REPORT 21

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 21 of the Australian Criminal Intelligence Commission (ACIC)'s National Wastewater Drug Monitoring Program (the Program).

This report is based on data collected in August and October 2023. In August 2023, the Program covered 57% of the Australian population. The findings are critical to the ACIC's insights on Australia's illicit drug markets which are supplied by serious and organised criminal groups.

The 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.

In addition to data for this reporting period, Report 21 provides data for the full 7th year of the program, enabling comparison with previous years. Report 21 reveals that over 16.5 tonnes of methylamphetamine, cocaine, heroin and 3,4-methylenedioxymethylamphetamine (MDMA) was consumed between August 2022 and August 2023. This is a 17% increase from the previous year, driven by increases in consumption of methylamphetamine (17%) and cocaine (19%). The 1.5 tonne increase in national methylamphetamine consumption is concerning, because of the significant community harms it causes.

While MDMA saw a larger proportional increase in consumption over the year (33%), this was from a low base, and less than one tonne of MDMA was consumed nationally, compared to an estimated 10.5 tonnes of methylamphetamine and 4 tonnes of cocaine. A further estimated 13.6 tonnes of THC (cannabis) was consumed nationally during the year ending August 2023, taking the total consumed weight of these 5 drugs to over 30 tonnes.

Moreover, an estimated $12.4 billion was spent on methylamphetamine, cocaine, MDMA and heroin between August 2022 and August 2023, with methylamphetamine accounting for 85% of this expenditure ($10.5 billion). This is money laundered domestically and out of Australia to line the pockets of serious organised crime bosses offshore.

Seven years of longitudinal data enables monitoring of short and longer-term market trends, key events and law enforcement interventions, and the identification and monitoring of drug consumption in geographic locations that may benefit from focused responses.

A multi-dimensional approach that targets supply, demand and harm reduction is critical to reducing drug use in Australia. Drug consumption estimates derived from wastewater data, when used in combination with other data—such as seizure, arrest, price, health and availability data—provide the most comprehensive, empirically-based insights into Australian drug markets. In turn, this data reveals 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 domestic and international intelligence and law enforcement partners to identify and disrupt serious organised criminal networks that continue to supply illicit drugs to Australia. Some law enforcement investigations are now conducted in conjunction with bespoke high intensity wastewater analysis by the ACIC so that the effectiveness of responses and the reaction of organised crime groups and drug consumers can be monitored. The geographic spread of this work is increasing.

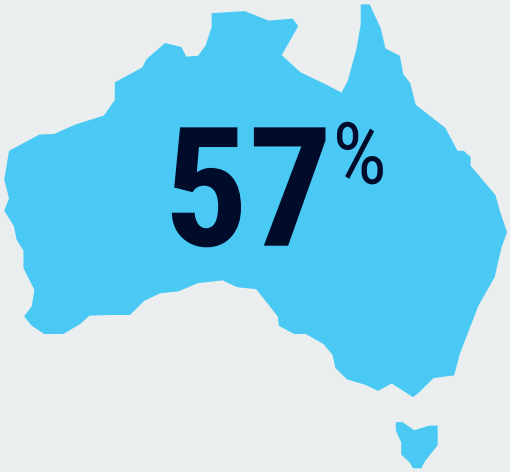
Australia is a global leader in wastewater analysis and its use to inform policy and operational decision making. This knowledge is informing ACIC engagement with multi-lateral bodies such as the United Nations and international partners targeting illicit drug use.

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 August 2023 collection covers around **57 per cent** of Australia's population – about **14.5 million Australians**.

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

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

AUGUST AND OCTOBER 2023 HIGHLIGHTS

RECORD LOW

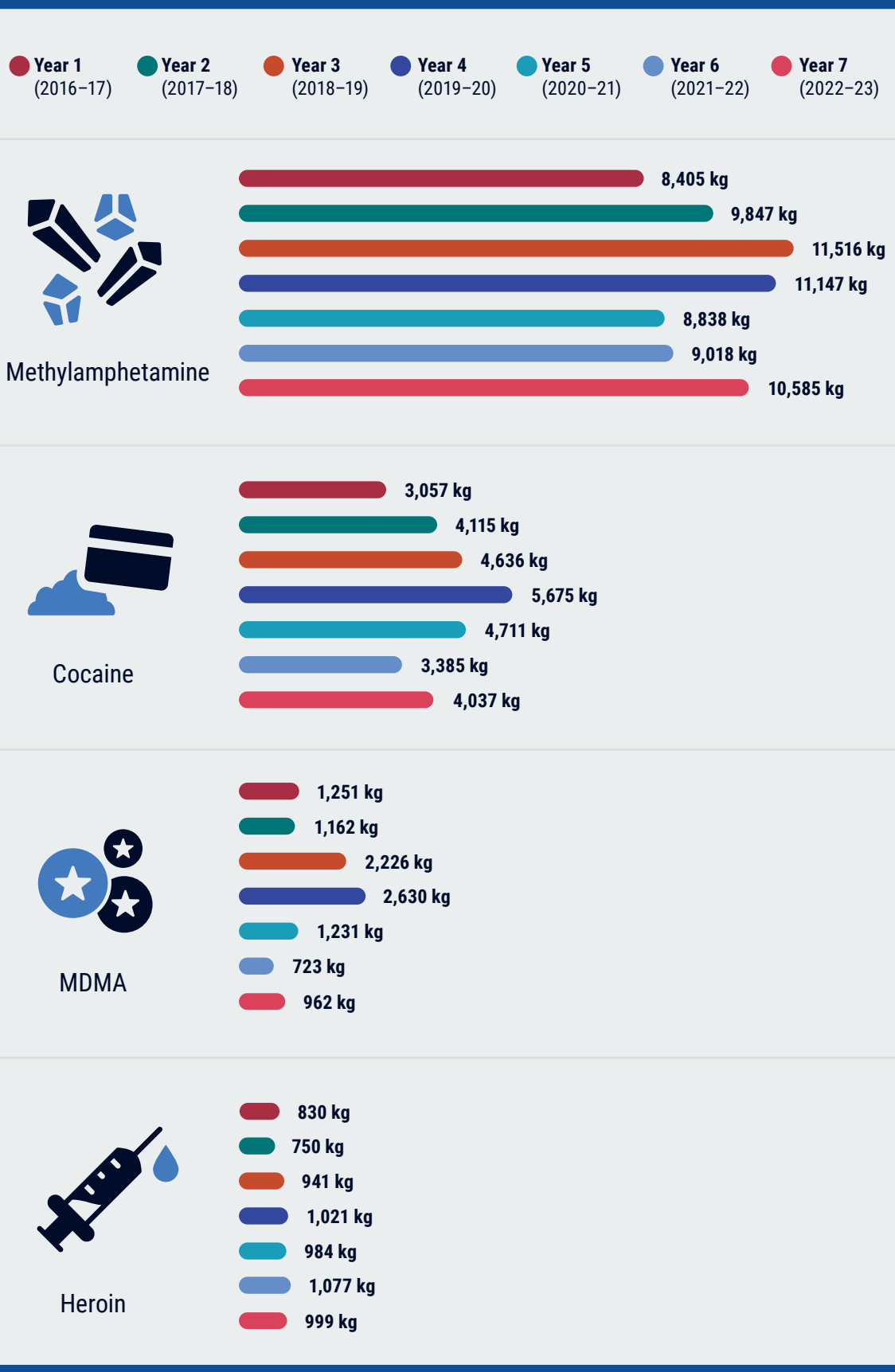
ALCOHOL
regional (August, tied with December 2022)

RECORD HIGH

COCAINE
regional (August)

Between April and August 2023, the population-weighted average capital city consumption of:

Between April and August 2023, the population-weighted average regional consumption of:


Year 1 (2016–17)
Year 2 (2017–18)
Year 3 (2018–19)
Year 4 (2019–20)
Year 5 (2020–21)
Year 6 (2021–22)
Year 7 (2022–23)
Methylamphetamine
8,405 kg
9,847 kg
11,516 kg
11,147 kg
8,838 kg
9,018 kg
10,585 kg
Cocaine
3,057 kg
4,115 kg
4,636 kg
5,675 kg
4,711 kg
3,385 kg
4,037 kg
MDMA
1,251 kg
1,162 kg
2,226 kg
2,630 kg
1,231 kg
723 kg
962 kg
Heroin
830 kg
750 kg
941 kg
1,021 kg
984 kg
1,077 kg
999 kg

Estimated state and territory annual consumption of methylamphetamine, cocaine, MDMA and heroin for Year 7 of the Program.

