in capital cities compared to regional areas (Figure 10). A site in Sydney had the highest mean cocaine consumption. Consumption at some regional sites in New South Wales, as well as a site in Queensland, was also relatively high.

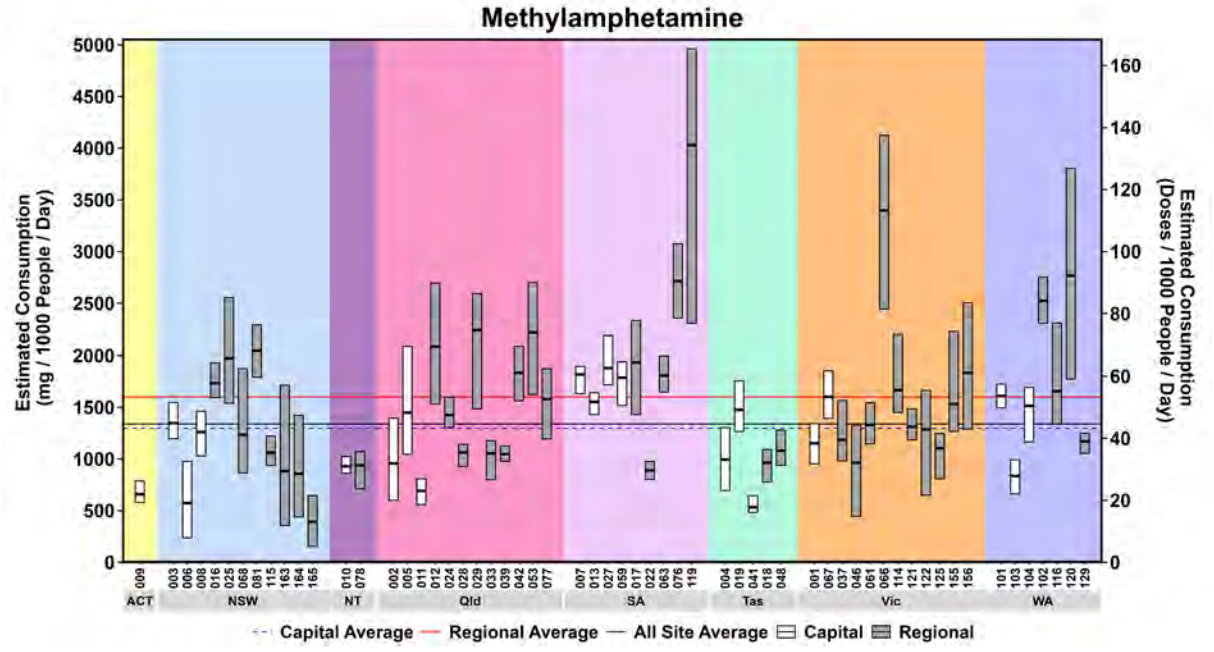
4.1.2.4 MDMA (3,4-METHYLENEDIOXYMETHYLAMPHETAMINE)

Average consumption of MDMA was lower in capital cities than in regional areas in April 2024 (Figure 11). A site in regional Queensland had the highest mean MDMA consumption in the country in April 2024, with consumption also high in a site in Melbourne, Perth, Hobart and Sydney. Average regional consumption of MDMA was also high at another regional site in Queensland and a site in Tasmania. Nevertheless, the consumption should be seen in the context of the relatively low MDMA dose amounts compared to the other stimulants.

4.1.2.5 MDA (3,4-METHYLENEDIOXYAMPHETAMINE)

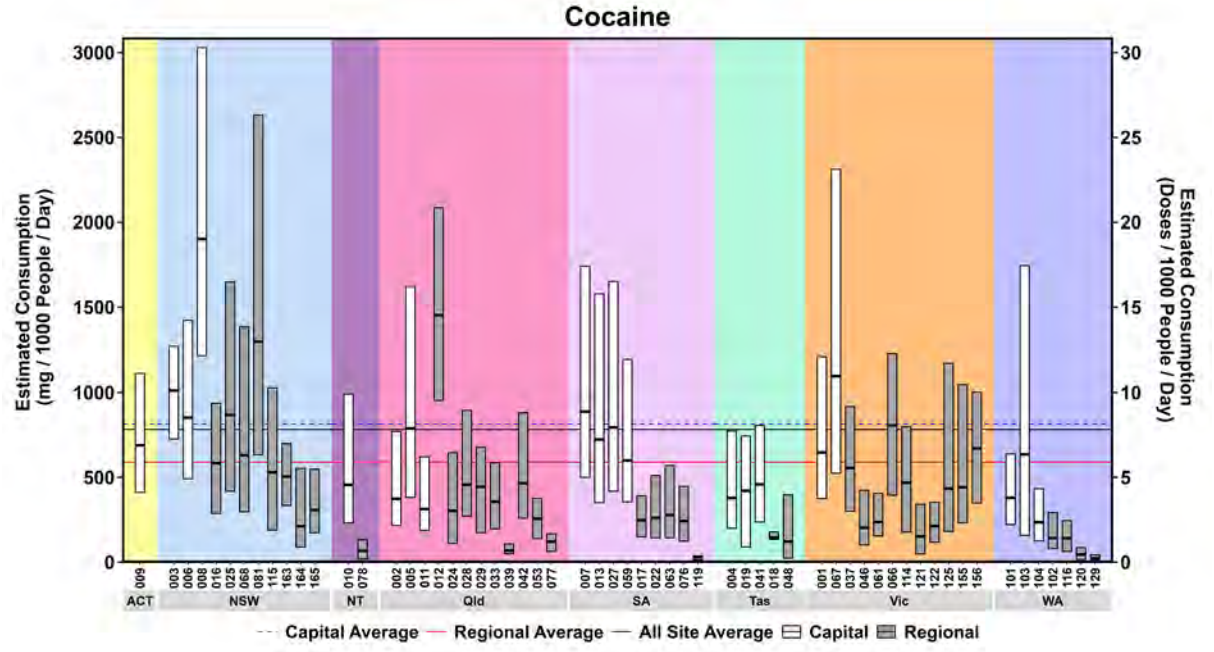
The results for MDA are expressed as excreted amounts (Figure 12). The national average MDA excretion for regional areas was similar to the capital cities. Sites across several states recorded very high levels of excretion.

Figure 9: Estimated methylamphetamine consumption for April 2024 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days can vary from 5 to 7.



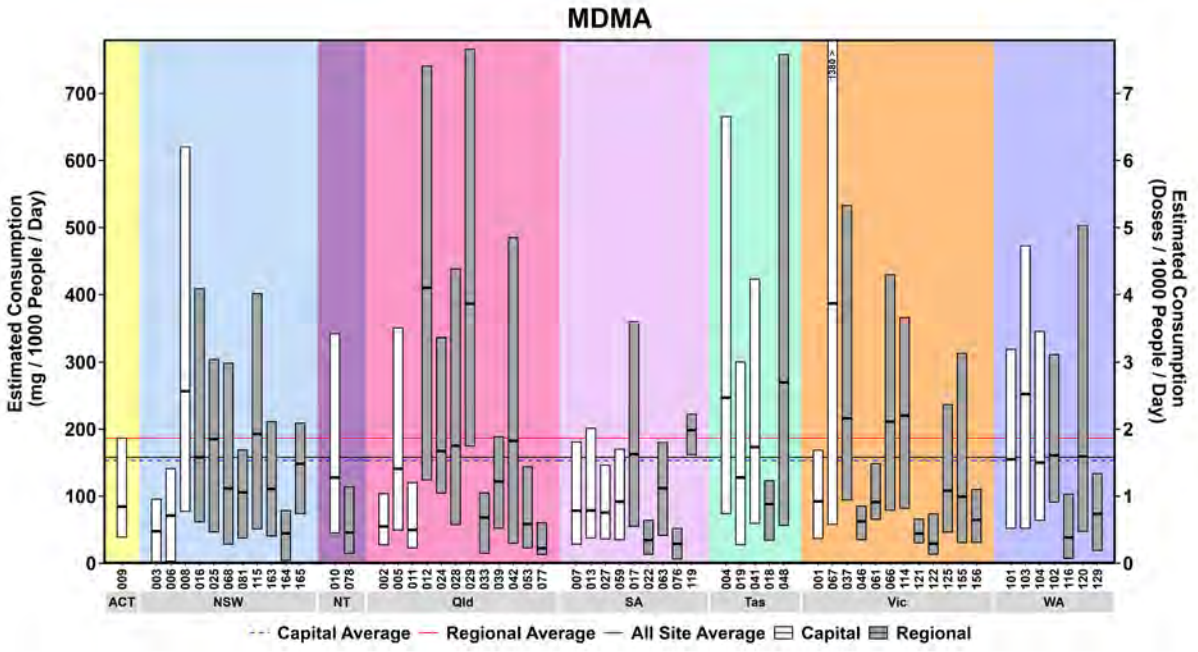
- Higher consumption in regional areas
- High mean consumption at some regional SA, Vic and WA sites

Figure 10: Estimated cocaine consumption for April 2024 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days can vary from 5 to 7.



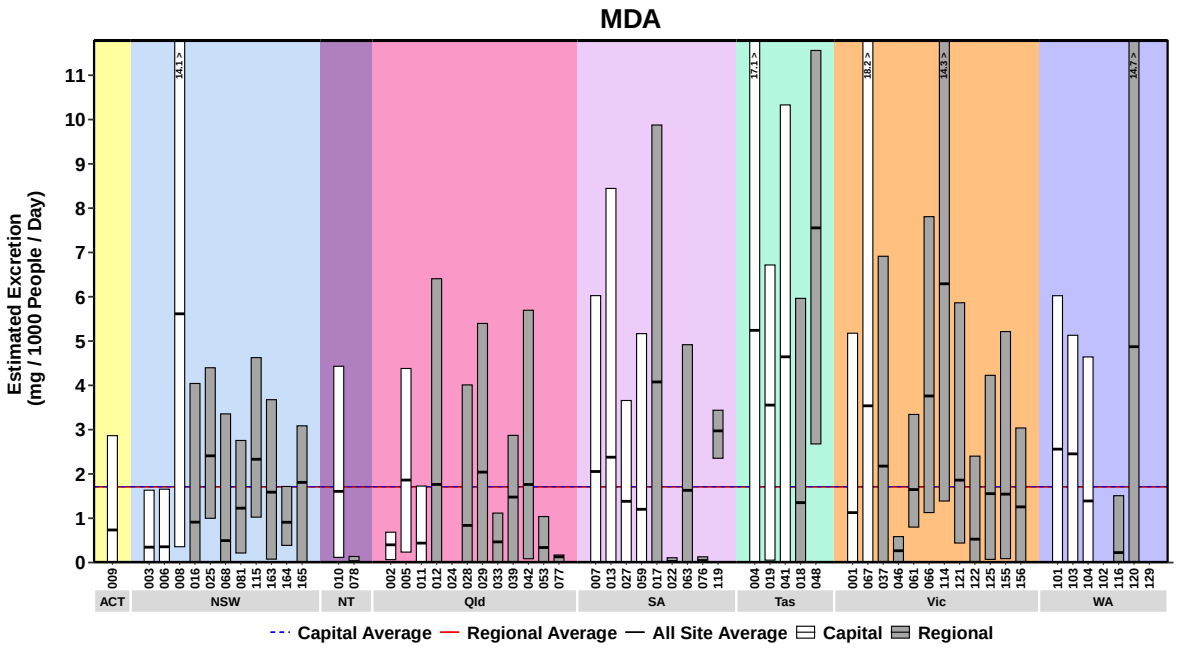
- Higher consumption in capital cities
- Higher consumption in parts of Sydney

Figure 11: Estimated MDMA consumption for April 2024 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. Text describing the extreme values shown above the graph are based on the left y axis. The number of collection days can vary from 5 to 7.



- Higher regional consumption
- Relatively high consumption at 3 sites

Figure 12: Estimated MDA excretion for April 2024 in mass excreted per day per thousand people. Text describing the extreme values shown above the graph are based on the left y axis. The number of collection days can vary from 5 to 7.



- Similar average regional and capital city excretion
- Very high excretion at several sites

4.1.3 OPIOIDS

Two prescription opioids, oxycodone and fentanyl, are included in the report, as well as heroin, an illicit drug. The main metabolites (noroxycodone, norfentanyl and 6-monoacetylmorphine, respectively) were measured to estimate the consumption of these drugs. Oxycodone and fentanyl are legally prescribed pharmaceuticals to treat pain. Wastewater analysis cannot differentiate between prescribed consumption and consumption for non-medical purposes.

4.1.3.1 OXYCODONE

Oxycodone consumption in April 2024 is shown in Figure 13. The average consumption of oxycodone was higher in regional areas than in the capital cities, with large variation in consumption observed across different sites. Several sites had consumption well below the national capital city and regional averages. This was particularly notable in Western Australia and the Northern Territory, where all sites had mean consumption below the respective averages.

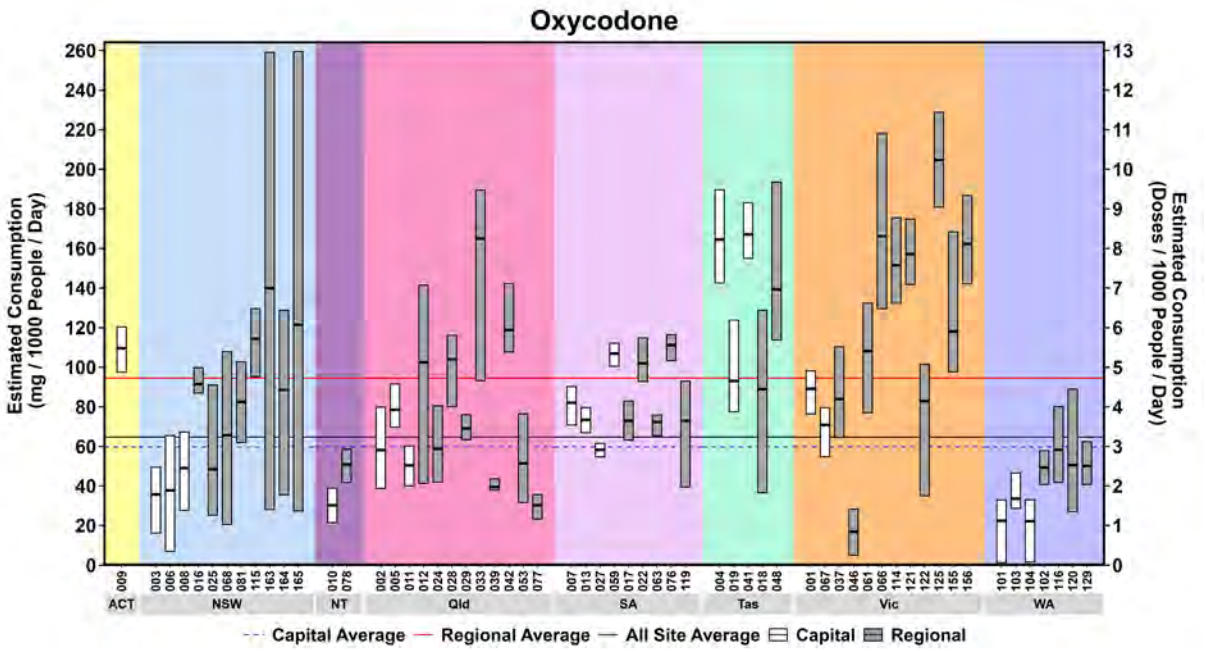
4.1.3.2 FENTANYL

Average fentanyl consumption has been higher in regional areas compared to the capital cities over the life of the Program. However, this trend reversed in April 2024, with higher average capital city consumption (Figure 14). Mean consumption was highest at a regional site in New South Wales. Fentanyl consumption levels fell below the limit of detection and quantification for all or some days of the week at several sites.

4.1.3.3 HEROIN

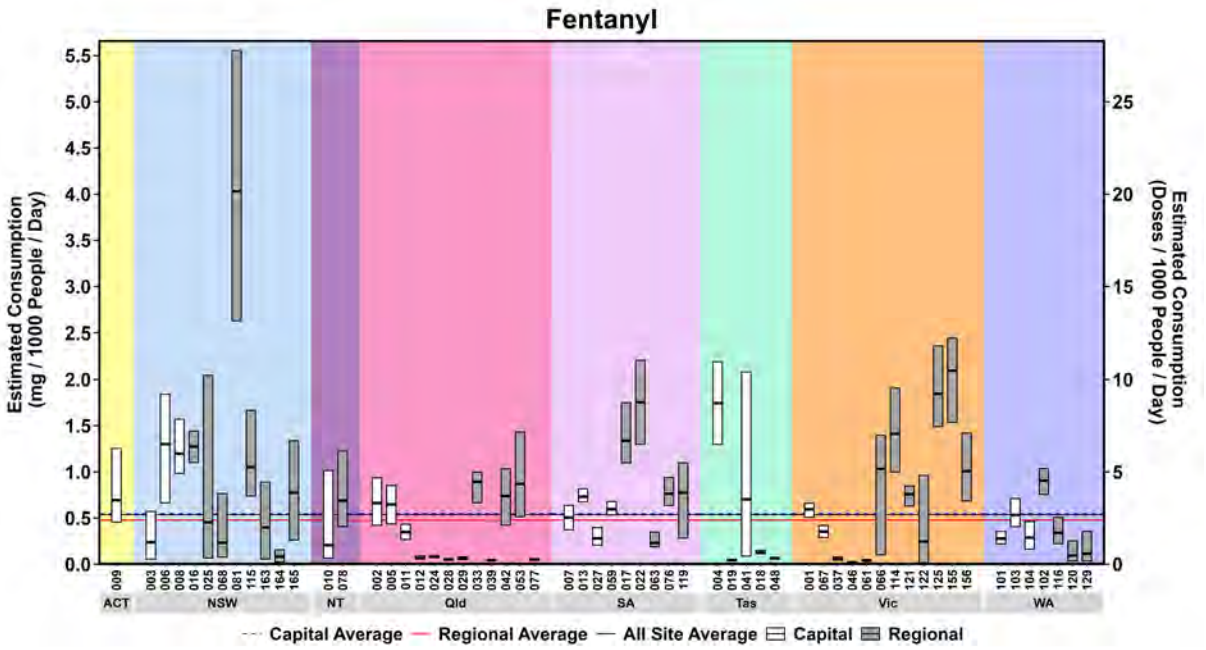
Heroin consumption was substantially higher on average in the capital cities in April 2024 (Figure 15). Consumption fell below the limits of detection in most regional areas. This is in contrast to regional sites in New South Wales and Victoria, where heroin consumption in some cases matched the capital cities.