Methylamphetamine

ACT	93.9 kg
NSW	3,290.9 kg
NT	52.8 kg
QLD	1,953.8 kg
SA	938.6 kg
TAS	134.7 kg
VIC	2,798.6 kg
WA	1,322.3 kg
NATIONAL	10,585 kg

Cocaine

ACT	63.1 kg
NSW	1,933.7 kg
NT	9.7 kg
QLD	705.1 kg
SA	201.8 kg
TAS	24.5 kg
VIC	974.4 kg
WA	124.8 kg
NATIONAL	4,037 kg

MDMA

ACT	10.5 kg
NSW	334.0 kg
NT	8.5 kg
QLD	195.8 kg
SA	38.6 kg
TAS	22.8 kg
VIC	285.1 kg
WA	66.9 kg
NATIONAL	962 kg

Heroin

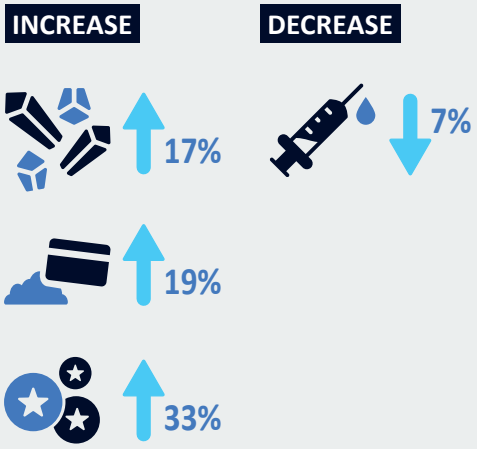
ACT	22.6 kg
NSW	366.4 kg
NT	1.0 kg
QLD	82.0 kg
SA	28.5 kg
TAS	3.1 kg
VIC	456.0 kg
WA	40.0 kg
NATIONAL	999 kg

YEAR 7 TRENDS

Between Year 6 and 7 of the Program (August 2022 to August 2023) total estimated consumption of **methylamphetamine**, **cocaine**, **MDMA** and **heroin** increased by 2.3 tonnes, or 17 per cent of the combined weight.

MARKET IMPACTS:

Consumption of **methylamphetamine**, **cocaine** and **MDMA** increased 17%, 19% and 33% respectively. Heroin consumption decreased by 7%.



MARKET VALUE:

The estimated street value of the 4 drugs in Year 7 was **$12.4 billion**, up from $10 billion in Year 6.

INTRODUCTION

This is the 21st report of the National Wastewater Drug Monitoring Program (the Program) to be publicly released by the Australian Criminal Intelligence Commission (ACIC). Report 21 presents data on Australia's drug consumption for 12 substances and includes data for August (capital city and regional sites) and October 2023 (capital city sites).

The Program is an Australian Government-funded initiative that assists in understanding drug use within populations, providing a measure of one important aspect of national health—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 the level of harm experienced by the community. This is because the level of community harm is directly related to the quantity of substances consumed.

Findings presented in ACIC wastewater reports provide government, law enforcement, policy, regulatory and health agencies with additional, objective data on drug use. This data creates opportunities to shape responses to the demand and supply 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 and broader world circumstances.

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

IMPLEMENTATION

The ACIC has 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 the collection and analysis of samples.

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

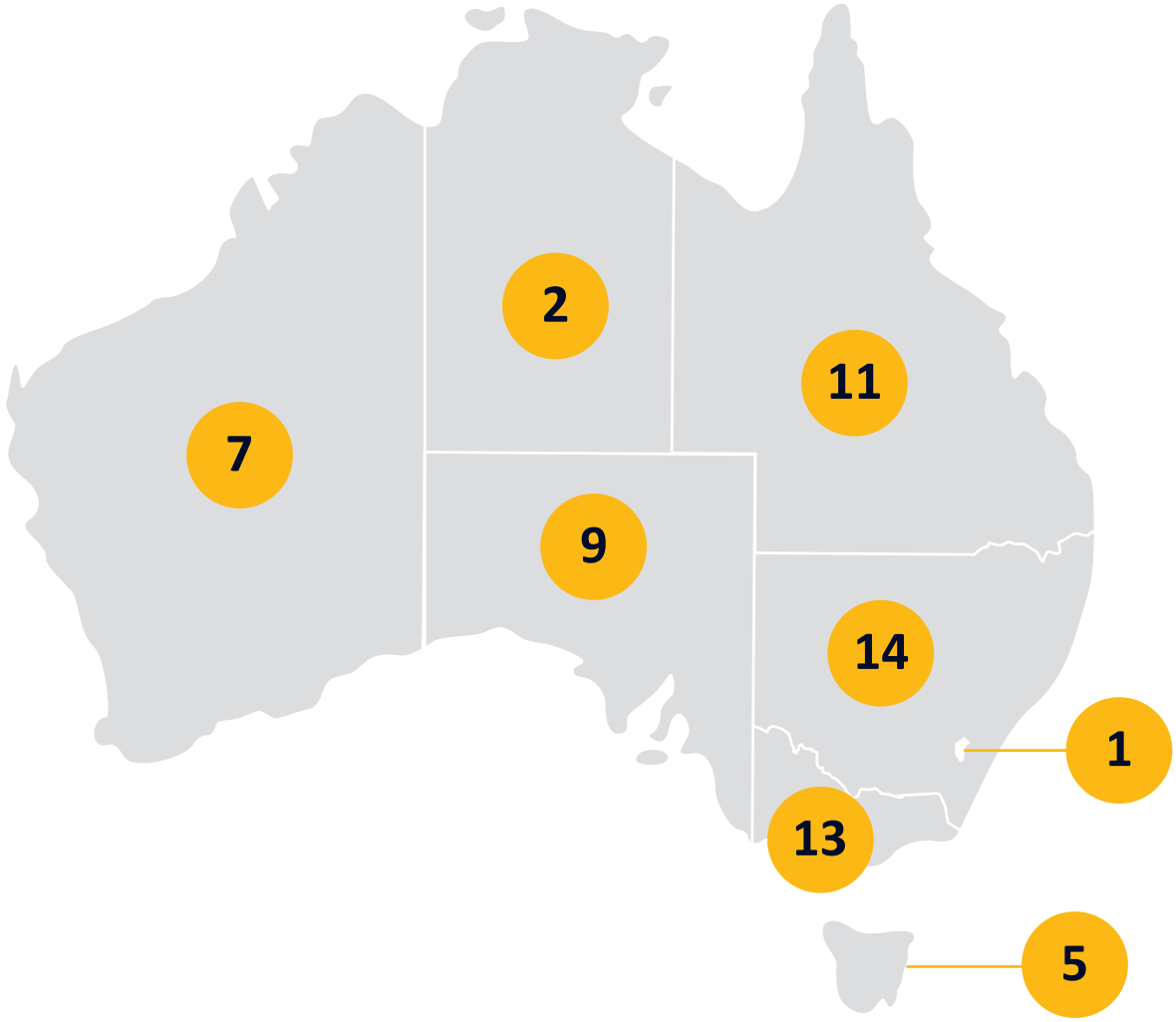
- methylamphetamine
- amphetamine
- cocaine
- 3,4-methylenedioxymethylamphetamine (MDMA)
- 3,4-methylenedioxyamphetamine (MDA)
- heroin
- cannabis
- oxycodone
- fentanyl
- nicotine
- alcohol
- ketamine.

The ACIC continues to review the range of monitored substances with its partners, stakeholders and the 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 August 2023, 62 wastewater treatment plants participated nationally, covering 57% of the Australian population (see Figure 1).[2] Sites were selected to permit the ACIC to provide data on major population areas, sites of actual or potential concern from a drug use perspective and sites where the treatment plant operators have established relationships with the 2 universities.

Figure 1: Breakdown of sites by jurisdiction for August 2023.



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.

2 Sampling also occurred in October 2023 in capital city sites, with 20 participating wastewater sites nationally, covering approximately 48 per cent of the Australian population.

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. Stakeholders in law enforcement, health and other relevant policy agencies are provided with classified information identifying sampling locations to inform appropriate responses. 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 city and regional areas of Australia. The data reinforce 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 times. Other Program data illustrated that consumption of the respective drugs also varied considerably at different sites within jurisdictions. It is important that Australian drug datasets are interpreted holistically.

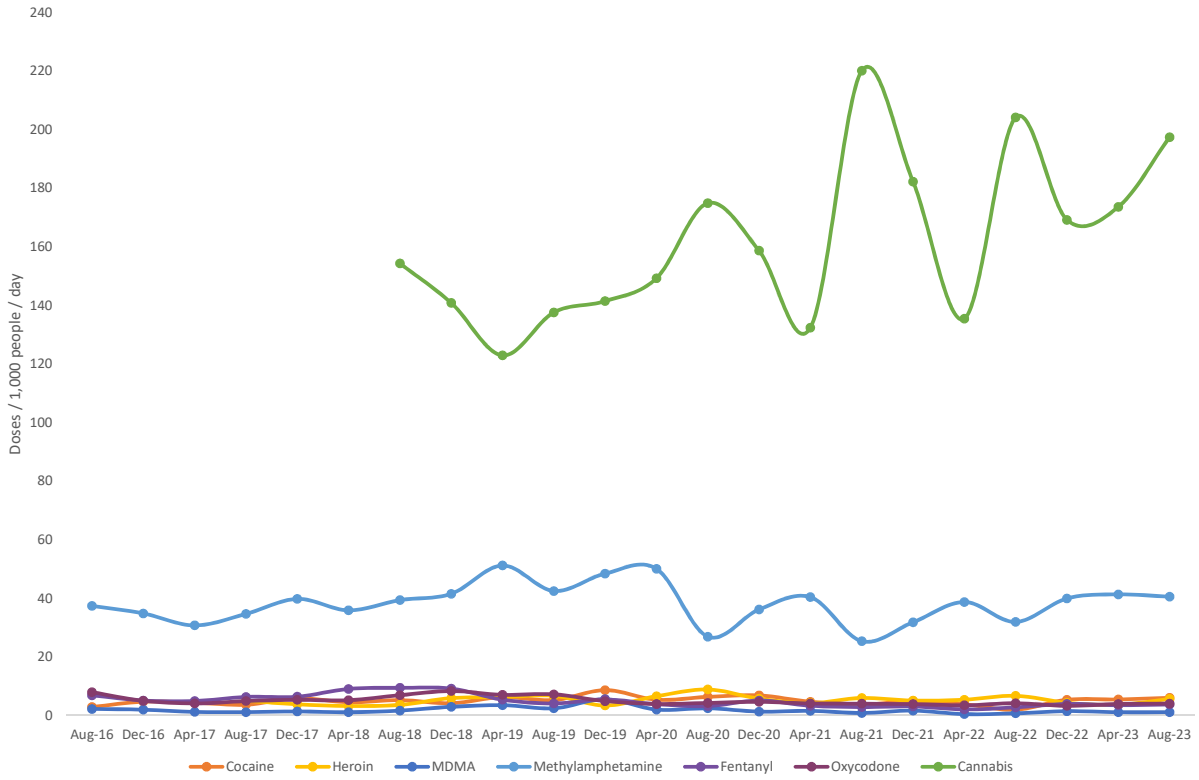
The ACIC engages with academic institutions, industry and public sector agencies to identify further data applications. Identified opportunities included informing responses in high risk areas; measuring drug use in specific local areas; estimating the size of discrete illicit markets; and exploring 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

Average consumption of alcohol decreased in the capital cities and regional areas between April and August 2023, with regional consumption a record low, tied with December 2022. For nicotine, average consumption decreased in capital cities but increased in regional areas.

Nicotine and alcohol aside, cannabis is the most consumed drug by a large margin, despite substantial fluctuations (Figure 2). Cannabis consumption increased in both capital cities and regional areas. Cannabis consumption has shown considerable variability since August 2020, although this was less pronounced in the current reporting period.

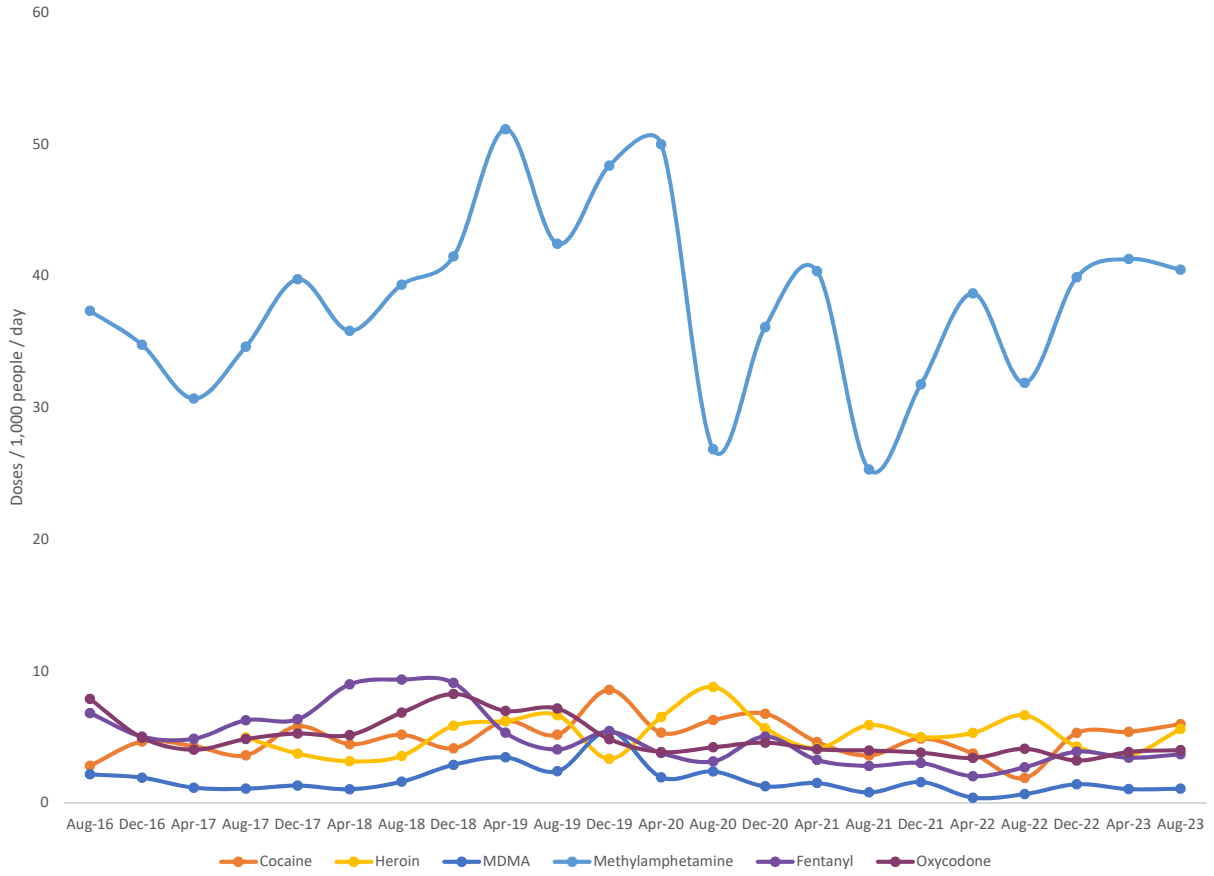
Figure 2: National average drug consumption of cannabis, methylamphetamine, cocaine, MDMA, heroin, oxycodone and fentanyl.