Figure 13: Estimated oxycodone consumption for April 2024 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days can vary from 5 to 7.



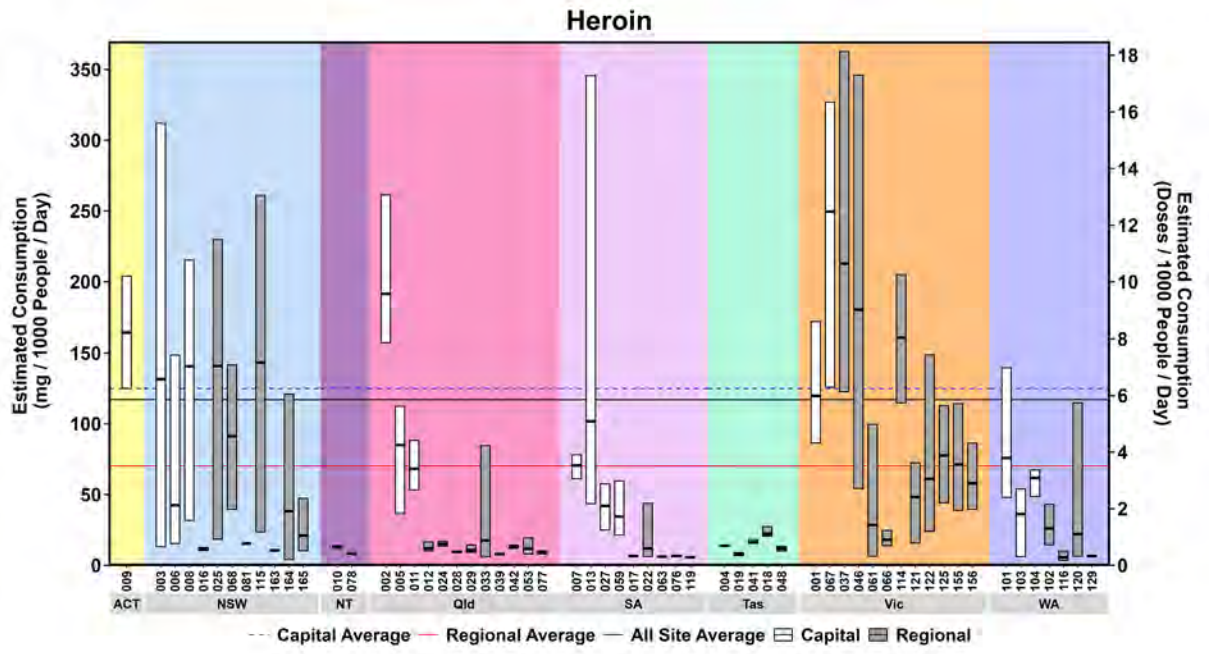
- Higher consumption in regional areas
- Large variation in consumption between sites

Figure 14: Estimated fentanyl consumption for April 2024 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days can vary from 5 to 7.



- Higher consumption in capital cities
- Several sites had consumption levels below quantification limits

Figure 15: Estimated heroin consumption for April 2024 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days can vary from 5 to 7.



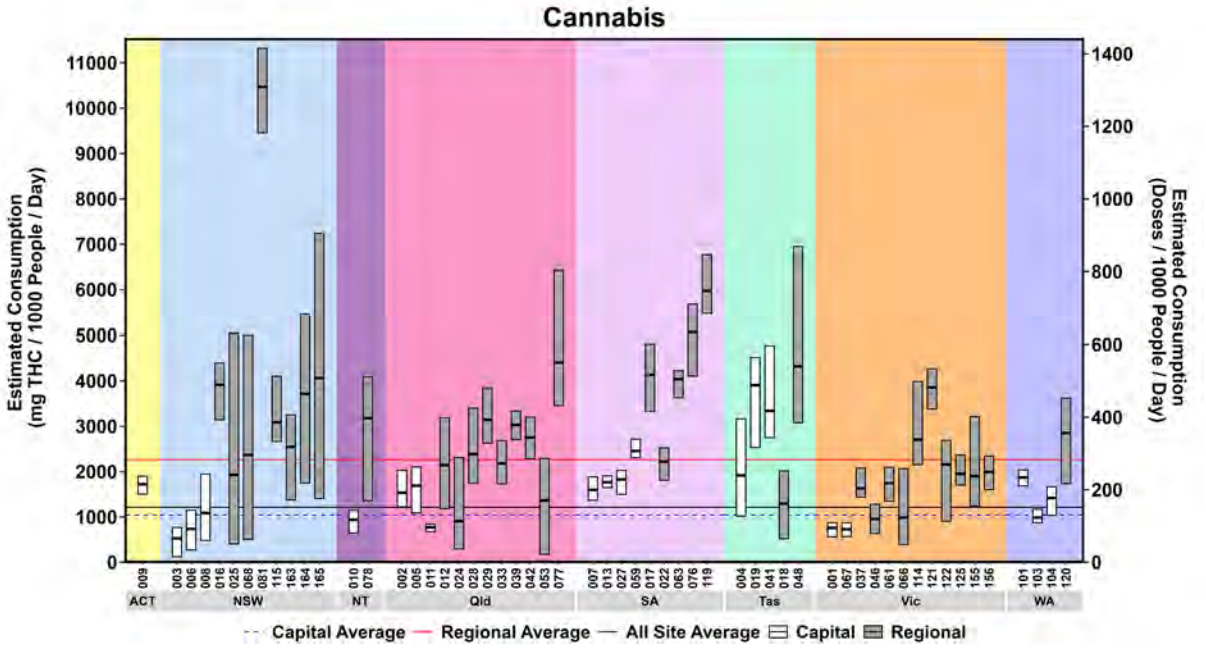
- **Higher consumption in capital cities**
- **Regional consumption often very low**

4.1.4 CANNABIS

In terms of wastewater analysis, the sewer design and collection method may play a part in the reportable levels of THC-COOH used for the purposes of the NWDMP. Accordingly, any spatial comparisons should be made with caution. For the NWDMP, separate samples are collected each day and preserved specifically for THC-COOH analysis, except in some sites in regional Western Australia where this is not possible. The dose amount (8 mg) used in the report is based on the desired effect on an average user of the active ingredient, regardless of the route of administration, e.g. inhaled smoke, part of a plant being used or oral ingestion through edible forms (Freeman & Lorenzetti, 2020). An 8 mg amount would represent between 210–450 mg of dried cannabis containing 15% THC, depending on occasional or regular users consuming the product (Sharma et al. 2012).

Cannabis consumption in April 2024 is shown in Figure 16. Regional cannabis consumption was higher than in the capital cities and a large spread was observed between sites. Several capital city sites had cannabis consumption below the national averages.

Figure 16: Estimated cannabis consumption for April 2024 in mass consumed per day (left axis) and doses per day (right axis). The number of collection days can vary from 5 to 7.



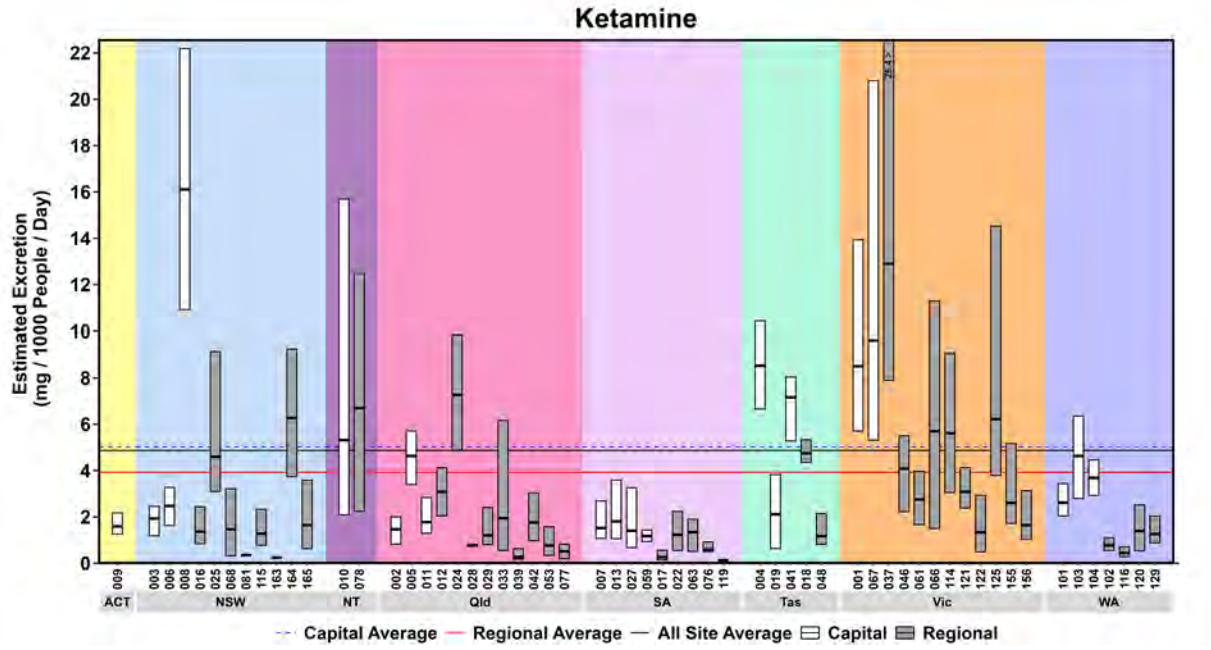
- **Higher consumption in regional areas**
- **Variable consumption within jurisdictions and across the country**

4.1.5 KETAMINE

Ketamine, measured as its metabolite norketamine, is used medically for the management of acute pain often associated with surgery or trauma. Ketamine also has veterinary applications. Due to its sedative and hallucinogenic effects, the drug has been associated with illicit substance use and is listed as a new psychoactive substance by the United Nations Office on Drugs and Crime. The reported proportions of ketamine and its metabolites in wastewater leave some doubt as to an appropriate factor to convert excreted amounts to consumed amounts. Therefore, measured levels are being shown here as excreted daily mass loads.

Ketamine excretion in April 2024 was higher in capital cities than in regional sites (Figure 17). The results were highly variable across Australia. A few sites in several states and territories had levels well-above the relevant averages. In contrast, multiple sites had very low ketamine excretion levels.

Figure 17: Estimated ketamine excretion for April 2024 in mass excreted per day (left axis) per thousand people. Text describing the extreme values shown above the graph are based on the left y axis. The number of collection days can vary from 5 to 7.



- Higher excretion in capital cities
- Excretion levels highly variable

4.2 TEMPORAL CHANGES IN DRUG CONSUMPTION ESTIMATES BY JURISDICTION

The per capita consumption of each drug outlined in the following figures compares data acquired in this report to previous collection periods on a state or territory basis. The data relating to capital cities in this section have been updated to include both the April and June 2024 collections, while regional areas were updated for April 2024. This needs to be considered when comparing results between sections 4.1 and 4.2.

Although every effort has been made to assess the same sites for each period, the individual sites and the number of sites used to generate the population-weighted averages may have changed between periods. Comparing between time points should be done with caution. This is most evident for the regional averages, where regional participation has been more varied between periods, while capital city site participation is much more consistent (see Appendix 2 for participating sites). Due to the larger number of data points collected by the Program, the current report presents the last 2 years of data. Prior data dating back to 2016 for each substance of interest is available on the ACIC website by jurisdiction.

Note: The horizontal red, blue and black lines on each graph in this section represent the cumulative average across all sampling time points and all samples analysed for each substance. They are not the averages for only the current reporting period as found in section 4.1. Updated changes to the graphs relating to this report are the 2 most recent bars consisting of capital cities (April and June 2024) and the single most recent bar for regional areas (April 2024). Some temporal changes reflected in these bars may be a consequence of updated populations used in the calculations. See Appendix 4 of Report 17 for the difference in populations for the 2016 and 2021 Census for each catchment.

4.2.1 NICOTINE AND ALCOHOL

The consumption of nicotine (which includes tobacco, e-cigarettes, and replacement therapies) has been consistently higher in regional areas since the Program commenced (Figure 18). The Northern Territory had the highest average capital city and regional consumption of nicotine in April 2024.

Long-term average alcohol consumption is higher in regional areas than in the capital cities (Figure 19). This gap has been narrowing, with some jurisdictions recording similar consumption in regional areas and capital cities in April 2024. South Australia and Tasmania are the exceptions, where regional averages are lower than in the capital cities. The Northern Territory and Hobart had the highest average consumption in April 2024.

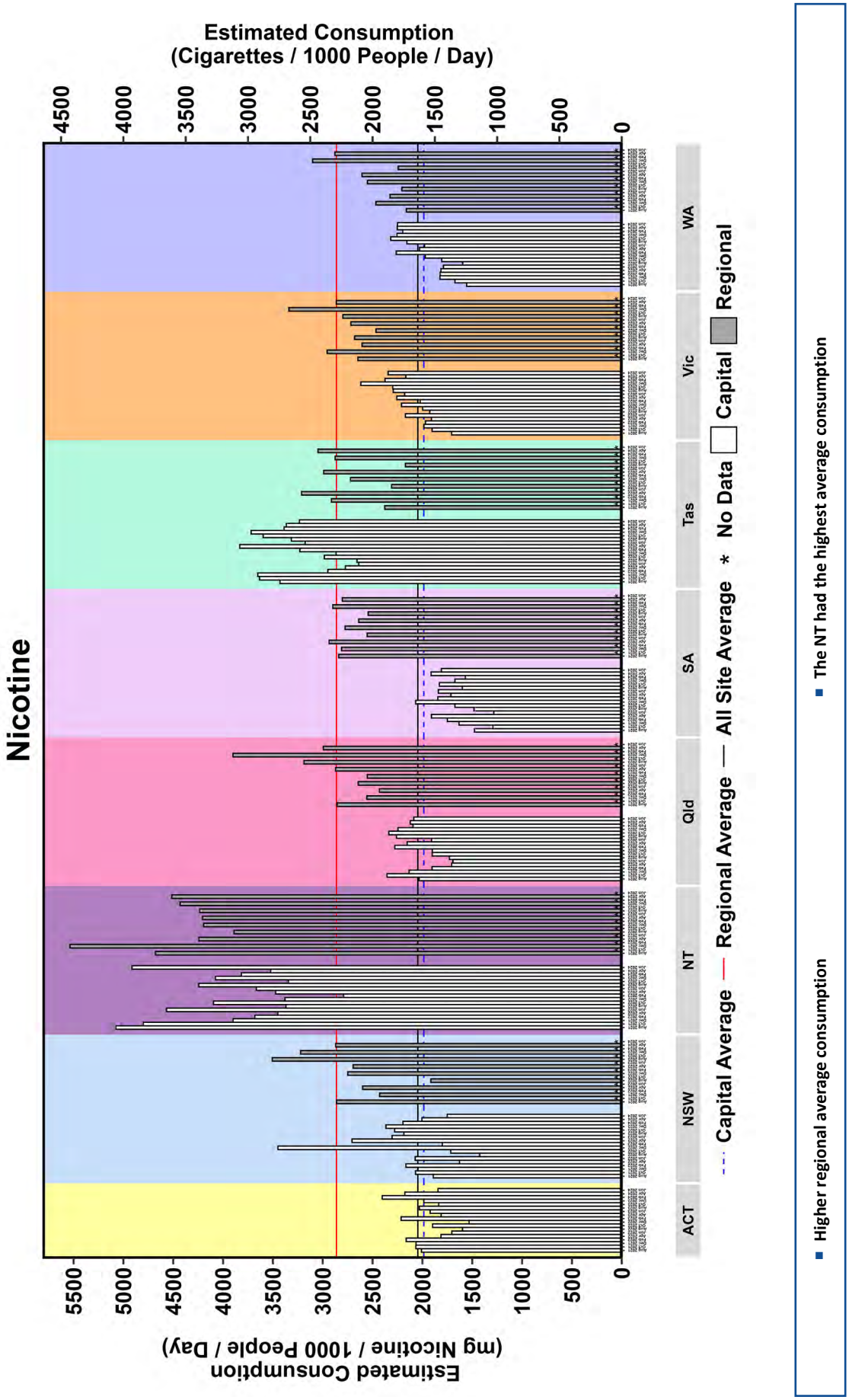


Figure 18: Estimated average consumption of nicotine by state/territory, August 2021 to June 2024, where 1 cigarette provides 1.25 mg of nicotine.