Methylamphetamine consumption decreased in the capital cities, but increased in regional areas, resulting in national consumption that decreased since the last reporting period (Figure 3). Cocaine consumption decreased in the capital cities, but increased in regional areas, resulting in an increase in consumption nationally. There was record high regional consumption of cocaine in August 2023. MDMA consumption increased but remained at a relatively low level.

Heroin consumption increased in both capital city and regional areas to a combined national consumption level that is considerably higher than in the previous reporting period. Of the pharmaceutical opioids, oxycodone consumption increased in the capital cities and decreased in regional areas, while fentanyl consumption increased in both.

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



A 7 YEAR RETROSPECTIVE

With the passage of 7 years, sufficient data have now been collected by the Program to permit longitudinal analysis of consumption trends. Moreover, Program data have proven amenable to analysis from a variety of perspectives, including highlighting differences at the national versus regional levels, and differences in consumption between city and regional settings.

Throughout the life of the Program, national consumption of nicotine and alcohol far exceeded consumption of all other substances monitored. Moreover, cannabis consumption has exceeded by some margin consumption of all other illicit drugs.

In Year 7 of the NWDMP (2022–23) total national consumption of methylamphetamine, cocaine, MDMA and heroin was 16.5 tonnes. When THC (cannabis) is added to the total, over 30 tonnes of these 5 illicit drugs was consumed in 2022–23, an increase of 10% over the figure in Year 6.

The combined estimated national consumption of methylamphetamine, cocaine, MDMA and heroin increased 17% during the year to August 2023, which amounts to the third highest national consumption figure since the Program commenced. This increase amounts to 17%, or some 2.3 tonnes, more consumption than in Year 6, chiefly driven by increases in methylamphetamine, cocaine and MDMA consumption (Table 1). In contrast, the consumption of heroin decreased by 7% in Year 7. Methylamphetamine accounted for approximately 64% of the combined estimated

consumption of these 4 drugs in Year 7 of the Program, the same proportion as in Year 6. By way of comparison, the next most consumed illicit stimulant (cocaine) accounted for approximately 24% of the combined consumption.

Table 1. Estimated annual cannabis (THC), methylamphetamine, cocaine, MDMA and heroin consumption, as total weight consumed nationally, Year 1 to Year 7 of the Program.

Drug	Estimated consumption (kilograms per annum)							% Change
	Year 1 2016–17	Year 2 2017–18	Year 3 2018–19	Year 4 2019–20	Year 5 2020–21	Year 6 2021–22	Year 7 2022–23	Year 6 to Year 7
Methylamphetamine	8,405	9,847	11,516	11,147	8,838	9,018	10,585	↑ 17
Cocaine	3,057	4,115	4,636	5,675	4,711	3,385	4,037	↑ 19
MDMA	1,251	1,162	2,226	2,630	1,231	723	962	↑ 33
Heroin	830[a]	750	941	1,021	984	1,077	999	↓ -7
Total	**13,543**	**15,874**	**19,319**	**20,473**	**15,764**	**14,203**	**16,583**	↑ **17**[c]
Cannabis[b]	NA	NA	9,808	10,733	11,922	13,396	13,638	↑ **2**
Total	**NA**	**NA**	**29,127**	**31,206**	**27,686**	**27,599**	**30,221**	↑ **10**

a. Heroin estimates for Year 1 are based on one collection period.
b. The cannabis figure represents the quantity of THC consumed nationally.
c. This figure is not a summation of percentage change entries in this column, it represents the percentage difference in total consumption between Years 6 and 7 of the Program.

Program data also show fluctuating consumption over time for the drugs covered by the Program, including record high and low consumption of various drugs at different times since August 2016, emphasising that illicit drug markets do not operate in a consistent manner. However, there has been limited change over the life of the Program in the hierarchy of consumption of the 5 major illicit drugs. Cannabis has always been the most consumed illicit substance since it has been measured by the Program, followed by methylamphetamine and then cocaine. The only change that has occurred in the hierarchy has been heroin overtaking MDMA in Years 6 and 7 of the Program.

VALUE OF DRUGS CONSUMED

Using Program consumption data and the most recent national median price data available to the ACIC, it is possible to calculate the overall estimated street value of the major illicit drugs. In Year 7 (2022–23) the total market value of the 4 major illicit drugs of concern increased to a record $12.4 billion (Table 2). The methylamphetamine market, which is the most expensive of the 4 drug types and where consumption increased by 17%, accounted for the majority of that expenditure, amounting to $10.58 billion (85% of the total estimated expenditure). When cannabis is also considered, the total estimated street value of the 5 drugs increases to $12.7 billion. Analysis over a long period has indicated that in Australia street prices of the major drugs change little in response to external factors, including changes in wholesale prices or variations in supply. We judge that this is due in part to the large profit margin enjoyed by SOC groups and the fact that illicit drug users in Australia are ‘price-takers’. Also, the differences in prices between the 5 drugs do not appear to be a major factor in drug choice: the median national street price of a cocaine ‘deal’ is less than the price for a crystal methylamphetamine ‘deal’, so price does not appear to be a factor in the relative consumption of cocaine.

Table 2. Estimated street value of annual methylamphetamine, cocaine, MDMA, heroin and cannabis consumption for Year 1 to 7 of the Program.

Drug	Estimated street value						
	Year 1 (A$) 2016–17	Year 2 (A$) 2017–18	Year 3 (A$) 2018–19	Year 4 (A$) 2019–20	Year 5 (A$) 2020–21	Year 6 (A$) 2021–22	Year 7 (A$) 2022–23
Meth	7.24b	7.38b	8.63b	6.96b	7.95b	8.34b	10.58b
Cocaine	1.06b	1.54b	2.08b	1.41b	1.88b	1.10b	1.31b
MDMA	145.59m	114.19m	211.08m	226.72m	95.50m	62.32m	99.51m
Heroin	207.50m	375.00m	423.45m	382.87m	418.20m	538.50m	449.55m
Total	**8.6b**	**9.4b**	**11.3b**	**8.9b**	**10.3 b**	**10.0b**	**12.4b**
Cannabis[a]	NA	NA	232.94m	268.32m	268.24m	334.90m	340.95m
Total	**8.6b**	**9.4b**	**11.5b**	**9.1b**	**10.5b**	**10.3b**	**12.7b**

a. The cannabis figure represents the quantity of THC consumed nationally.

ESTIMATED STATE AND TERRITORY CONSUMPTION

At the state and territory level, methylamphetamine consumption increased in all jurisdictions in Year 7, cocaine and MDMA increased in all but one jurisdiction and heroin consumption decreased in all but one jurisdiction (Tables 3 to 6). There were varying changes in methylamphetamine consumption across jurisdictions, with the highest increases being in Western Australia (40%) and Tasmania (36%). Cocaine consumption during Year 7 was marked by a considerable increase in Western Australia (55%). There were notable increases in MDMA consumption in most jurisdictions, particularly Tasmania (84%) and the Australian Capital Territory (62%). There were relatively modest decreases in heroin consumption in all jurisdictions except the Australian Capital Territory, where consumption increased 31%. There was a marked decrease in cannabis consumption in the Northern Territory (-25%) and a tangible increase in consumption in Western Australia (17%).

Table 3. Estimated methylamphetamine consumption per jurisdiction in Year 1 to Year 7 of the Program.

Jurisdiction	Estimated consumption (kilograms per annum)							% Change	
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 6 to Year 7	
ACT	80.3	93.0	119.4	122.1	93.2	83.2	93.9	↑	13
NSW	2,298.3	2,604.5	3,337.4	3,409.7	2,877.0	2,912.3	3,290.9	↑	13
NT	65.5	75.5	84.8	66.6	54.7	50.1	52.8	↑	5
Qld	1,277.5	1,893.3	2,247.7	2,246.8	1,608.8	1,650.7	1,953.8	↑	18
SA	1,005.3	1,159.5	943.2	980.5	838.5	775.9	938.6	↑	21
Tas	92.0	127.1	177.1	155.0	88.5	99.3	134.7	↑	36
Vic	2,039.2	2,477.7	3,124.6	2,980.2	2,307.9	2,502.2	2,798.6	↑	12
WA	1,547.3	1,416.8	1,482.7	1,186.2	969.9	944.8	1,322.3	↑	40

Table 4. Estimated cocaine consumption per jurisdiction in Year 1 to Year 7 of the Program.

Jurisdiction	Estimated consumption (kilograms per annum)							% Change	
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 6 to Year 7	
ACT	67.8	81.2	83.4	113.9	91.9	54.0	63.1	↑	17
NSW	1,812.3	2,397.8	2,548.0	2,988.2	2,374.5	1,622.9	1,933.7	↑	19
NT	19.0	27.4	22.8	20.9	12.4	7.6	9.7	↑	28
Qld	319.4	576.6	714.1	918.5	845.3	570.1	705.1	↑	24
SA	107.1	129.2	173.1	243.8	170.5	160.2	201.8	↑	26
Tas	10.9	15.5	16.6	26.8	35.1	29.2	24.5	↓	-16
Vic	676.5	819.9	968.0	1,216.0	1,083.9	860.6	974.4	↑	13
WA	43.9	67.9	110.0	147.0	98.3	80.7	124.8	↑	55

Table 5. Estimated MDMA consumption per jurisdiction in Year 1 to Year 7 of the Program.

Jurisdiction	Estimated consumption (kilograms per annum)							% Change	
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 6 to Year 7	
ACT	28.4	14.4	36.5	38.6	17.8	6.5	10.5	↑	62
NSW	462.8	450.5	834.7	986.1	446.1	234.2	334.0	↑	43
NT	37.8	24.1	32.4	46.4	32.1	13.7	8.5	↓	-38
Qld	216.5	223.2	502.4	627.6	301.3	189.3	195.8	↑	3
SA	56.5	66.6	70.8	127.8	79.6	26.8	38.6	↑	44
Tas	30.6	16.7	54.9	54.1	31.0	12.4	22.8	↑	84
Vic	319.6	291.3	511.9	479.0	232.0	194.3	285.1	↑	47
WA	99.0	74.9	182.4	271.3	91.5	46.6	66.9	↑	44

Table 6. Estimated heroin consumption per jurisdiction in Year 1 to Year 7 of the Program.

Jurisdiction	Estimated consumption (kilograms per annum)							% Change	
	Year 1[a]	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 6 to Year 7	
ACT	14.7	15.3	10.3	16.9	15.3	17.3	22.6	↑	31
NSW	264.6	222.2	307.0	323.9	356.9	389.6	366.4	↓	-6
NT	1.0	1.0	1.0	1.4	1.6	1.1	1.0	↓	-9
Qld	65.5	66.2	66.4	77.7	84.8	100.5	82.0	↓	-18
SA	47.8	34.8	30.5	41.8	37.5	34.7	28.5	↓	-18
Tas	3.3	4.5	2.8	4.3	5.4	3.2	3.1	↓	-3
Vic	402.1	359.4	469.7	464.4	424.4	479.3	456.0	↓	-5
WA	31.1	46.8	53.8	91.4	58.7	51.4	40.0	↓	-22

a. Annual heroin consumption estimates for Year 1 are informed by data from only one collection period.

Table 7. Estimated cannabis[a] consumption per jurisdiction in Year 1 to Year 7 of the Program.

Jurisdiction	Estimated consumption (kilograms per annum)							% Change	
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 6 to Year 7	
ACT	NA	NA	218.4	249.7	265.9	322.7	323.4	→	0
NSW	NA	NA	2,112.8	2,377.1	3,094.8	3,088.3	3,096.7	→	0
NT	NA	NA	202.3	230.2	239.9	303.6	227.1	↓	-25
Qld	NA	NA	2,188.1	2,486.0	2,639.6	3,167.2	3,338.9	↑	5
SA	NA	NA	1,207.6	1,169.8	1,273.9	1,477.1	1,389.7	↓	-6
Tas	NA	NA	463.0	484.5	456.7	492.3	499.6	↑	1
Vic	NA	NA	1,946.2	2,311.0	2,481.5	2,732.2	2,634.2	↓	-4
WA	NA	NA	1,469.6	1,424.9	1,470.5	1,813.5	2,128.4	↑	17

a. The cannabis figure represents the quantity of THC consumed.

CAPITAL CITY V REGIONAL COMPARISON

Over the life of the Program, consumption of most drugs was generally higher per capita in regional areas. In the case of cannabis and oxycodone, regional consumption has consistently exceeded capital city consumption by a large margin. With the exception of one time period, regional nicotine consumption has exceeded capital city consumption, but to a lesser extent than cannabis and oxycodone over the life of the Program. Conversely, cocaine, heroin and ketamine consumption was generally higher in capital cities. Per capita consumption of methylamphetamine from December 2020 has fluctuated between higher levels in the capital cities and regional areas. A similar situation was observed for MDMA since April 2021. In the case of alcohol, the margin between capital city and regional consumption has generally been relatively narrow, and has fluctuated between higher levels in the capital cities and regional areas over the life of the Program. In relation to fentanyl, the disparity between regional and capital city consumption narrowed between August 2020 and August 2022 before the gap between regional and capital city consumption widened again.

BENEFITS OF THE PROGRAM

Wastewater data are an important part of the national suite of datasets that increase understanding of drug consumption, demand and supply in Australian cities and regional locations. Ensuring Program data are publicly available assists understanding and informs the national conversation on drug markets, including their supply, the harm they cause and policy responses. This report builds on national drug consumption data contained in the 20 preceding reports to identify trends over more than 7 years in drug use across states, territories and the nation.

The ACIC's wastewater work extends far beyond the Program. We are exploiting new technology developed by our university partners to take sampling to an increasing variety of sites beyond wastewater treatment plants and to more remote areas of the country. Innovation in the range of chemicals that can be reliably detected and quantified in wastewater is also occurring, with these advances having application for intelligence, law enforcement, health and broader community harm reduction purposes. Moreover, wastewater analysis now routinely extends to a broader range of drugs than is reported in the Program for research and development purposes, which aids future understanding of emerging drug market issues and responses.

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
THC-COOH	11-nor-9-carboxy-tetrahydrocannabinol
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

The Australian Criminal Intelligence Commission (ACIC)'s National Wastewater Drug Monitoring Program (NWDMP) has reported on selected substances of concern in most populated regions of Australia since August 2016. The current version of the NWDMP focuses on 12 licit and illicit drugs, including nicotine, alcohol; the stimulants methylamphetamine, amphetamine, cocaine, MDMA (ecstasy) 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. Each site has been allocated a unique code which is assigned to each WWTP throughout the course of the Program. Site names are not included in this report to maintain treatment plant confidentiality.