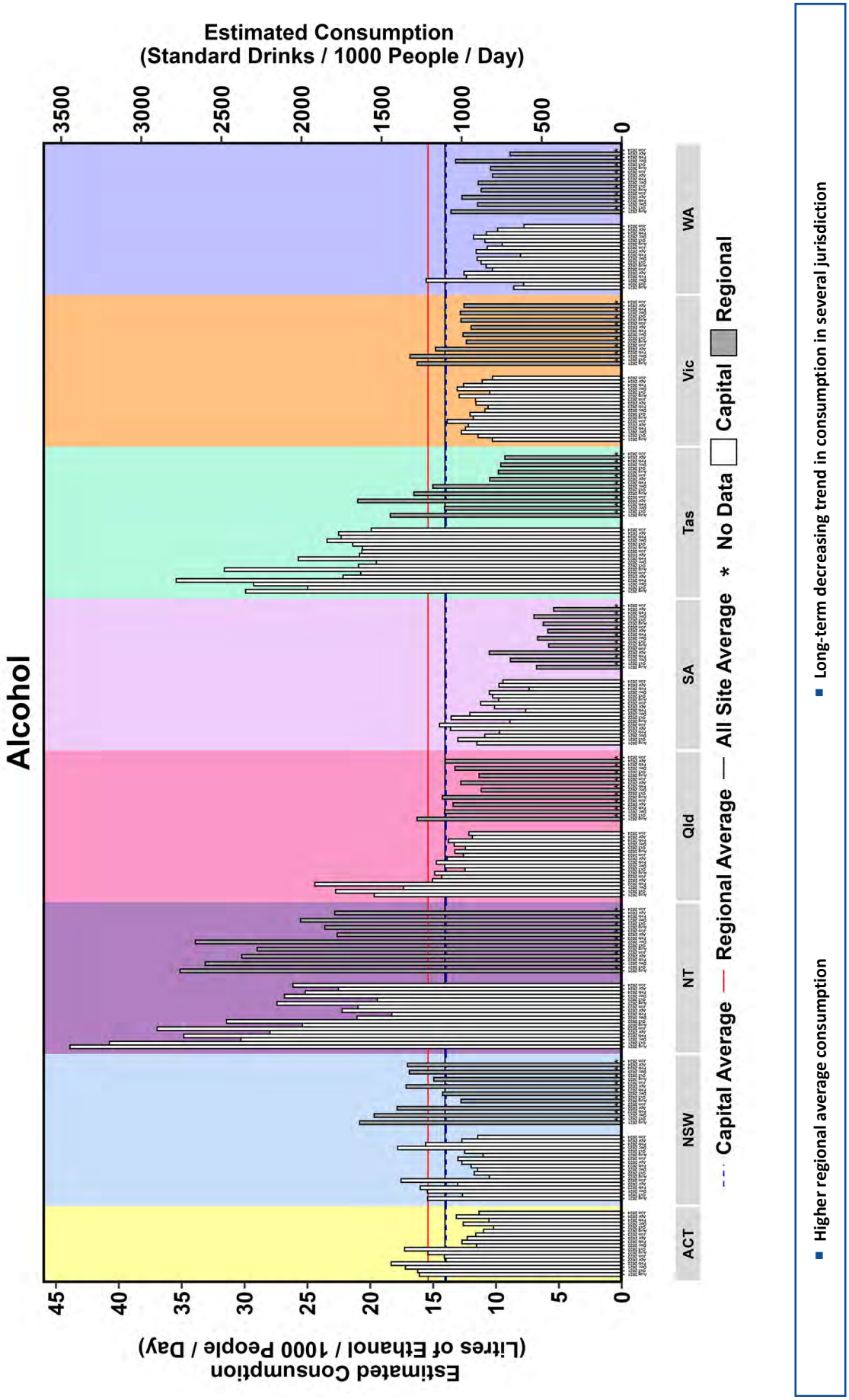


Figure 19: Estimated average consumption of alcohol by state/territory, August 2021 to June 2024. A standard drink is 10.0 g, or 12.6mL.

4.2.2 STIMULANTS

4.2.2.1 METHYLAMPHETAMINE

Temporal changes in the consumption of methylamphetamine are shown in Figure 20. The trend in methylamphetamine consumption varied between jurisdictions from December 2023 to April 2024, reaching the highest levels in the past 2 years in several jurisdictions. The increase is noteworthy in some regional areas and Hobart. Regional Western Australia had the highest consumption nationally in April 2024.

Historical levels of methylamphetamine consumption predating the NWDMP have been available for some sites, shown in Figures 21 and 22. Current results show that the drug continues to be consumed near historically high levels at 2 sites and at relatively stable levels at the remaining sites.

4.2.2.2 COCAINE

Long-term average cocaine consumption is higher in capital cities than in regional areas (Figure 23). Queensland is the only jurisdiction where regional consumption of cocaine is higher than the capital city. Cocaine consumption remains relatively high, but decreases were evident in most jurisdictions from December 2023 to April 2024. Sydney had the highest capital city consumption, while Queensland had the highest regional consumption.

4.2.2.3 MDMA

MDMA consumption is not showing any consistent trend (Figure 24). Average consumption has been higher in regional areas over the life of the Program. Melbourne had the highest capital city consumption in April 2024 and Queensland the highest regional consumption.

4.2.2.4 MDA

MDA is expressed in excreted amounts due to the lack of drug metabolism information (Figure 25). Excretion of MDA is low and excretion tends to fluctuate in most jurisdictions. On average, MDA excretion has been higher in regional areas than in the capital cities. However, this pattern has been reversing in several jurisdictions during 2024. Tasmania had the highest excretion levels in April 2024.

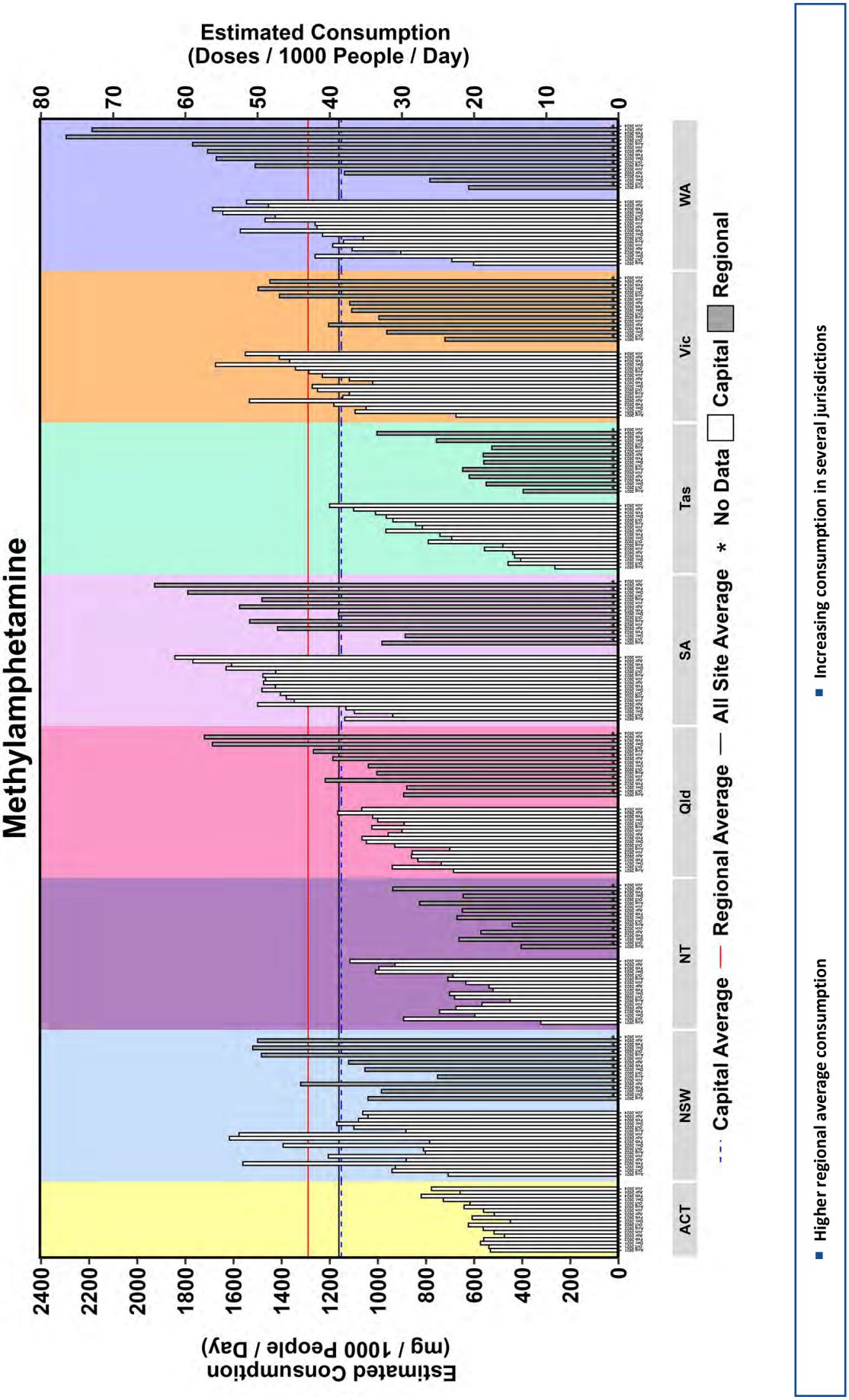


Figure 20: Estimated average consumption of methylamphetamine by state/territory, August 2021 to June 2024.

Figure 21: Change in methylamphetamine consumption for sites in Queensland and Adelaide with historical data.

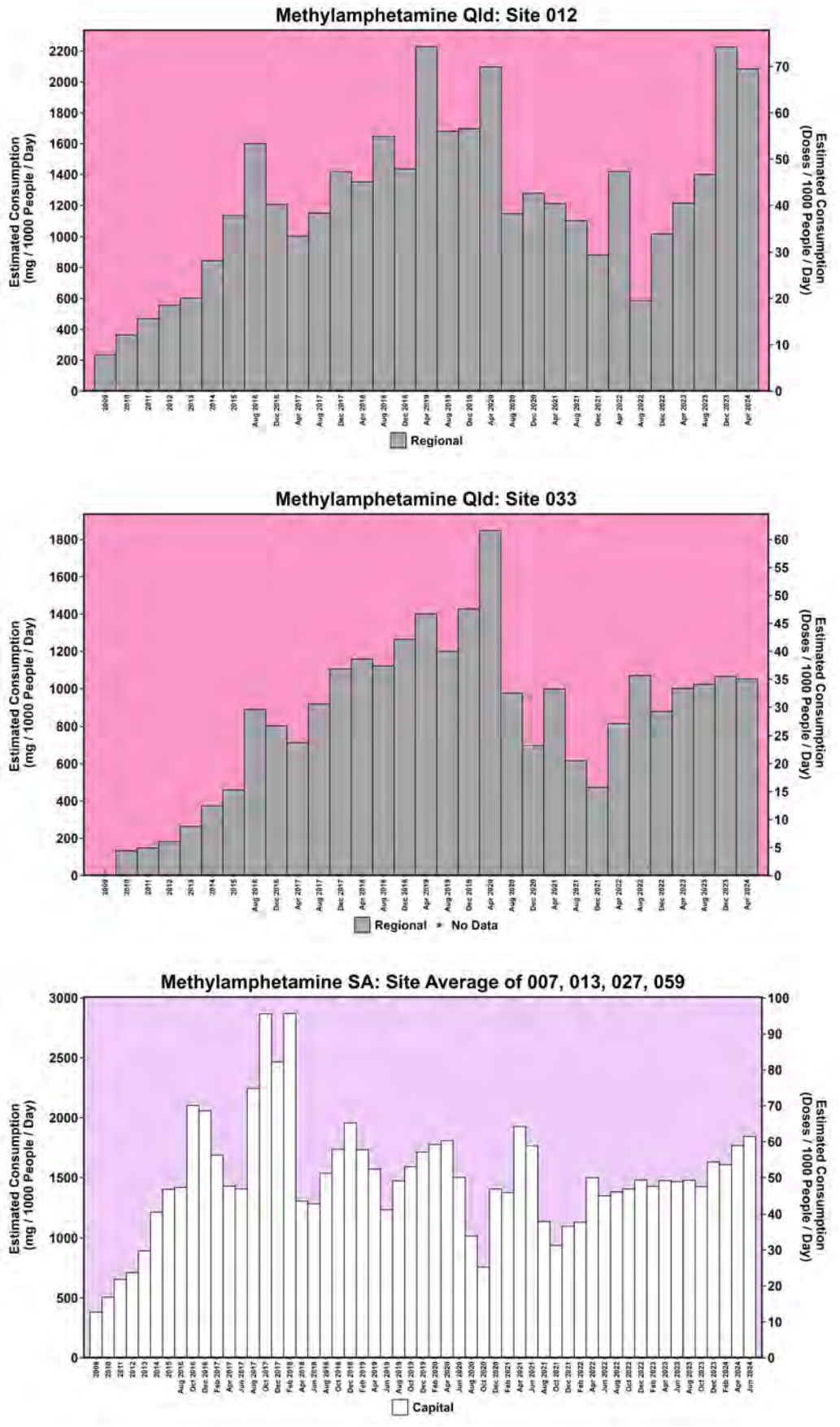
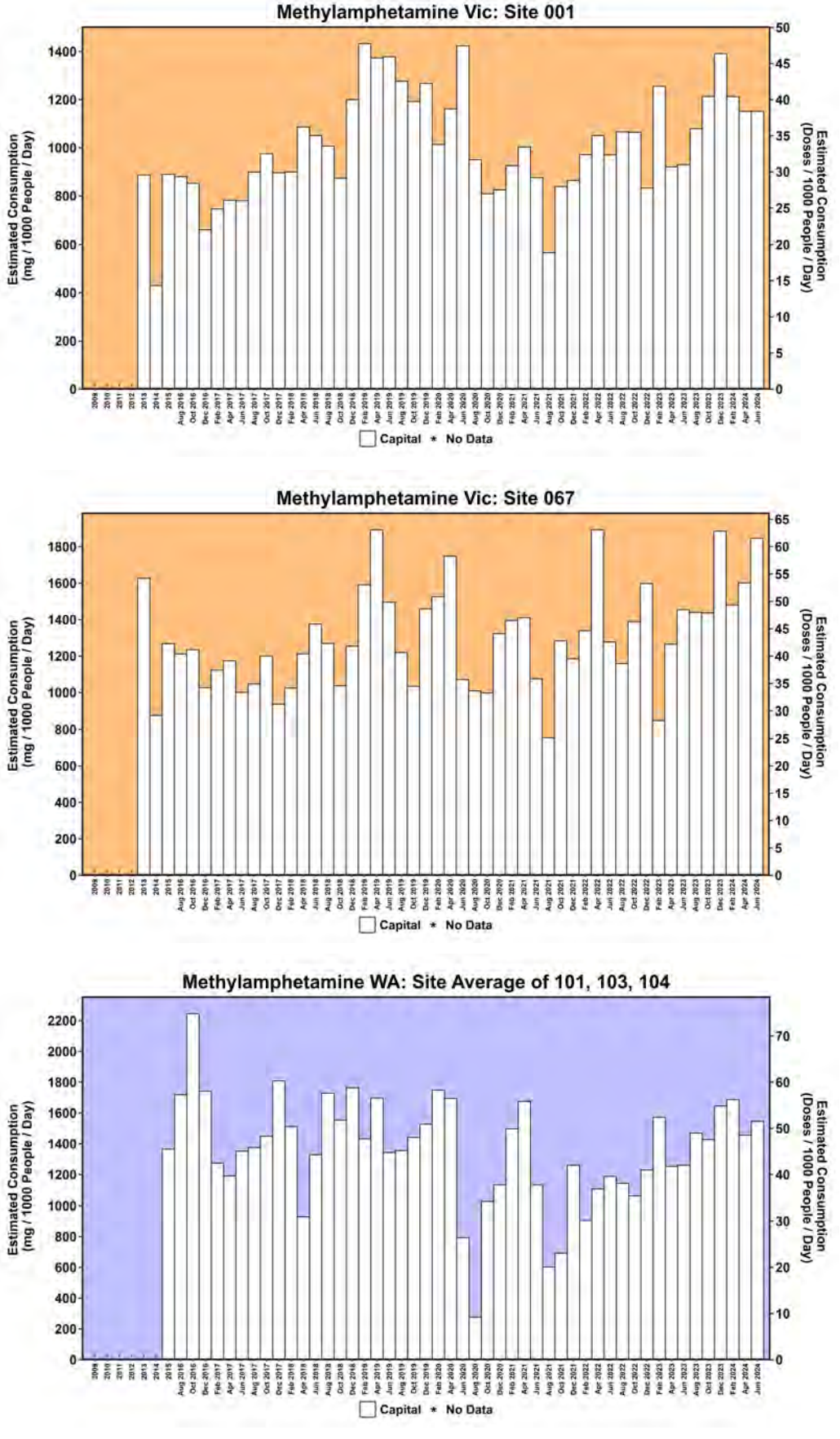


Figure 22: Change in methylamphetamine consumption for sites in Melbourne and Perth with historical data. Both Melbourne sites were the average of one week per year in 2013, 2014 and 2015.



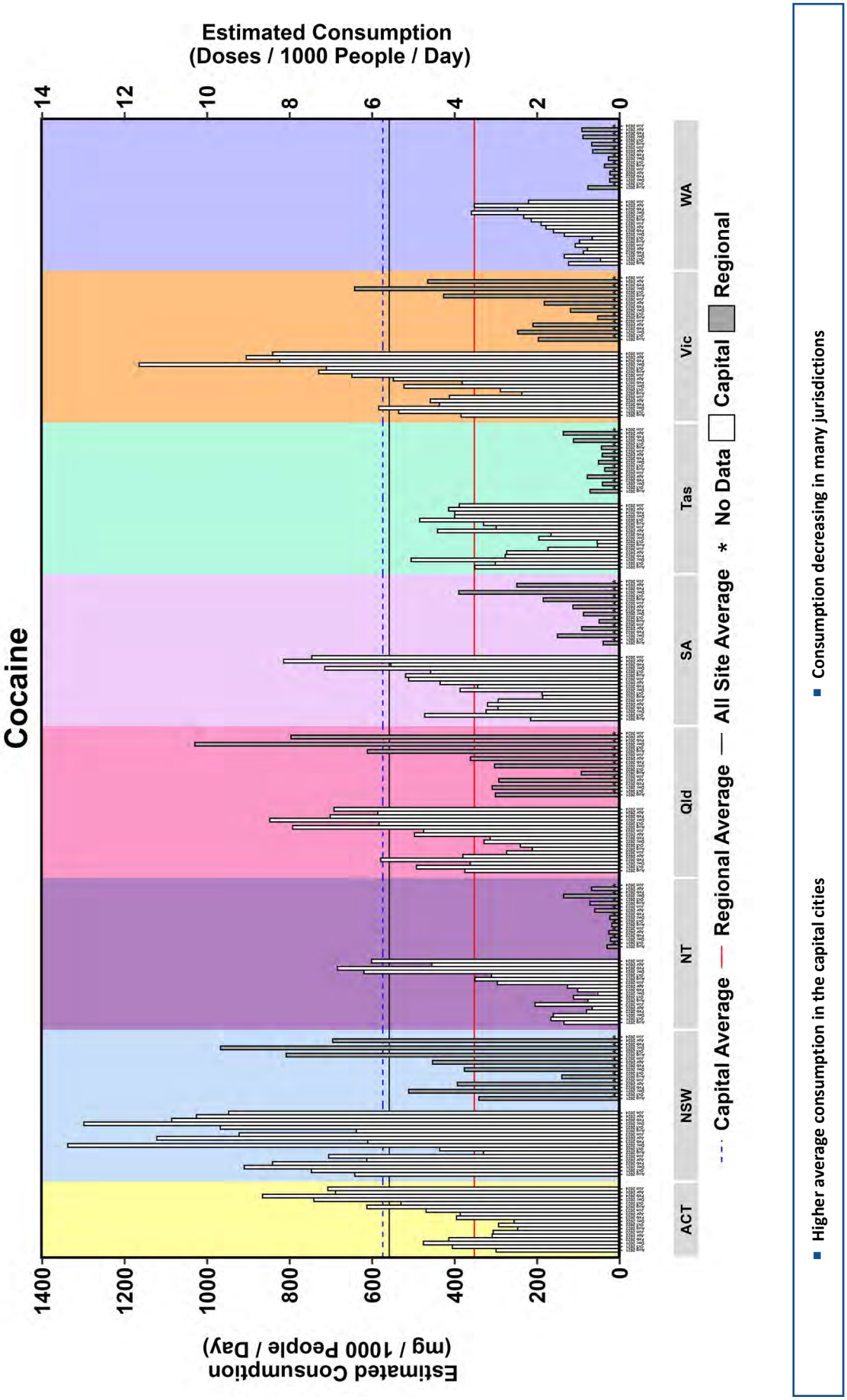


Figure 23: Estimated average consumption of cocaine by state/territory, August 2021 to June 2024.