Sampling for Report 21 included wastewater samples collected for up to 7 consecutive days during weeks in August and October 2023. The August 2023 collection involved regional and capital city sites, while October 2023 included capital city sites only. A total of 62 sites participated in August 2023, consisting of 22 capital city WWTPs and a further 40 regional WWTPs, covering a population of 14.5 million Australians. Data from this report equates to coverage of approximately 57 per cent of Australia's population for August 2023 and 48 per cent for October 2023 (capital city sites only).

A total of 564 new samples have been added to the 10,111 previously collected, bringing the total number since the beginning of the Program to 10,675. The collected samples provide comprehensive, Australia-wide baseline data against which subsequent results can be compared to ascertain both spatial and temporal trends. The snapshot of the scale of drug consumption over a week in August 2023 was compared with historical data included in previous reports. The August 2023 dataset was used for the spatial comparison as it was more comprehensive, including both capital city and regional sites. The temporal comparison includes the latest capital city collection data for October 2023.

When comparing between sites in August 2023, alcohol and nicotine were the highest consumed drugs in all states and territories. Cannabis was the next most consumed drug and the most consumed illicit drug across the country, followed by methylamphetamine. Consumption of the remaining drugs varied by state and territory.

Nicotine consumption was variable and generally highest in regional Australia. Current consumption levels were mostly within the same range as previously and no consistent trends are evident at a jurisdictional or national level.

Alcohol consumption was slightly higher in regional areas than in capital cities. Alcohol consumption has been declining in many states and territories, and nationally, over the past 2 years.

Methylamphetamine consumption varied substantially between sites and was generally higher in regional parts of the country. Specific regional sites in almost every state had well-above average methylamphetamine levels on some of the collection days. Tasmania was the exception. An increase in methylamphetamine consumption is particularly evident in parts of Tasmania, Victoria and Western Australia.

Cocaine consumption is on average higher in the capital cities. Sites in New South Wales had the highest consumption in the current reporting period. Cocaine consumption has been increasing in many jurisdictions over the past year.

MDMA consumption showed large variability over the collection period. Regional consumption of MDMA was higher on average. No clear pattern is emerging on a jurisdictional level, apart from sites in Hobart, where consumption has been increasing. Nationally, MDMA consumption remains on the lower end of levels recorded by the Program.

MDA is a stimulant and a metabolite of MDMA. It was excreted at relatively high levels at sites in regional South Australia, capital city Tasmania and all sites in Western Australia. On average, there was very little difference in MDA use between capital cities and regional Australia in August 2023, unlike the long-term averages for this drug.

Oxycodone and fentanyl are prescription pharmaceutical opioids with abuse potential. The average consumption of both drugs was higher in regional Australia. At both the national and jurisdictional level, oxycodone consumption fluctuated within the same levels in the past 2 years. In several jurisdictions, fentanyl consumption showed an increasing trend, with the August 2023 consumption levels higher than those reported 2 years ago.

Heroin consumption was relatively high in some sites in states and territories in South-Eastern Australia. In contrast, many other sites had levels below the detection limit of the method. Regional heroin consumption was lower than in the capital cities in the latest collection period.

Cannabis consumption was variable across the country in August 2023, with regional consumption above that of the capital cities. Regional sites in New South Wales, South Australia and Queensland were among the highest consumers. No clear temporal patterns are apparent in most jurisdictions.

In addition to its legitimate use in pain management, ketamine is a compound of emerging concern due to its abuse potential. In the current reporting period, ketamine was excreted more in the capital cities on average. Excretion levels in jurisdictions during the current reporting period largely reflected levels in the previous period, with the exception of the Northern Territory.

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 the wastewater data from 2016 to 2023 and have been re-commissioned to provide data for a further 4 years to 2027, including another 12 public reports. Wastewater treatment sites are assessed, bimonthly in the case of capital city sites and every 4 months for regional sites. The aim has been to acquire data on the population-scale use of substances that cause potential harm, either through addiction, health risks, or criminal and anti-social behaviour. The intention is to build on the baseline data of substance consumption across Australia to establish trends. This latest NWDMP report compares consumption data from previous reports with results obtained from all sites in August 2023 and capital cities in October 2023. 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.

Compounds of concern include nicotine from nicotine intake (cigarettes, gum, patches, e-cigarettes, etc.), ethanol from alcohol consumption, pharmaceutical substances with abuse potential such as oxycodone, fentanyl and ketamine, as well as illicit substances including methylamphetamine, MDMA, MDA, cocaine, cannabis and heroin.

Some drugs share a common clearance pathway from the body. Methylamphetamine is partially metabolised and excreted as amphetamine, while part of a MDMA dose is converted to MDA. The pharmacokinetics of these 4 compounds have been documented and have been accounted for in this report (Pizarro et al. 2002; Khan & Nicell 2011). MDA is a drug in its own right and a metabolite of MDMA. Since the proportion of MDA eliminated after MDMA consumption is known, the proportion of MDA attributable to MDMA metabolism was subtracted from the total measured amount of MDA for each site and expressed as mg excreted per 1,000 people per day (daily mass load). Due to the lack of information concerning MDA elimination following MDA ingestion, consumption estimates cannot be calculated.

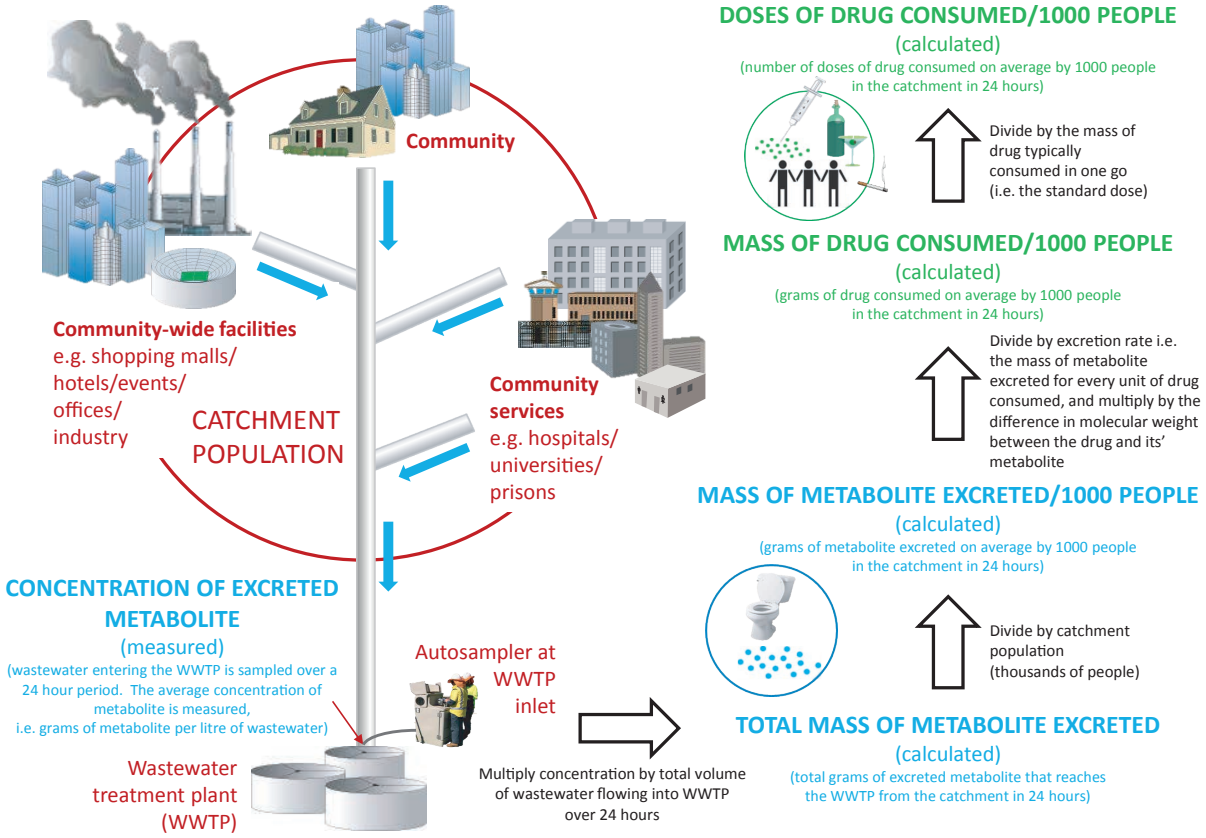
Cannabis results in earlier reports were expressed as the amount consumed per day per 1,000 people. From Report 19, a revised excretion factor and dose were applied in the back-calculation to estimate consumption so that the scale of cannabis use can be compared to other drugs. More information is provided in Appendix 1. MDA and ketamine results continue to be reported as the amount (mg) of drug excreted per day per 1,000 people due to the absence of clear information available in the scientific literature around suitable factors to estimate consumption of the substances in wastewater.

3: METHODS

The method underlying wastewater-based monitoring of drug consumption in a given population is based on the principle that any given compound that is consumed (irrespective of whether it is swallowed, inhaled/smoked or injected) will subsequently be excreted. 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 compound or metabolite is flushed into the sewer network, it will arrive at a wastewater treatment plant, assuming the toilet forms part of a wastewater catchment.

Information on the drugs and their metabolites of interest are described in the first NWDMP report (available at www.acic.gov.au), as well as an in-depth description of the methodologies involved.[3] Collectively, waste products in the sewer system arrive at a WWTP where wastewater samples are collected over a defined sampling period. Measuring the amount of a target compound in the wastewater stream allows for a back-calculation factor to be applied to determine the amount of drug that was used over the collection period (Figure 4). The method is non-invasive and is conducted on a population-scale level, so individuals are not targeted, and privacy is respected.

Figure 4: Schematic of the population catchment area and methodology employed to convert measured concentration of substances in wastewater to mass loads or doses consumed per day per population.



3 Information in relation to heroin appears in Report 3.

To obtain an estimate of drug use, representative samples are collected over a given period (typically 24 hours) using autosamplers that collect time or flow proportional samples. Wastewater treatment plant operators aid with collecting the samples from the influent autosampler (where the wastewater enters the treatment plants). Details of the calculation methods are given in Report 1. Apart from a few sites in regional Western Australia, from August 2018 operators have been collecting a second daily influent sample with the preservative sodium metabisulphite (0.5% m/v) to allow for the detection of the cannabis metabolite.

Collected wastewater samples were analysed at the University of South Australia and The University of Queensland laboratories. The steps routinely performed in these laboratories are based on filtration of the samples followed by an enrichment or concentration step where the concentrated sample is injected, or (for chemicals with sufficiently high concentrations) direct injection of samples into the analytical instruments. The instrumental analysis consists of chromatographic separation and subsequent compound specific detection. A summary of the extraction and analytical methods is given in Report 1. An updated excretion table including THC-COOH and dose can be found in Appendix 1 of this report. Methods to extract and analyse the cannabis metabolite are outlined in Tscharke et al. (2016). Concentrations of drug metabolites were determined in the wastewater using liquid chromatography-tandem mass spectrometric (LC-MS/MS) analytical methods. Drug consumption estimates for each catchment population were calculated from these measured concentrations using daily flow volumes 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.

3.1 PARTICIPATING WASTEWATER TREATMENT PLANTS (WWTPs)

Sixty-two WWTPs across Australia participated in the NWDMP for the August 2023 collection period (Figure 5). Of these, 22 sites were in capital cities and a further 40 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 8 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 de-identified site codes are presented in the results.

Figure 5: Participating WWTPs in August 2023 showing the number of capital city and regional plants by state and territory. The colours in this figure are matched with others in the remainder of the report to identify results relating to individual states and territories.

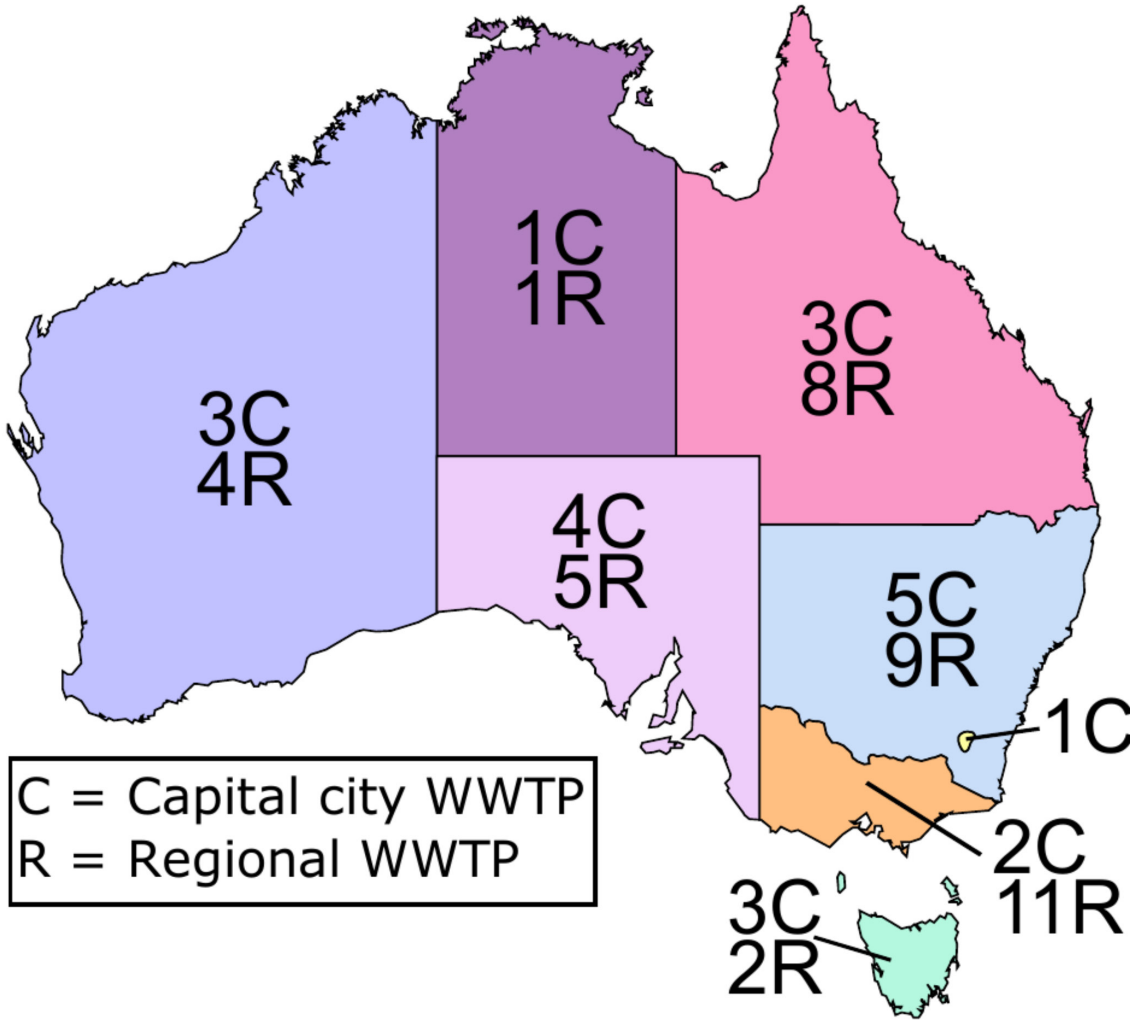


Table 8: Number of participating WWTPs for the periods covered in this report. One collection period aims to collect data from both capital city (C) and regional (R) sites, while the other collection period aims to collect data from capital city sites only.