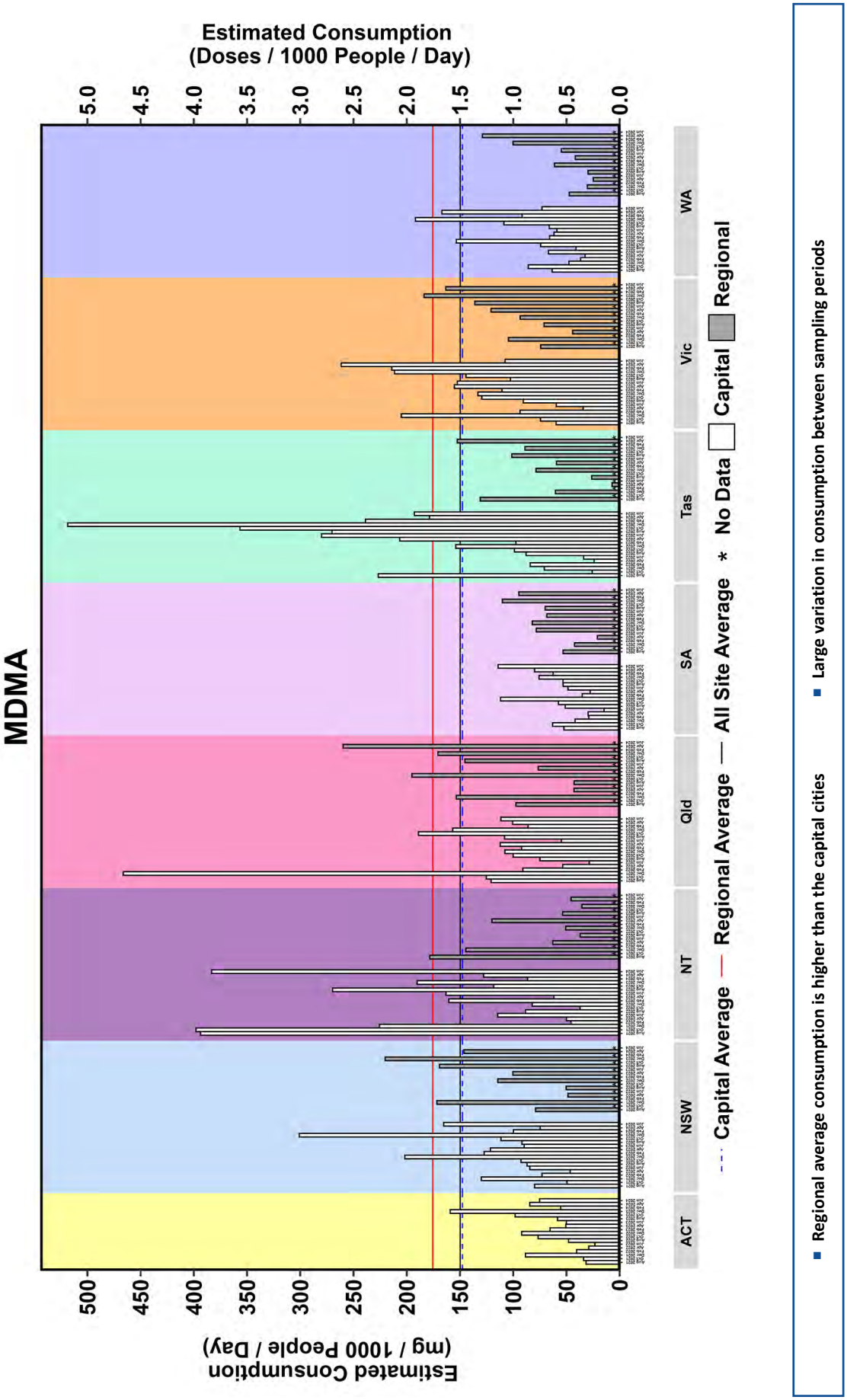
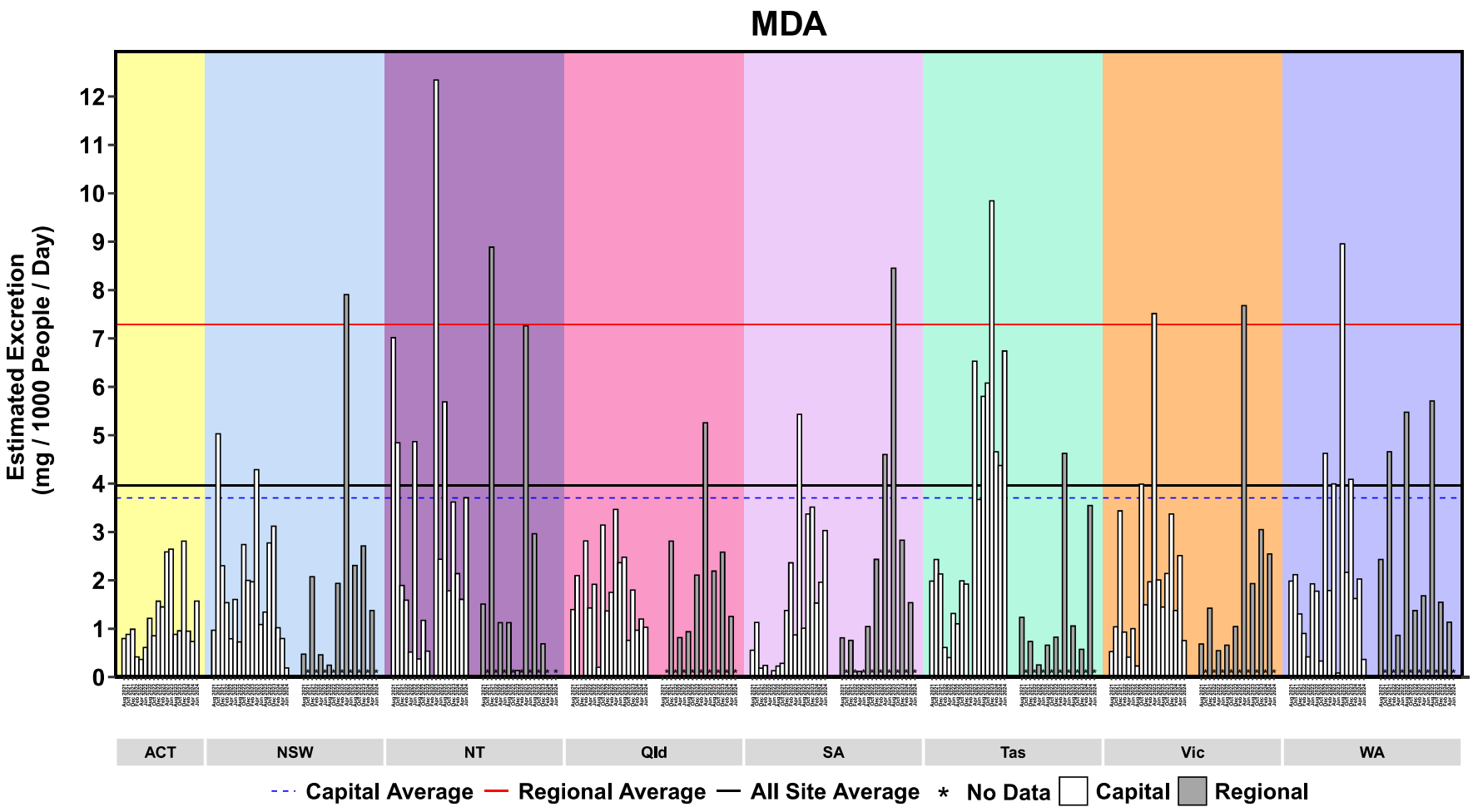


Figure 24: Estimated average consumption of MDMA by state/territory, August 2021 to June 2024.

Figure 25: Estimated average excretion of MDA by state/territory, August 2021 to June 2024.



- Higher average excretion in regional areas
- Some large fluctuations in excretion

4.2.3 OPIOIDS

4.2.3.1 OXYCODONE

Changes in oxycodone consumption over time are shown in Figure 26. Long-term averages for oxycodone consumption have been substantially higher in regional areas compared to the capital cities. The main exception is Tasmania, which has higher consumption in Hobart than in regional areas. Hobart had the highest capital city oxycodone consumption in April 2024, while Victoria had the highest regional consumption.

4.2.3.2 FENTANYL

Fentanyl also has higher average regional consumption than in the capital cities, with the exception of Tasmania (Figure 27). Regional consumption decreased in all jurisdictions apart from the Northern Territory from December 2023 to April 2024. Hobart had the highest capital city fentanyl consumption in April 2024 and South Australia the highest regional consumption.

4.2.3.3 HEROIN

Unlike the pharmaceutical opioids, heroin consumption has tended to be higher in the capital cities than in regional areas (Figure 28). Heroin consumption in Melbourne is consistently high, whereas consumption in Darwin and Hobart is low. Heroin consumption in regional New South Wales and Victoria is much higher than other regional areas, where consumption is very low.

Historical heroin data from before the Program commenced in 2016 are available for Adelaide. Combined with recent results, it shows that heroin consumption has declined over the past decade (Figure 29).

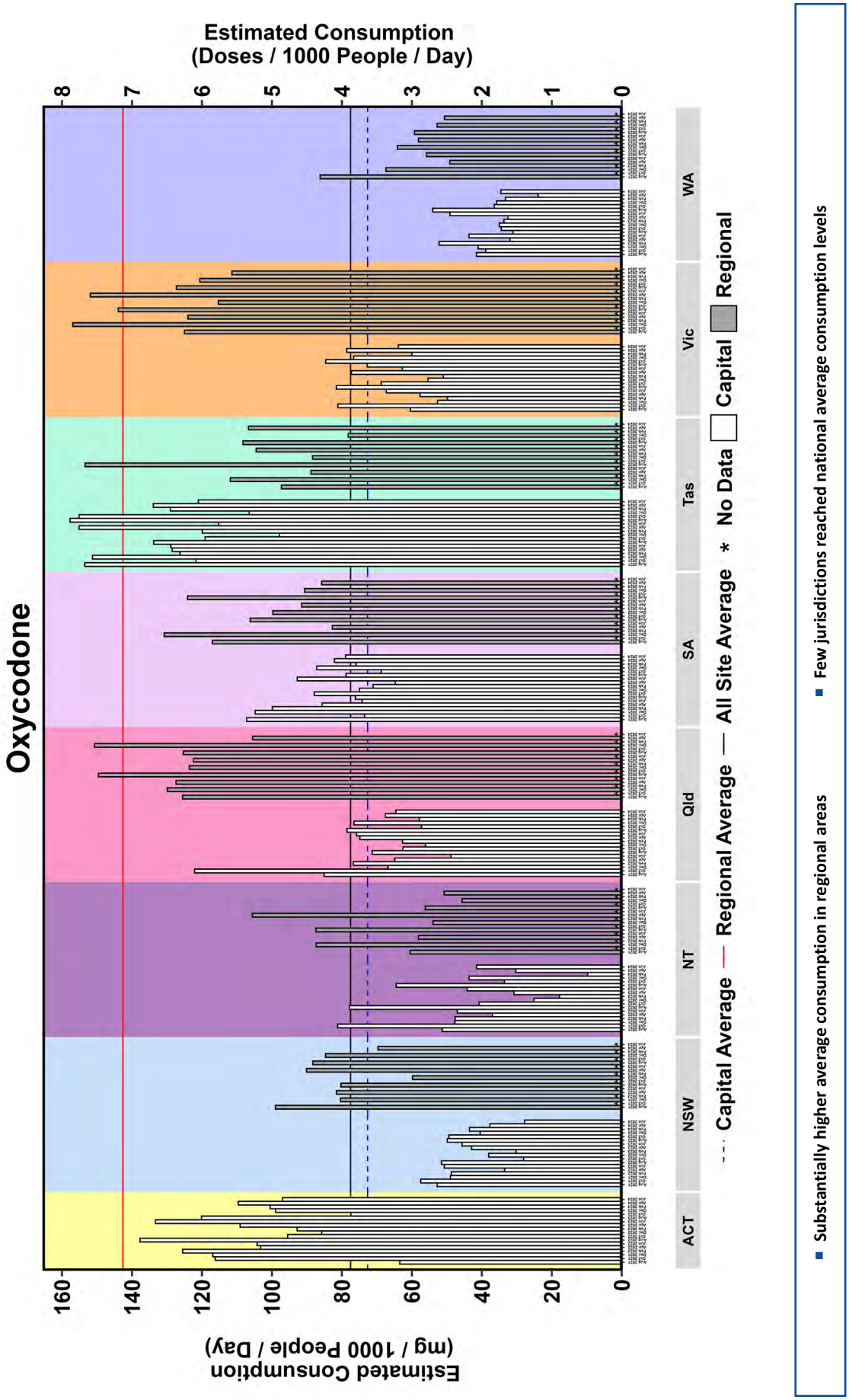


Figure 26: Estimated average consumption of oxycodone by state/territory, August 2021 to June 2024.

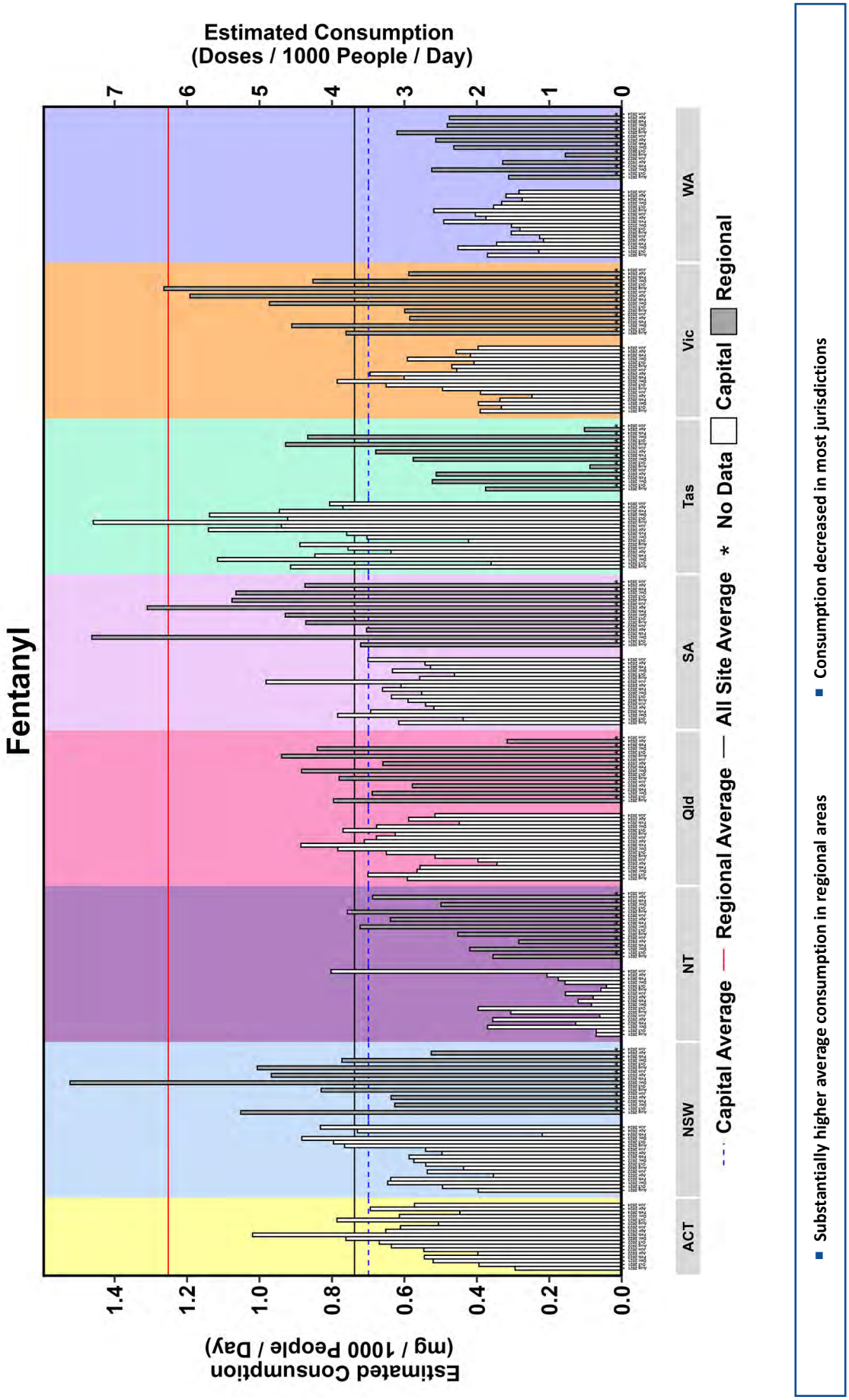


Figure 27: Estimated average consumption of fentanyl by state/territory, August 2021 to June 2024.

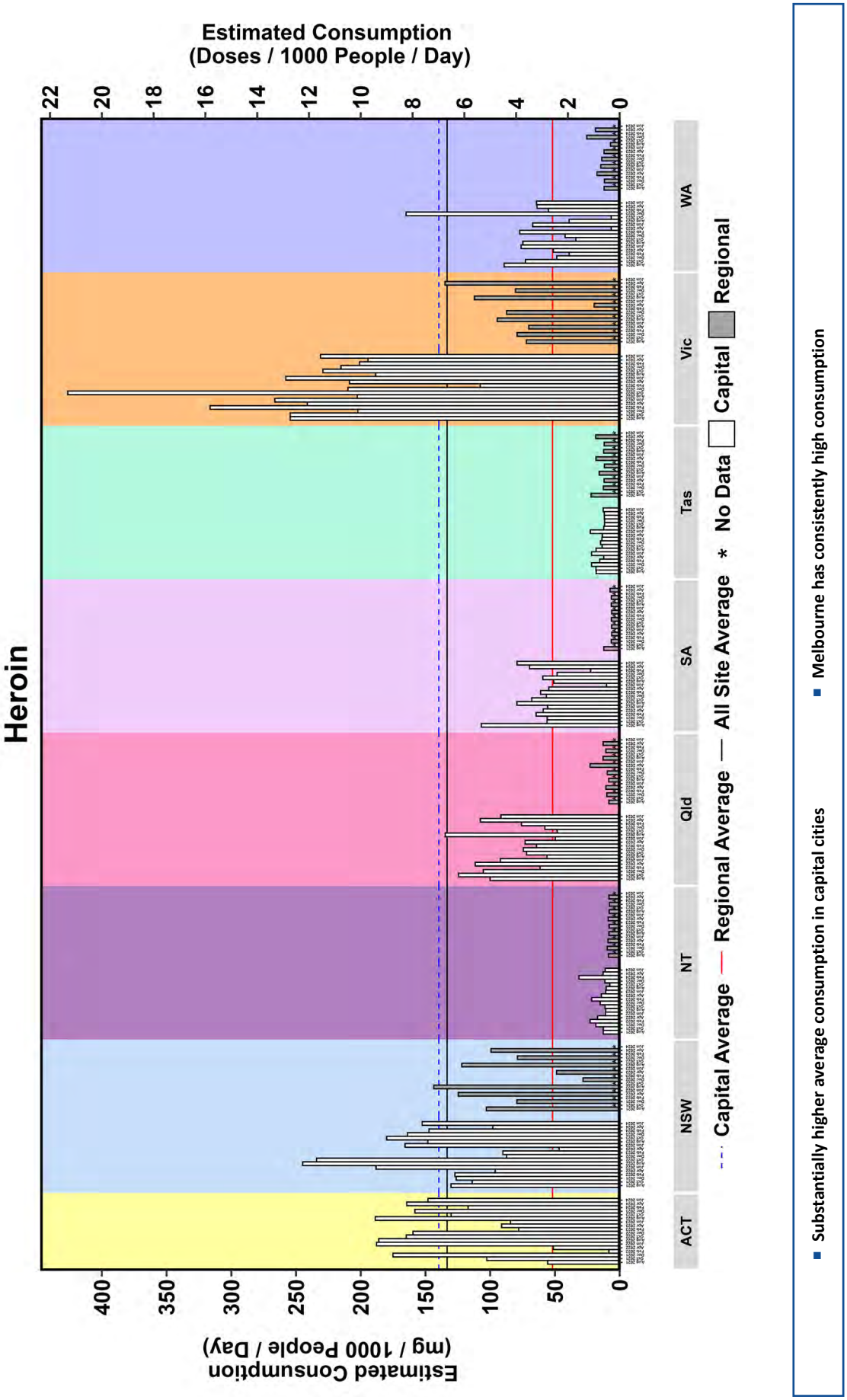
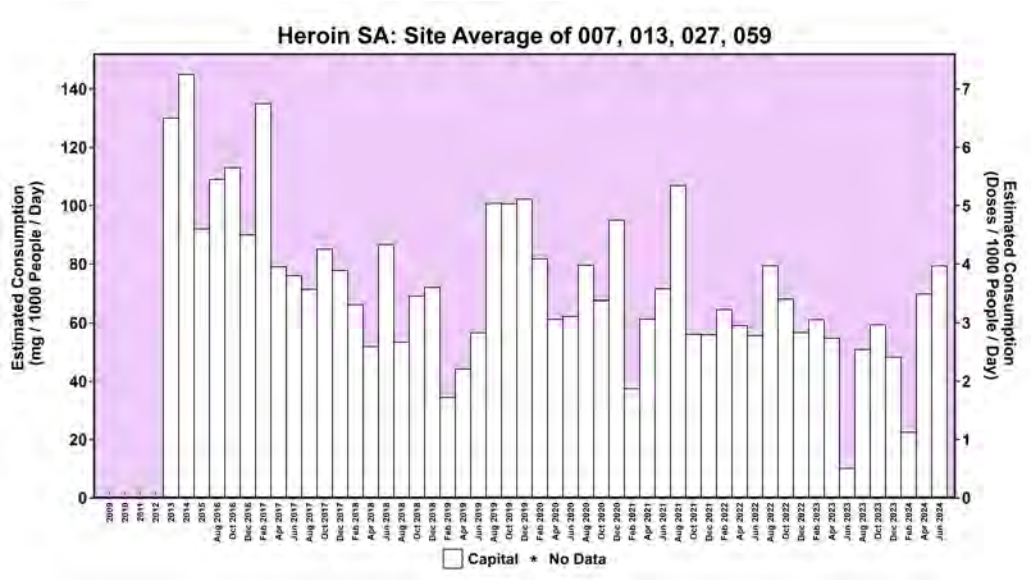


Figure 28: Estimated average consumption of heroin by state/territory, August 2021 to June 2024.

Figure 29: Change in heroin consumption for sites in Adelaide with historic data.



4.2.4 CANNABIS

Longer-term average cannabis consumption in regional areas is substantially higher than in the capital cities (Figure 30). This national trend is reversed in Tasmania. Cannabis consumption in regional South Australia and the Northern Territory has been consistently among the highest in the country, while Hobart has the highest consumption level of the capital cities.

Long-term cannabis data are available for Adelaide (Figure 31). The June 2024 results show cannabis consumption almost reaching the historical high levels observed in August 2023.

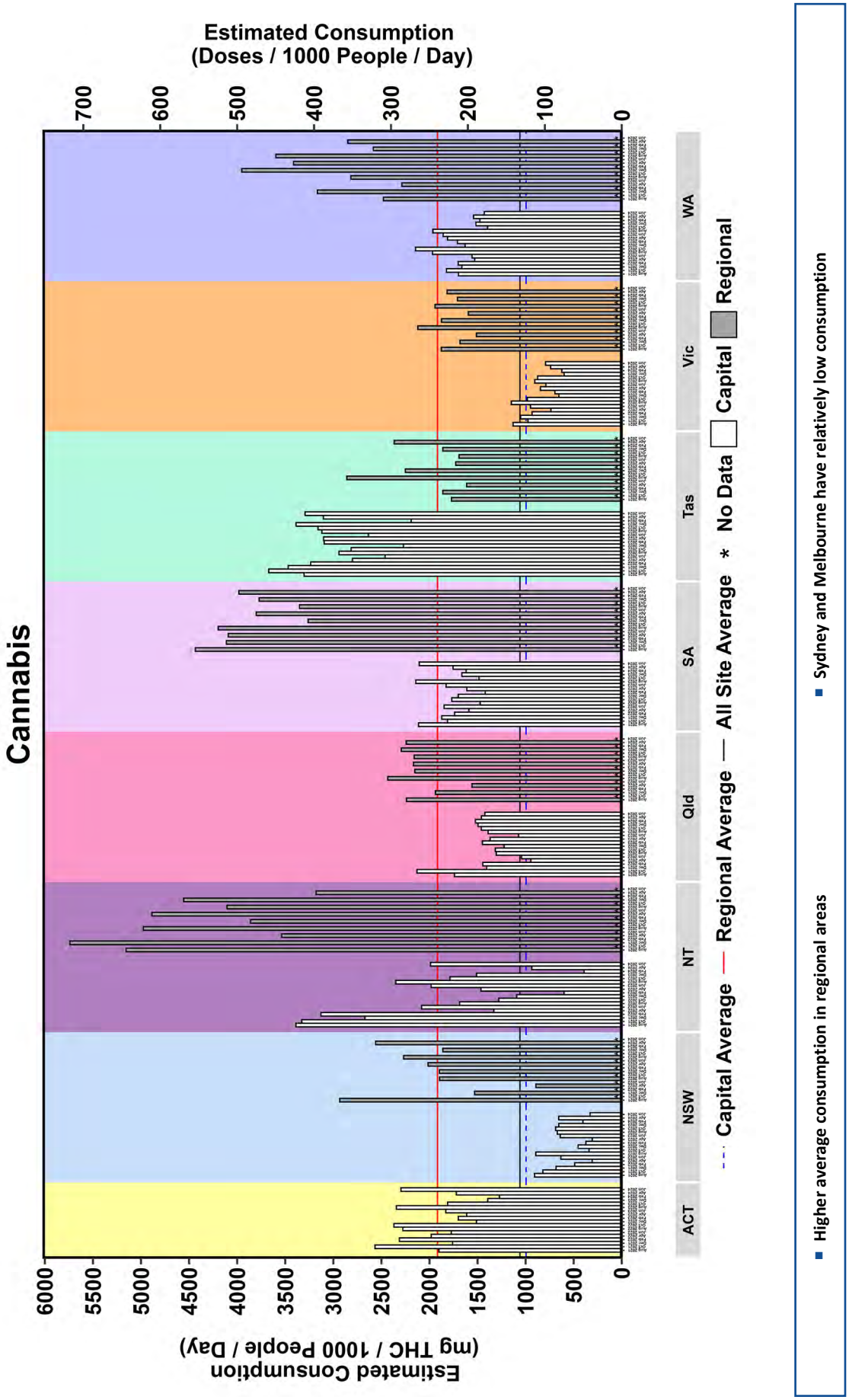
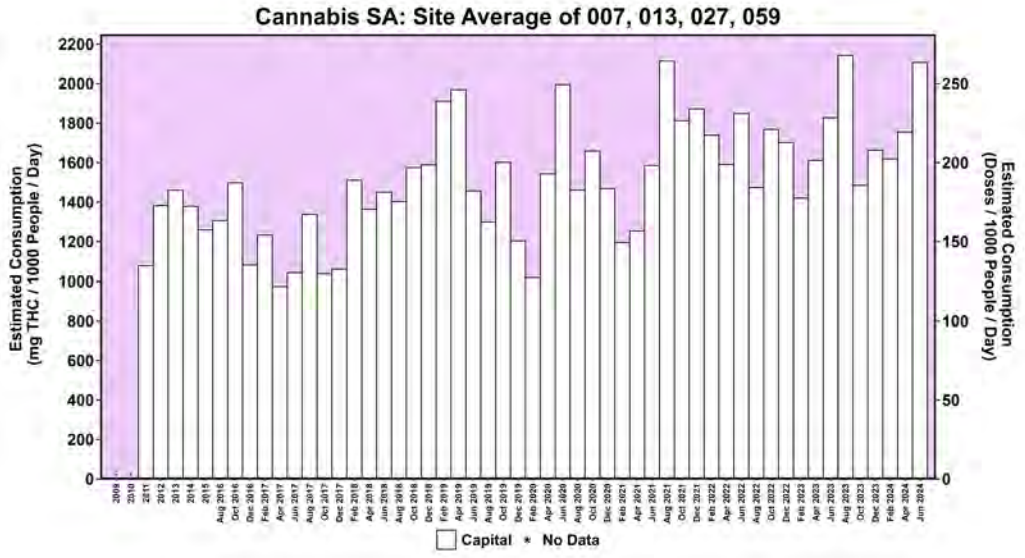


Figure 30: Estimated average consumption of cannabis by state/territory, August 2021 to June 2024.

Figure 31: Change in cannabis consumption for sites in Adelaide with historical data. Cannabis is detected via the THC metabolite, THC-COOH.



4.2.5 KETAMINE

Ketamine excretion is relatively low compared to other drugs, but is generally higher in the capital cities compared to regional areas (Figure 32). Excreted amounts in Darwin and Hobart tend to be more variable than other jurisdictions. Long-term ketamine excretion is either relatively stable or increasing in most parts of the country.

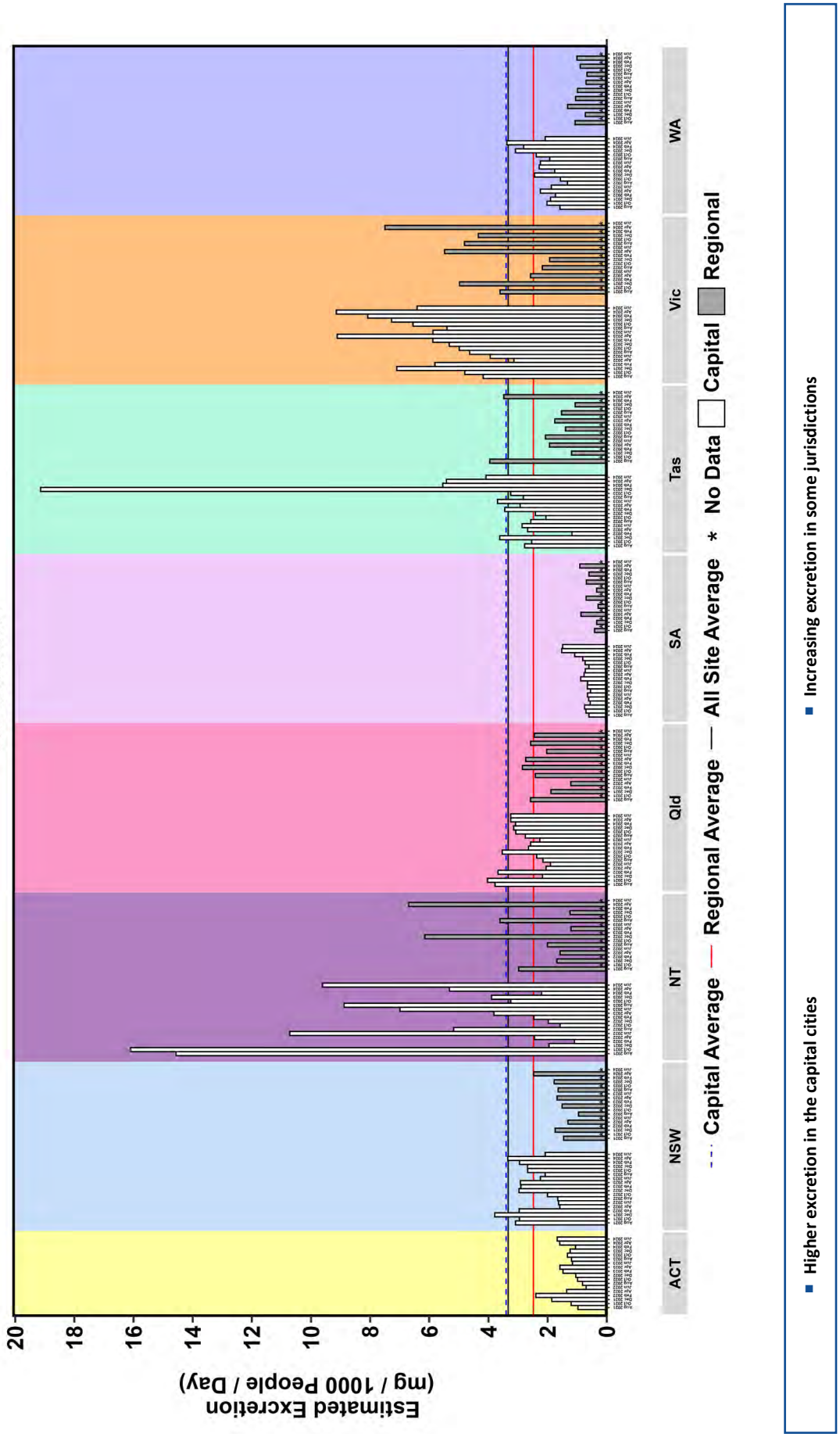


Figure 32: Estimated average excretion of ketamine by state/territory, August 2021 to June 2024.

4.3 NATIONAL CAPITAL CITY AND REGIONAL AVERAGES

To show national trends for the individual substances, all capital city and regional sites were combined for each substance (Figures 33 to 38). Fewer sites participated in October 2016 and to account for this, the average consumption in August and December 2016 was used to provide the overall October 2016 estimate. Regional sites are sampled every second sampling period.

4.3.1 NICOTINE AND ALCOHOL

National nicotine consumption is shown in Figure 33. Regional averages of nicotine have been higher than capital city averages over the life of the Program. The results show that nicotine consumption decreased after the record high levels in capital cities and regional areas in December 2022 and December 2023, respectively.

Alcohol consumption has fluctuated over the life of the Program, but consumption has decreased in the capital cities and regional areas over the life of the Program (Figure 33). Average regional alcohol consumption has been above that of the capital cities in most periods. Capital city consumption decreased from December 2023 to June 2024, while regional consumption remained relatively stable from December 2023 to April 2024.

4.3.2 STIMULANTS

4.3.2.1 METHYLAMPHETAMINE

National methylamphetamine consumption trends are shown in Figure 34. The average national regional consumption was higher than capital cities in April 2024. Methylamphetamine consumption has been increasing since August 2022 and is returning to pre-COVID levels.

4.3.2.2 COCAINE

Cocaine consumption has been higher in capital cities than in regional areas over the life of the Program (Figure 34). After the record low of August 2022, cocaine consumption in capital cities and regional areas increased to reach historically high levels in December 2023. Results from then to April 2024 showed a decrease in consumption in the capital cities and regional areas.

4.3.2.3 MDMA

National average MDMA consumption was lower for the capital cities than in regional areas in April 2024, similar to the long-term trend (Figure 35). Since the record low levels of MDMA consumption reported in April 2022, MDMA consumption has increased, with April 2024 regional levels the highest since August 2020. Capital city MDMA consumption has generally decreased since December 2023.

4.3.2.4 MDA

MDA excretion showed very similar levels between the capital cities and regional areas for April 2024, while the long-term average shows greater excretion in regional areas (Figure 35). Excretion levels remain low compared to sporadic highs observed prior to August 2020, particularly in regional areas.

4.3.3 OPIOIDS

4.3.3.1 OXYCODONE

Oxycodone consumption was higher in regional areas than in the capital cities for the current collection period and over the life of the Program (Figure 36). Since the highest levels recorded in December 2018 and February 2019, oxycodone consumption has been relatively stable at a lower level. The latest results show a small decrease in average consumption in both capital cities and regional areas.

4.3.3.2 FENTANYL

Regional consumption of fentanyl has generally exceeded that of the capital cities, similar to oxycodone (Figure 36). However, in April 2024, this trend was reversed for the first time, with higher consumption in the capital cities than in regional areas. Fentanyl consumption in regional Australia has now reached its lowest levels since the Program started in 2016. More samples are falling below the detection and quantification limits.

4.3.3.3 HEROIN

Heroin consumption is higher in capital cities than in regional areas (Figure 37). The consumption of heroin has fluctuated over the life of the Program and is below the limit of detection at many sites, particularly in regional areas. Compared to the same time a year ago, heroin consumption has increased in both regional areas and the capital cities.

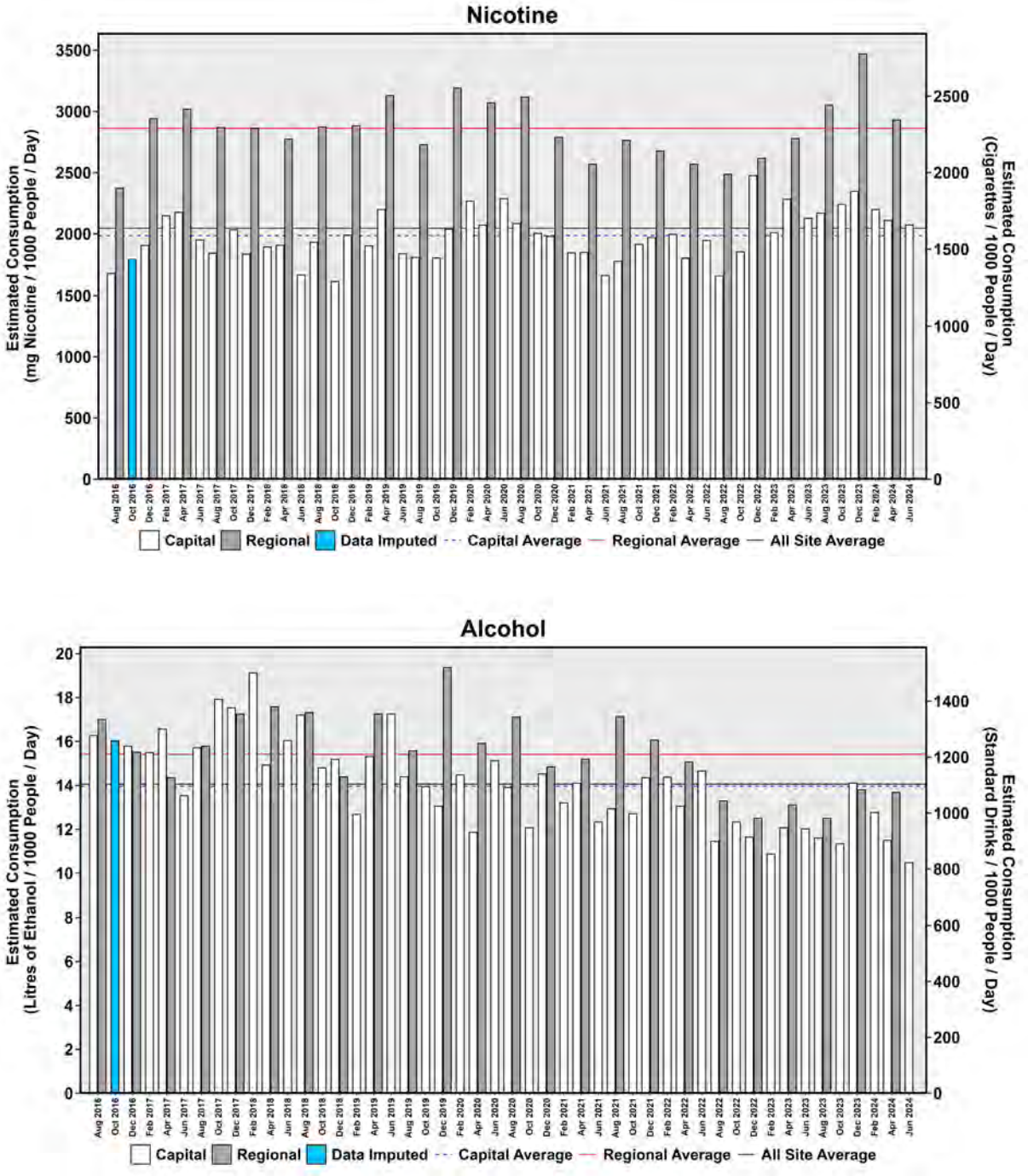
4.3.4 CANNABIS

Cannabis has been monitored since August 2018 and results show that consumption is substantially higher in regional areas than in the capital cities (Figure 37). Average consumption has been relatively stable over the past year.

4.3.5 KETAMINE

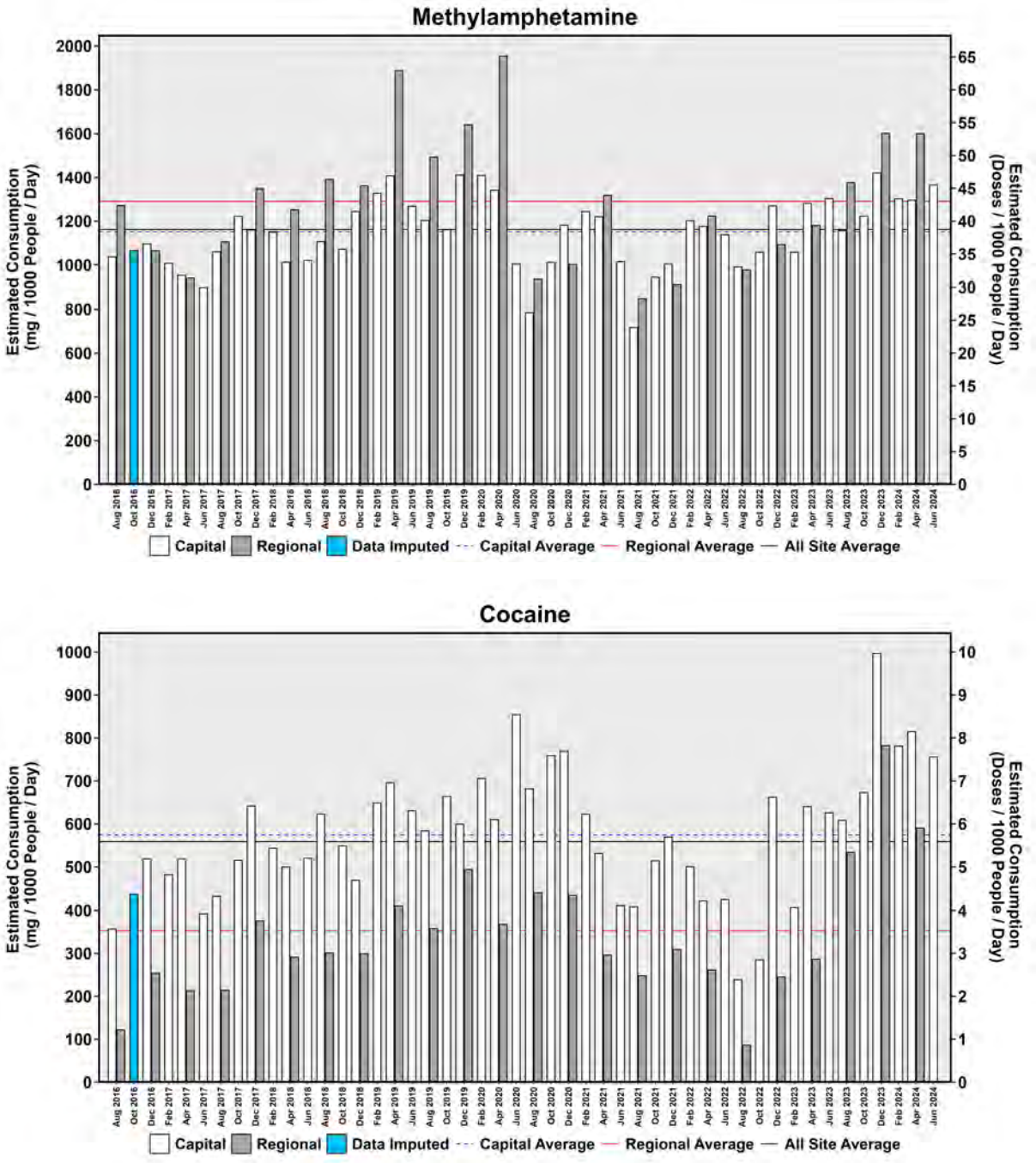
Ketamine excretion in regional parts of Australia has generally been lower than the capital cities (Figure 38). Excretion levels in the capital cities and regional areas increased from December 2023 to April 2024, to the highest levels recorded by the Program. In the capital cities, excretion levels decreased in June 2024, but were still above the long-term average.

Figure 33: The population-weighted average of all sites for nicotine and alcohol.



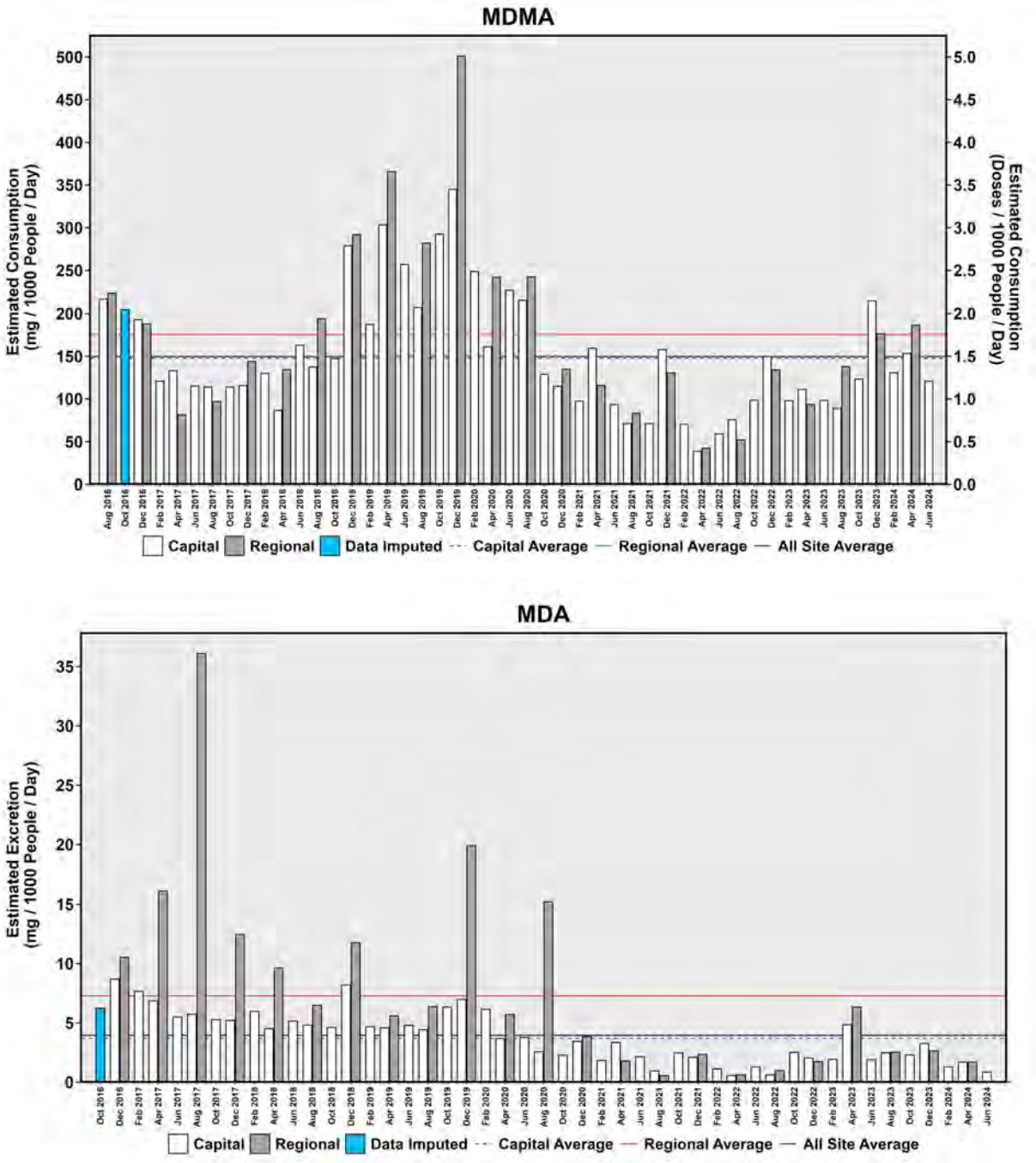
As Queensland and New South Wales capital city sites were not sampled in October 2016, their average consumption in August and December 2016 was used to provide the overall October estimate.

Figure 34: The population-weighted average of all sites for methylamphetamine and cocaine.



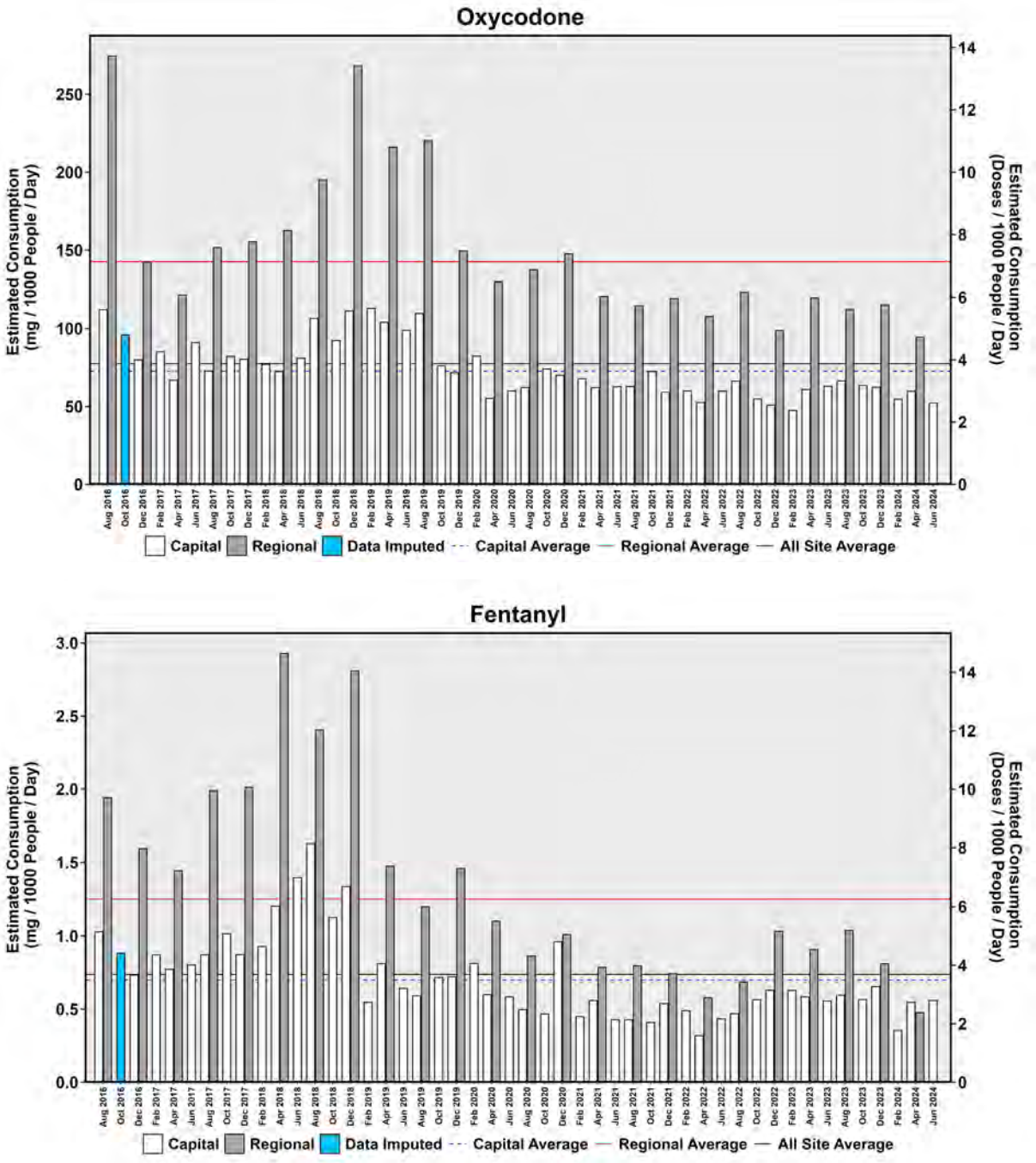
As Queensland and New South Wales capital city sites were not sampled in October 2016, their average consumption in August and December 2016 was used to provide the overall October estimate.

Figure 35: The population-weighted average of all sites for MDMA and MDA.



As Queensland and New South Wales capital city sites were not sampled in October 2016, their average consumption in August and December 2016 was used to provide the overall October estimate.

Figure 36: The population-weighted average of all sites for oxycodone and fentanyl.



As Queensland and New South Wales capital city sites were not sampled in October 2016, their average consumption in August and December 2016 was used to provide the overall October estimate.

Figure 37: The population-weighted average of all sites for heroin and cannabis.

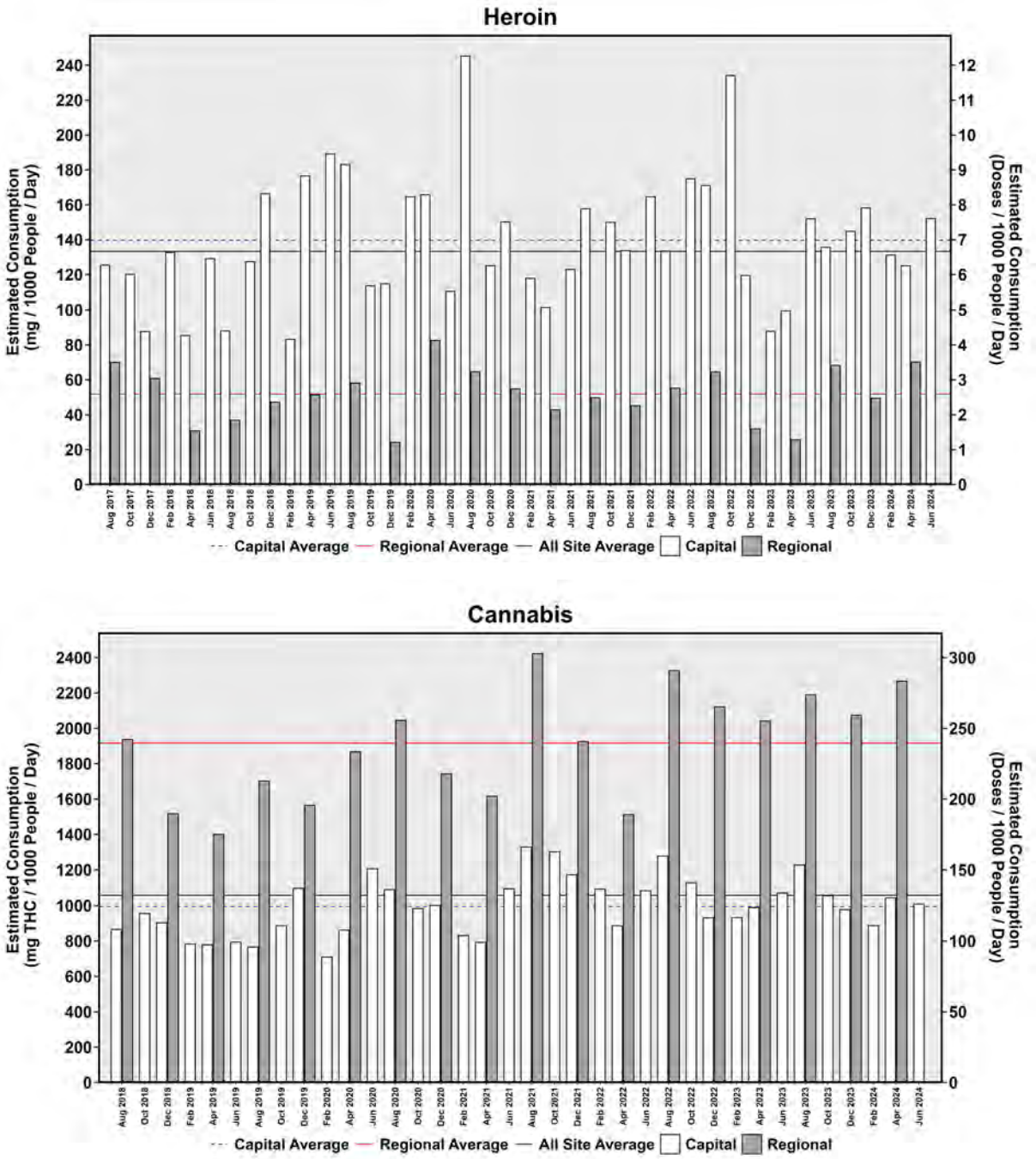
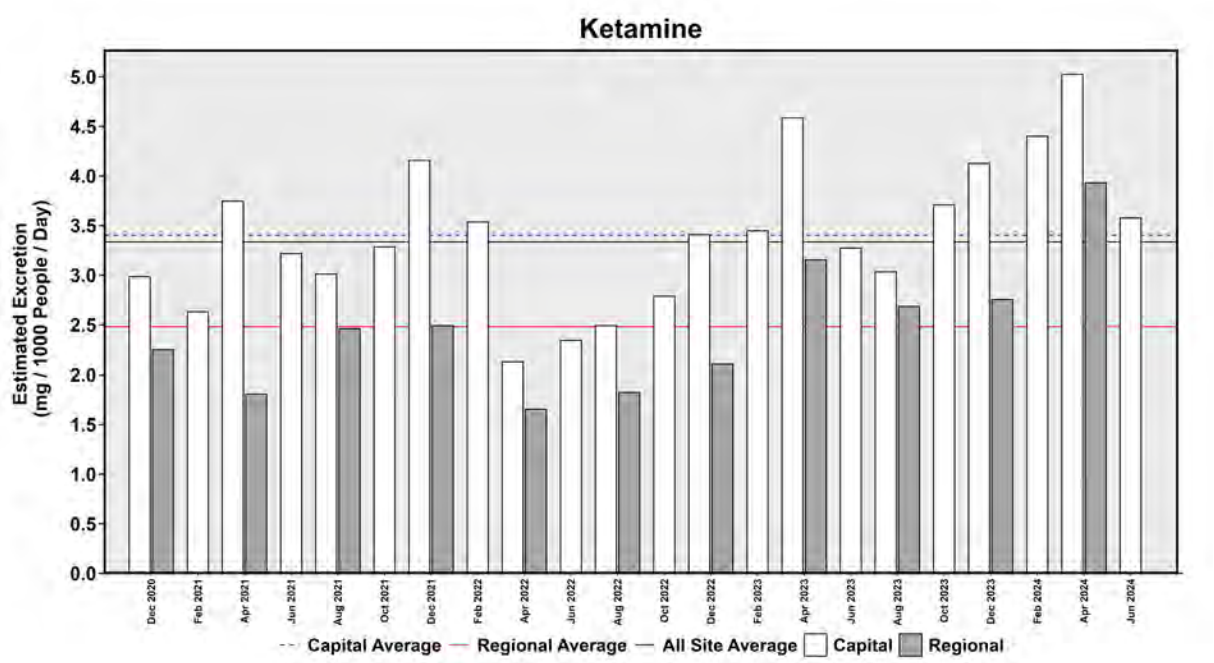


Figure 38: The population-weighted average of all sites for ketamine.



4.4 DRUG PROFILE FOR EACH STATE AND TERRITORY

Drug consumption is reported as the number of doses consumed to compare the scale of different drug consumption within the same region (for example, within a state or territory), and plotted on the same figure. In the absence of clear pharmacokinetic excretion data for MDA and ketamine, these compounds are excluded from the section as they are reported as the amount excreted.

The population-normalised dose amounts (excretion factors listed in Appendix 1) show that alcohol and nicotine remained consistently the highest consumed substances in all states and territories.

In terms of the remaining substances with available dose information, cannabis ranked the highest in all jurisdictions (Figures 39 to 42). The scale of cannabis consumption is substantially higher than the other substances included in the figures. Due to this, the graphs have been divided into 2 parts so all drugs remain visible. Following cannabis, methylamphetamine is by far the next highest-ranking illicit drug included in the Program. Subsequent rankings differ by jurisdiction.

Figure 39: Profile of average drug consumption by state or territory, August 2021 to June 2024 for capital sites and to April 2024 for regional sites, Australian Capital Territory and New South Wales. Consumption is shown as the number of doses per 1,000 people per day to allow comparison of drugs of different types within the same region (state or territory). The circles represent the cumulative national average of all time points for the respective drugs.

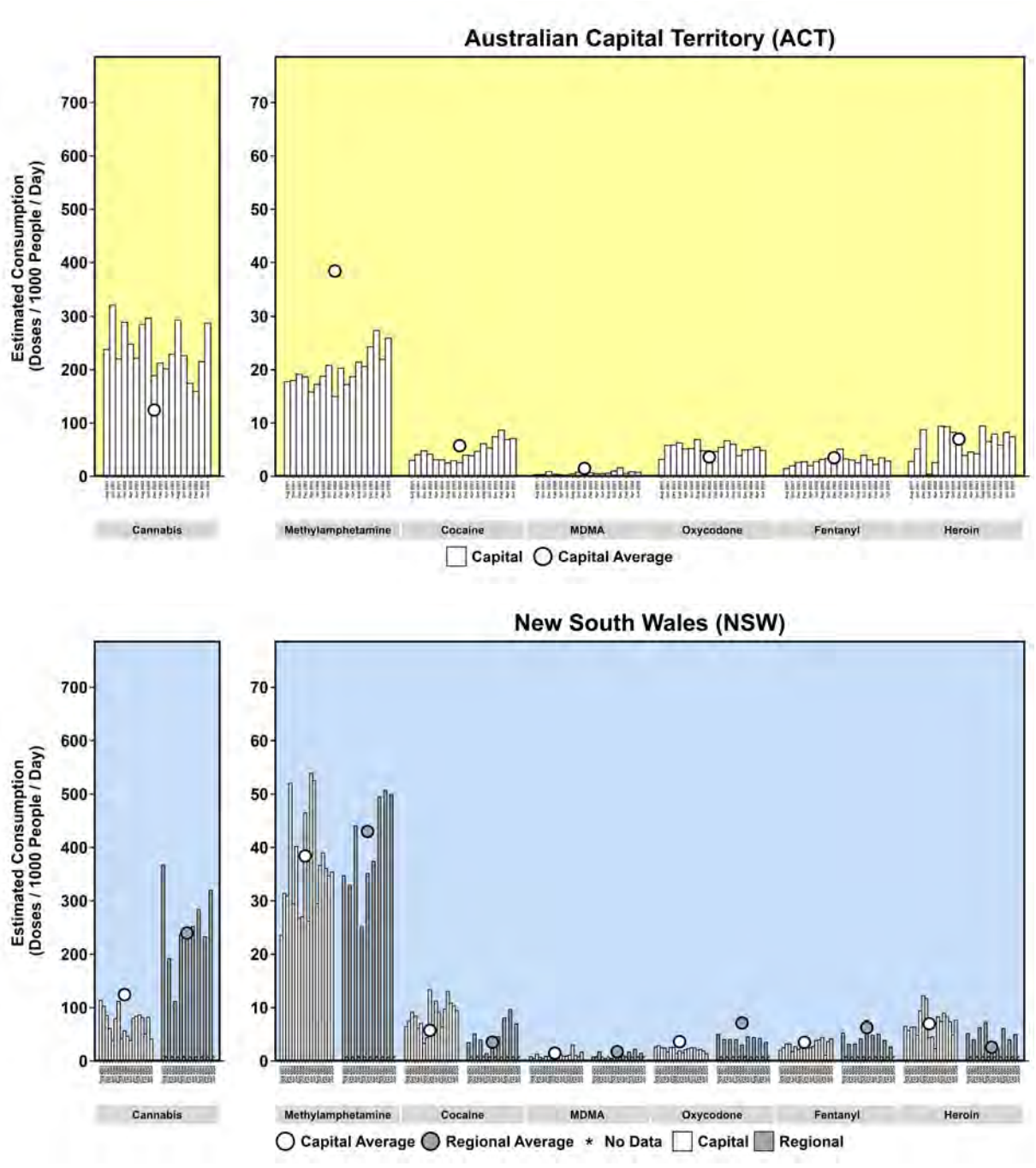


Figure 40: Profile of average drug consumption by state or territory, August 2021 to June 2024 for capital sites and to April 2024 for regional sites, Northern Territory and Queensland. Consumption is shown as the number of doses per 1,000 people per day to allow comparison of drugs of different types within the same region (state or territory). The circles represent the cumulative national average of all time points for the respective drugs.

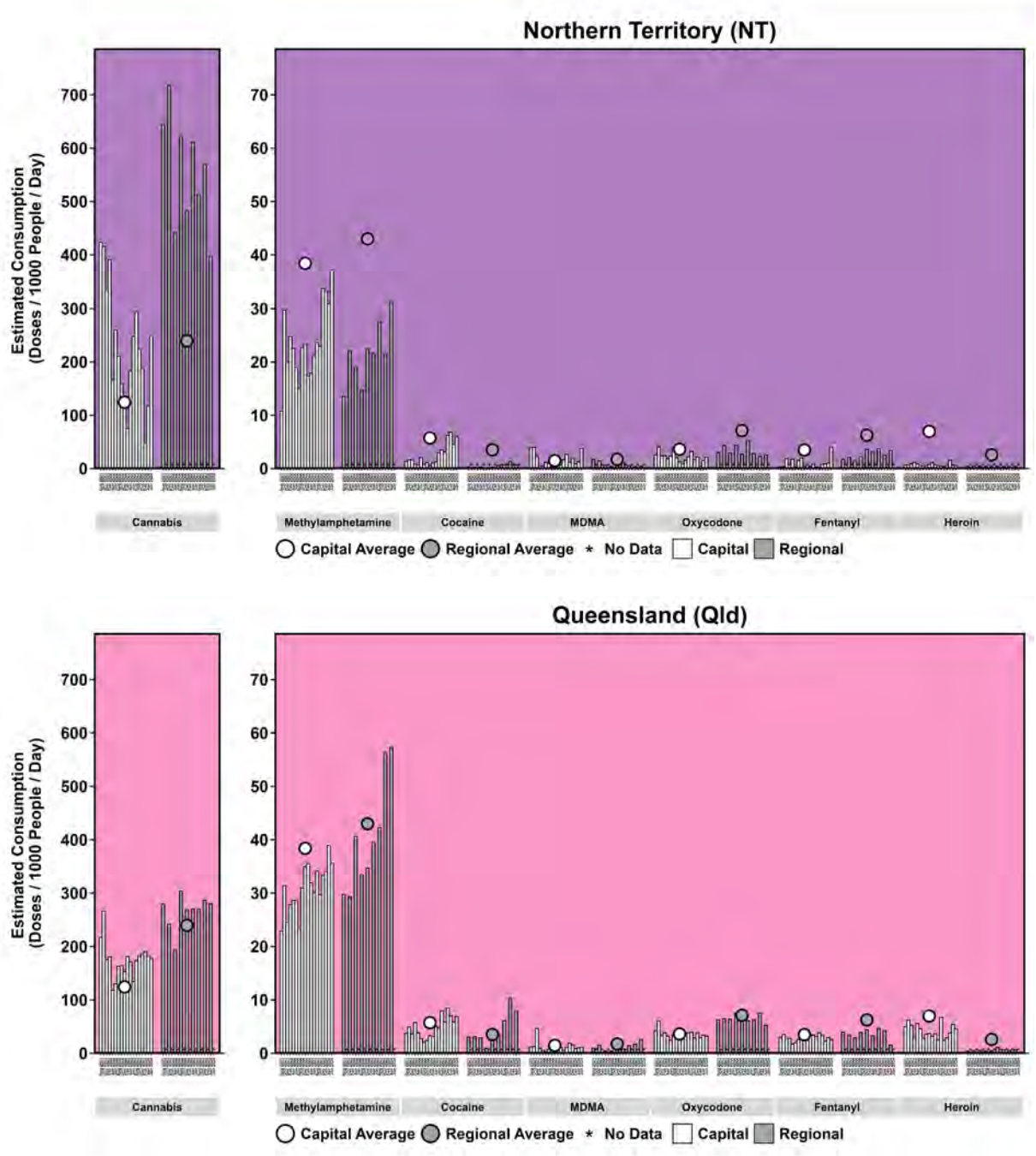


Figure 41: Profile of average drug consumption by state or territory, August 2021 to June 2024 for capital sites and to April 2024 for regional sites, South Australia, and Tasmania. Consumption is shown as the number of doses per 1,000 people per day to allow comparison of drugs of different types within the same region (state or territory). The circles represent the cumulative national average of all time points for the respective drugs.

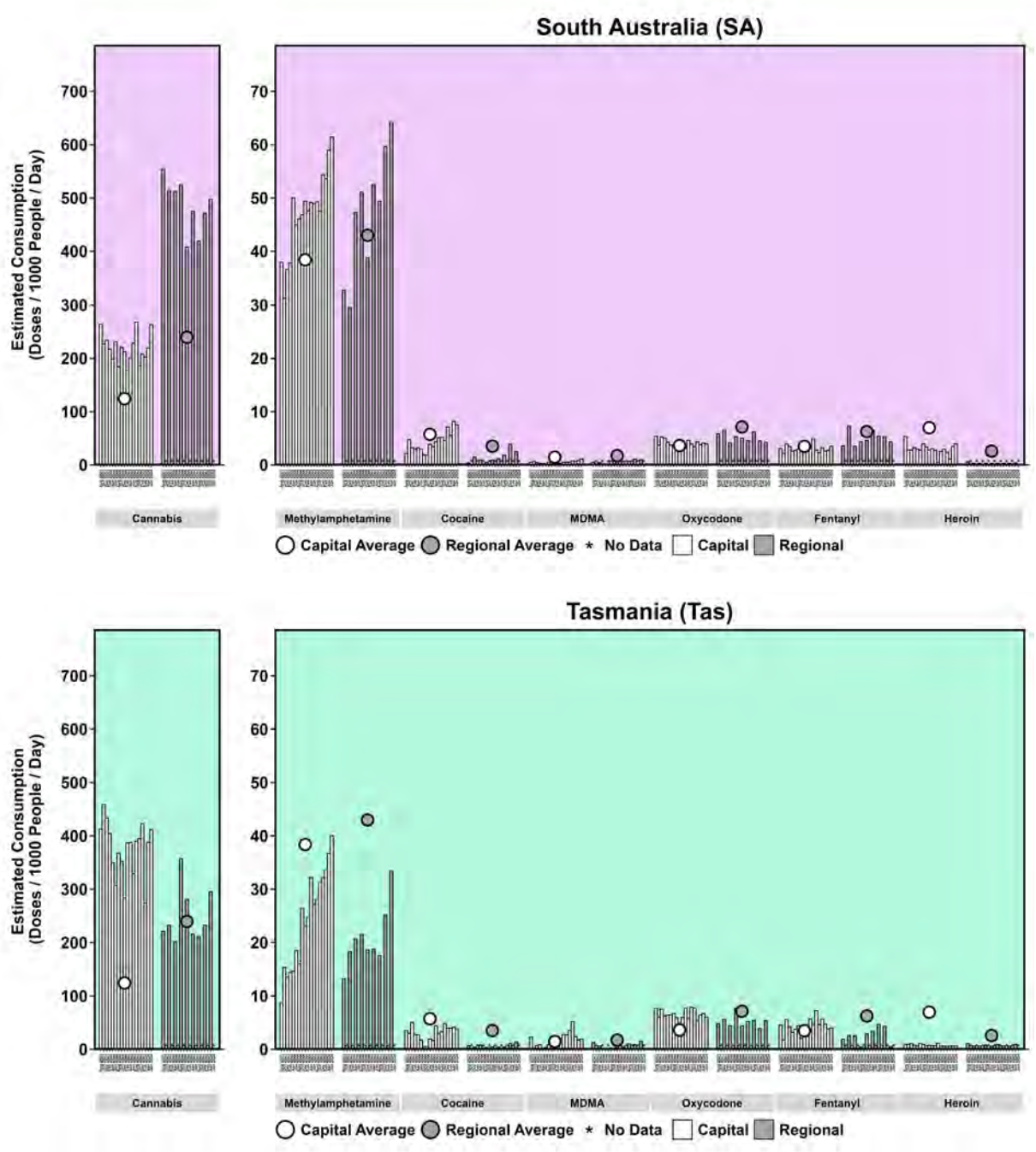
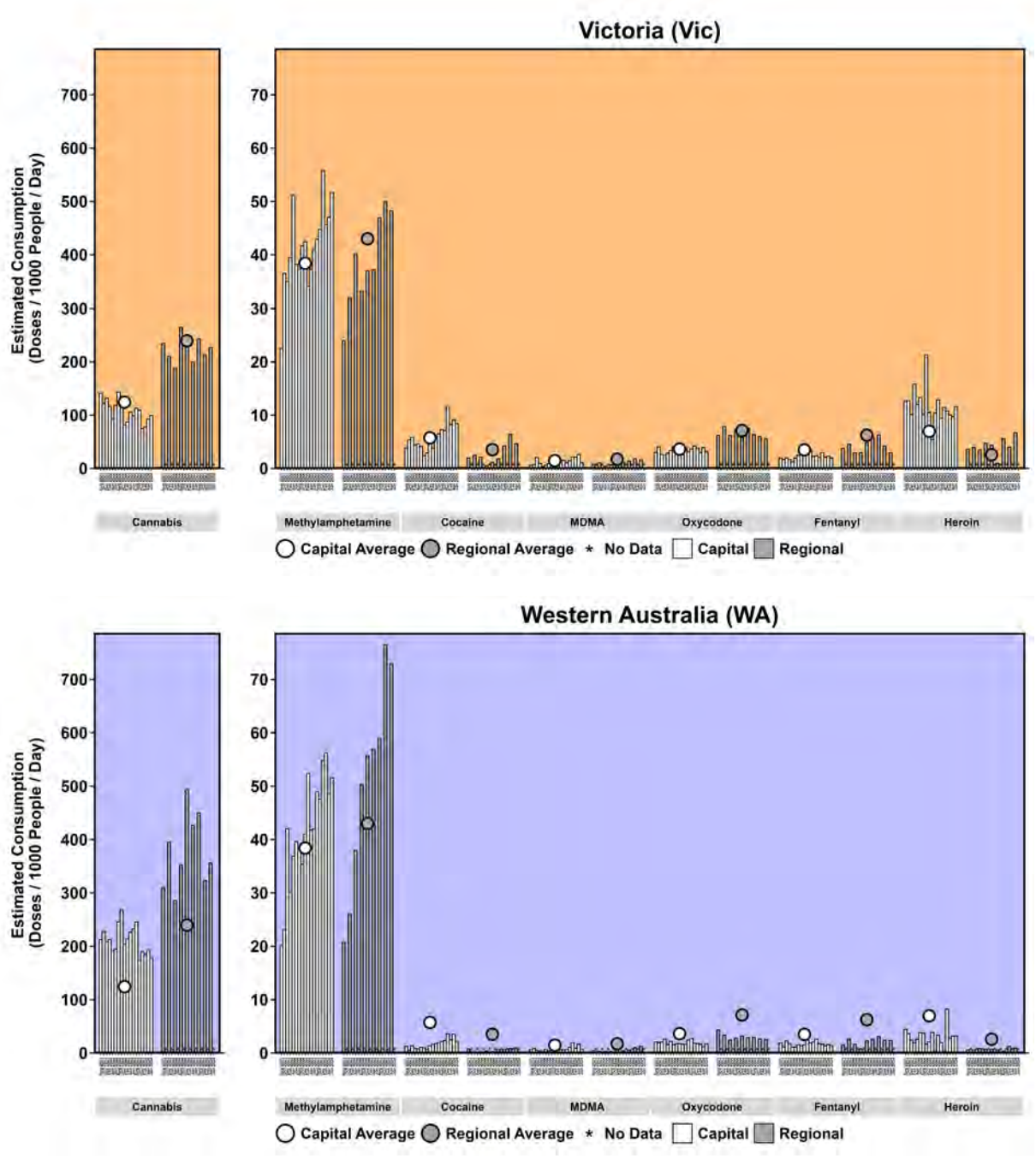


Figure 42: Profile of average drug consumption by state or territory, August 2021 to June 2024 for capital sites and to April 2024 for regional sites, Victoria, and Western Australia. Consumption is shown as the number of doses per 1,000 people per day to allow comparison of drugs of different types within the same region (state or territory). The circles represent the cumulative national average of all time points for the respective drugs.



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The symbols/images used in Figure 4 in the report were provided courtesy of the Integration and Application Network, University of Maryland, Center for Environmental Science (ian.umces.edu/symbols/).

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7: APPENDICES

APPENDIX 1: DRUG-SPECIFIC PARAMETERS FOR ANALYTICAL REPORTING AND USAGE CALCULATIONS

Analyte levels of detection, levels of reporting, highest detection, excretion factors and standard doses from the literature.

Analyte/metabolite	Drug	Limit of detection (LOD) [ng/L]	Limit of quantification (LOQ) [ng/L]	Excretion factor	Standard dose pure drug (mg)
Amphetamine	Amphetamine	12	16	0.394[a]	30[b]
Cocaine	Cocaine	17	50	0.075[b]	100[b]
Cotinine	Nicotine	33	100	0.3[c]	1.25[c]
Norfentanyl	Fentanyl	0.1	0.1	0.3[d]	0.2[d]
MDA*	MDA	1	4	n.a.	n.a.[#]
MDMA	MDMA	1.5	2	0.225[b]	100[b]
Mephedrone	Mephedrone	0.4	0.8	n.a.	n.a.
Methylamphetamine	Methylamphetamine	33	100	0.39[g]	30[b]
Methylone	Methylone	0.01	0.1	n.a.	n.a.
Hydroxycotinine	Nicotine	17	50	0.44[c]	1.25[c]
Noroxycodone	Oxycodone	0.1	1	0.22[f]	20[d]
Ethyl Sulphate	Alcohol (ethanol)	167	500	0.00012[e]	10g[e]
Benzoylecgonine	Cocaine	33	100	0.35[g]	100[b]
6-Monoacetylmorphine	Heroin	0.5	1.0	0.013[h]	20[i]
THC-COOH	THC (Cannabis)	30	180	0.1[##]	8[**]
Norketamine	Ketamine	1	2	n.a.[^]	n.a.

n.a. = data not available; a = (Khan and Nicell 2012); b = (Zuccato et al. 2008); c = (Castiglioni et al. 2015); d = (Rossi 2016); e = (Ryu et al. 2016); f = (Lalovic et al. 2006); g = (Lai et al. 2011); h = (Boerner et al. 1975); i = (Sullivan et al. 2006).

* Data is not available in the scientific literature for the proportion of MDA that is eliminated following MDA consumption. However, data is available detailing the proportion of MDA eliminated after MDMA consumption. Therefore, our MDA estimate of mg excreted per day per 1,000 people is the amount of MDA excreted from the population after considering the metabolic fraction excreted from MDMA.

\# It is likely that the dose for MDA is similar to that of MDMA, or 100 mg.

^ Ketamine is excreted as norketamine and several conjugated metabolites. As the level of conjugation is not well known and conjugated metabolites (e.g., glucuronides) are likely to deconjugate in the sewer, a ketamine excretion rate has not been assigned at this time. Once the impact of in-sewer deconjugation is known, this will be revised.

** A dose of 8 mg THC has been suggested to provide the desirable effect for the average user, regardless of the route of administration (Freeman and Lorenzetti, 2020). This takes into consideration that not all the available THC in a joint or edibles is inhaled or absorbed by the lung or the intestine and enters the blood stream.

Between 23% (edibles) and 31% (smoked) of an ingested dose of cannabis is excreted in faeces as the metabolite, THC-COOH, and another 3% in urine in free or conjugated form (Wall and Perez-Reyes, 1981). Recent research shows that the particulate fraction of wastewater can contain upwards of 40% of the total excreted THC-COOH load (Campos-Manas et al, 2022). Experiments by the authors of this report on wastewater from around Australia show that the water-soluble fraction of THC-COOH on average is about 33% of the total load, inclusive of the bound glucuronide which deconjugates in the sewer. Therefore, a correction factor of 10% has been applied in this report to convert the measured excreted load to consumed amounts. This number was derived as follows: of THC consumed, 30% enters the sewer as THC-COOH (Wall and Perez-Reyes, 1981). This load partitions with approximately 67% adsorbed to particulates and 33% dissolved in the water fraction on average (unpublished data). Therefore, the measured amount in water represents 10% of the original amount of THC consumed. This approach represents a reasonable average based on local data and may need to be refined further as more research becomes known. It should not be considered a universal correction factor for cannabis due to the differences between wastewater and infrastructure in other countries.

APPENDIX 2: SAMPLING DETAILS OF EACH SITE FOR APRIL AND JUNE 2024

Sites	Location	Apr 2024	Jun 2024	Population
ACT: 009	Capital	7	7	> 150,000
NSW: 003	Capital	7	7	> 150,000
NSW: 006	Capital	7	7	> 150,000
NSW: 008	Capital	7	7	> 150,000
NSW: 016	Regional	7	–	30,000 to 150,000
NSW: 025	Regional	7	–	> 150,000
NSW: 068	Regional	7	–	> 150,000
NSW: 081	Regional	6	–	< 30,000
NSW: 115	Regional	7	–	30,000 to 150,000
NSW: 163	Regional	7	–	< 30,000
NSW: 164	Regional	7	–	< 30,000
NSW: 165	Regional	6	–	< 30,000
NT: 010	Capital	7	7	30,000 to 150,000
NT: 078	Regional	7	–	< 30,000
Qld: 002	Capital	7	7	> 150,000
Qld: 005	Capital	7	7	> 150,000
Qld: 011	Capital	7	7	> 150,000
Qld: 012	Regional	7	–	> 150,000
Qld: 024	Regional	7	–	30,000 to 150,000
Qld: 028	Regional	7	–	30,000 to 150,000
Qld: 029	Regional	7	–	30,000 to 150,000
Qld: 033	Regional	7	–	30,000 to 150,000
Qld: 039	Regional	5	–	< 30,000
Qld: 042	Regional	6	–	30,000 to 150,000
Qld: 053	Regional	7	–	< 30,000
Qld: 077	Regional	6	–	< 30,000
SA: 007	Capital	7	7	> 150,000
SA: 013	Capital	7	7	> 150,000
SA: 027	Capital	7	7	30,000 to 150,000
SA: 059	Capital	7	7	> 150,000
SA: 017	Regional	7	–	< 30,000
SA: 022	Regional	7	–	< 30,000
SA: 063	Regional	7	–	< 30,000
SA: 076	Regional	7	–	< 30,000
SA: 119	Regional	7	–	< 30,000

APPENDIX 2 (CONTINUED)

Sites	Location	Apr 2024	Jun 2024	Population
Tas: 004	Capital	5	5	< 30,000
Tas: 019	Capital	5	5	30,000 to 150,000
Tas: 041	Capital	5	5	< 30,000
Tas: 018	Regional	5	–	30,000 to 150,000
Tas: 048	Regional	5	–	< 30,000
Vic: 001	Capital	7	7	> 150,000
Vic: 067	Capital	7	7	> 150,000
Vic: 037	Regional	7	–	> 150,000
Vic: 046	Regional	7	–	30,000 to 150,000
Vic: 061	Regional	7	–	30,000 to 150,000
Vic: 066	Regional	7	–	30,000 to 150,000
Vic: 114	Regional	7	–	30,000 to 150,000
Vic: 121	Regional	7	–	< 30,000
Vic: 122	Regional	7	–	< 30,000
Vic: 125	Regional	7	–	30,000 to 150,000
Vic: 155	Regional	7	–	30,000 to 150,000
Vic: 156	Regional	7	–	< 30,000
WA: 101	Capital	7	7	> 150,000
WA: 103	Capital	7	7	> 150,000
WA: 104	Capital	7	7	> 150,000
WA: 102	Regional	7	–	30,000 to 150,000
WA: 116	Regional	7	–	< 30,000
WA: 120	Regional	7	–	< 30,000
WA: 129	Regional	7	–	< 30,000
Regional Sites		39	–	
Capital Sites		20	20	
Total Sites		**59**	**20**	
Regional Sites		263	–	
Capital Samples		134	134	
Total Samples		**397**	**134**	
Cumulative Samples		**11,586**	**11,720**	

APPENDIX 3: PROPORTION OF SAMPLES ABOVE LOD (%) FOR EACH DRUG AND PERIOD ASSESSED[4]

Drug	Location	Apr 2024	Jun 2024
Alcohol	Capital	100	100
Alcohol	Regional	100	–
Amphetamine	Capital	100	100
Amphetamine	Regional	98	–
Cannabis	Capital	100	100
Cannabis	Regional	100	–
Cocaine	Capital	100	100
Cocaine	Regional	95	–
Fentanyl	Capital	87	100
Fentanyl	Regional	59	–
Heroin	Capital	75	65
Heroin	Regional	33	–
Ketamine	Capital	100	100
Ketamine	Regional	86	–
MDA	Capital	49	49
MDA	Regional	55	–
MDMA	Capital	97	99
MDMA	Regional	100	–
Methylamphetamine	Capital	100	100
Methylamphetamine	Regional	100	–
Nicotine	Capital	100	100
Nicotine	Regional	100	–
Oxycodone	Capital	100	100
Oxycodone	Regional	100	–

4 Percentage detections for previous collection periods are available in Appendix 4 of Report 6 and Appendix 3 of Reports 7 to 22.

CONCLUSIONS

CONCLUSIONS

For the 23rd report of the NWDMP, wastewater analysis was conducted in April (capital city and regional sites) and June 2024 (capital city sites only). The Program identified variations in patterns of drug consumption over time and within and between jurisdictions. Consistent with previous reports, findings show that of the substances monitored with known doses, nicotine and alcohol remain the most consumed licit drugs in Australia. Cannabis was the most consumed illicit drug in Australia, followed by methylamphetamine.[5]

METHYLAMPHETAMINE

When comparing data for December 2023 and April 2024, the population-weighted average consumption of methylamphetamine decreased in capital city sites and remained relatively stable in regional sites. Average capital city methylamphetamine consumption then increased from April to June 2024. Average regional methylamphetamine consumption exceeded capital city consumption. In April 2024, Adelaide had the highest estimated average capital city consumption of methylamphetamine, while Western Australia had the highest average regional consumption.

COCAINE

When comparing data for December 2023 and April 2024, the population-weighted average consumption of cocaine decreased in both capital city and regional sites. Average capital city cocaine consumption further decreased from April to June 2024. Average capital city cocaine consumption continued to exceed average regional consumption. In April 2024, Sydney had the highest estimated average capital city consumption of cocaine, while Queensland had the highest average regional consumption.

3,4-METHYLENEDIOXYMETHYLAMPHETAMINE (MDMA)

When comparing data for December 2023 and April 2024, the population-weighted average consumption of MDMA decreased in capital city sites and increased in regional sites. Average capital city MDMA consumption then decreased from April to June 2024. Average regional MDMA consumption exceeded capital city consumption. In April 2024, Melbourne had the highest estimated average capital city MDMA consumption, while Queensland had the highest average regional consumption.

3,4-METHYLENEDIOXYAMPHETAMINE (MDA)

MDA is a metabolite of MDMA, but also an illicit drug in its own right. When comparing data for December 2023 and April 2024, MDA excretion[6] decreased in both capital city and regional sites. Average capital city MDA excretion further decreased from April to June 2024. Average capital city and regional MDA excretion was very similar. In April 2024, Hobart had the highest estimated average capital city excretion and Tasmania the highest average regional excretion of MDA.

5 Throughout this report, unless otherwise stated, all comparisons on the consumption of different drugs are based on doses consumed rather than drug mass.

6 The term excretion (as opposed to consumption) is used for MDA and ketamine in this report due to the absence of clear information in the scientific literature around suitable factors to estimate consumption of the substances in wastewater.

HEROIN

When comparing data for December 2023 and April 2024, the population-weighted average consumption of heroin decreased in capital city sites and increased in regional sites. Average capital city heroin consumption then increased from April to June 2024. Average capital city heroin consumption continued to exceed average regional consumption. In April 2024, Melbourne had the highest estimated average capital city consumption and Victoria the highest average regional consumption of heroin.

CANNABIS

When comparing data for December 2023 and April 2024, the population-weighted average consumption of cannabis increased in both capital city and regional sites. Average capital city cannabis consumption decreased from April to June 2024. Average regional cannabis consumption continued to exceed average capital city consumption. In April 2024, Hobart had the highest estimated average capital city consumption of cannabis, while South Australia had the highest average regional consumption.

KETAMINE

When comparing data for December 2023 and April 2024, the population-weighted average excretion of ketamine increased in both capital city and regional sites, with the capital city and regional levels the highest recorded by the Program. Average capital city ketamine excretion decreased from April to June 2024. Average capital city ketamine excretion continued to exceed regional ketamine excretion. In April 2024, Melbourne had the highest estimated average capital city excretion of ketamine and Victoria the highest average regional excretion.

OXYCODONE

When comparing data for December 2023 and April 2024, the population-weighted average consumption of oxycodone decreased in both capital city and regional sites, with the regional level the lowest recorded by the Program. Average capital city oxycodone consumption further decreased from April to June 2024. Average regional oxycodone consumption continued to exceed average capital city consumption. In April 2024, Hobart had the highest estimated average capital city consumption of oxycodone, while Victoria had the highest average regional consumption.

FENTANYL

When comparing data for December 2023 and April 2024, the population-weighted average consumption of fentanyl decreased in both capital city and regional sites, with the regional level the lowest recorded by the Program. Average capital city fentanyl consumption then increased from April to June 2024. Average capital city fentanyl consumption exceeded average regional consumption for the first time in April 2024. In the same month, Hobart had the highest estimated average capital city consumption of fentanyl, while South Australia had the highest average regional consumption.

NICOTINE

When comparing data for December 2023 and April 2024, the population-weighted average consumption of nicotine decreased in both capital city and regional sites. Average capital city nicotine consumption further decreased from April to June 2024. Average regional nicotine consumption continued to exceed average capital city consumption. In April 2024, Darwin had the highest average capital city consumption of nicotine and Northern Territory[7] the highest average regional consumption.

ALCOHOL

When comparing data for December 2023 and April 2024, the population-weighted average consumption of alcohol decreased in both capital city and regional sites. Average capital city consumption further decreased from April to June 2024, to the lowest level recorded by the Program. Average regional alcohol consumption exceeded average capital city consumption. In April 2024, Darwin had the highest average capital city consumption of alcohol and the Northern Territory[8] the highest average regional consumption.

NEXT REPORT

The 24th report of the NWDMP is scheduled for public release in March 2025.

7 As the Northern Territory only has 2 participating sites, results may not be representative of the Territory as a whole. The 2 sites cover approximately 25% of the population of the Northern Territory.

8 Ibid.