State/territory	Aug 2023 Capital	Aug 2023 Regional	Oct 2023 Capital
ACT	1	0	1
NSW	5	9	3
NT	1	1	1
Qld	3	8	3
SA	4	5	4
Tas	3	2	3
Vic	2	11	2
WA	3	4	3
Sites	**22**	**40**	**20**
Population (millions) C & R	**12.4**	**2.1**	**12.1**
% of Australian population	**48.9**	**8.1**	**47.6**
Total population (millions)		**14.5**	**12.1**
% of Australian population		**57.0**	**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 feasible, across as many consecutive days as possible. Weekend samples in many of the Tasmanian sites were not available. Small revisions may be made to historical data when more accurate data become available, for example, when updated flow measurements supplied by wastewater treatment authorities or population estimates become 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).

3.3 PRESENTATION OF DATA AND INTERPRETATION OF GRAPHS

Reported averages: All averages for state/territory or Australia-wide drug consumption data 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 number, 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 are presented as doses per day per 1,000 people, in addition to the mg per day per 1,000 people, similar to other drugs included in the report. This has to be considered when referring to historical reports where results were shown only as daily mass load consumed per 1,000, and the calculation of cannabis used a different excretion rate which was revised in Report 19. From Report 19 all current and historical data have been revised and are comparable within the report. Bubble maps are included to represent the relative extent of consumption in capital city and regional areas for each jurisdiction. See Figure 7 for descriptions on how to interpret bubble maps.

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)[4] 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 of each analyte of interest is included in Appendix 3.

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

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 in the current report. 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-based epidemiology studies indicate that some substances such as cocaine, MDMA and alcohol have high variation in weekly consumption rates, with higher consumption on weekends. Other drugs such as methylamphetamine, oxycodone and fentanyl tend to have lower daily variation, suggesting that their consumption is consistent throughout the week (Lai et al. 2015, Tscharke et al. 2016).

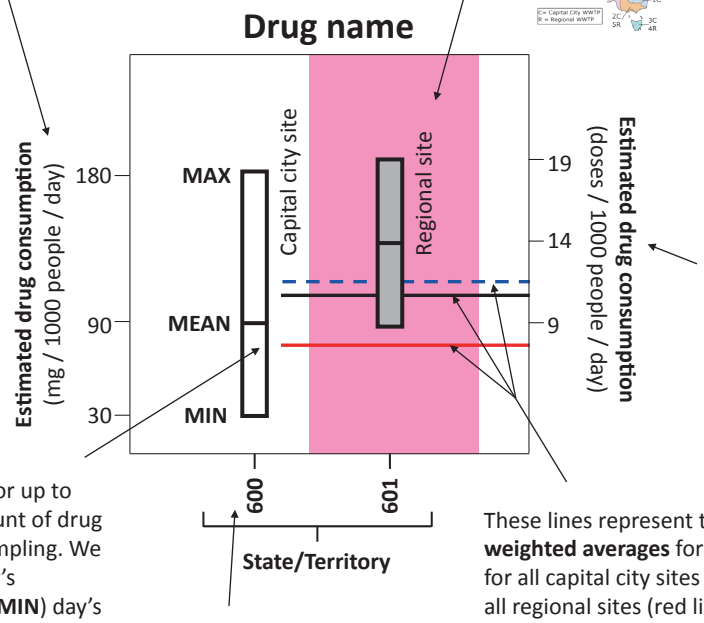
Figure 6: Explanation of the graphs used for individual sites. General concepts relevant to all graphs in the report are also outlined (unique site codes, explanation of vertical axes, colour coding).

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).

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 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.

Colours help identify the State or Territory that the data relates to (colours are consistent between Figures).



Unique number allocated to each WWTP to maintain confidentiality. WWTP names will not be disclosed publicly.

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 one day, the maximum was 19 and average was 14 per day over the sampling period (for every 1,000 people).

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 within 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.

Figure 7: Explanation of the bubble maps. General concepts relevant to all graphs in the report are also outlined.

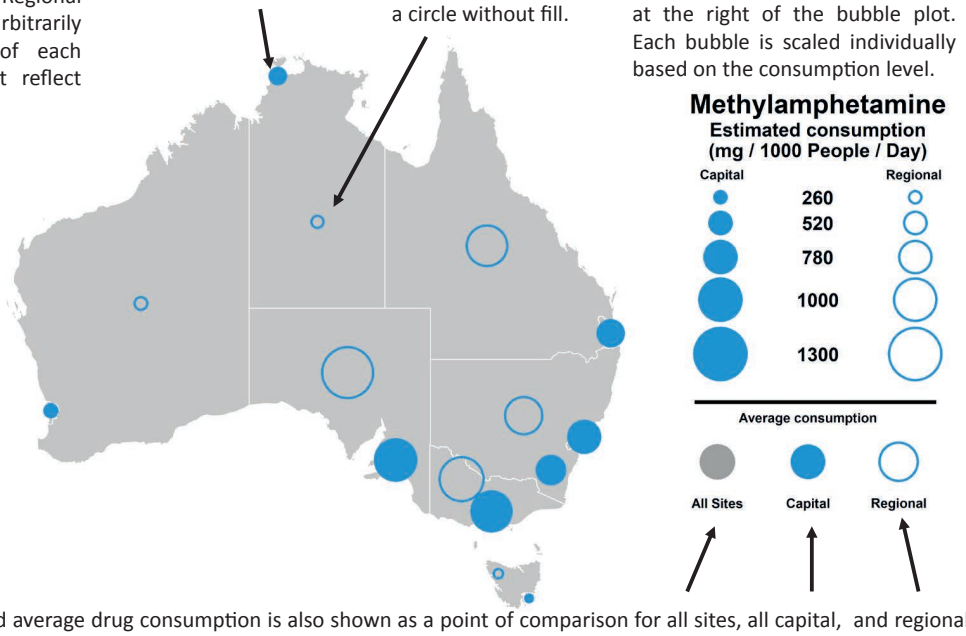
Bubbles:
Capital city site averages are drawn over the capital city of a jurisdiction and the regional site averages are drawn in the middle of the State or Territory. Regional bubbles are drawn arbitrarily close to the centre of each jurisdiction and do not reflect location of sites.

This type of plot gives a rough overview of drug consumption per jurisdiction. The other temporal and spatial comparison graphs give greater resolution to compare between locations and over time, and should be used for analysis.

Capital city average:
Population-weighted average of all capital sites tested per jurisdiction. Capital sites are indicated by a filled circle.

Regional city average:
Population-weighted average of all regional sites tested per jurisdiction. Regional sites are indicated by a circle without fill.

Legend:
The population-weighted average drug consumption for each jurisdiction is represented as a scaled circle. Representative consumption estimates are shown at the right of the bubble plot. Each bubble is scaled individually based on the consumption level.



Aggregated data:
The population-weighted average drug consumption is also shown as a point of comparison for all sites, all capital, and regional sites that were tested within the timepoint. This incorporates sites from **all jurisdictions** for the timepoint under investigation. These are also represented with sizes representing the scale of use categories used for the jurisdictional averages.

4: RESULTS

Estimated drug consumption data are presented in different ways in the following sections to allow comparisons of drug consumption at the individual site level (section 4.1), temporal trends for states and territories for the past 2 years (section 4.2) and within each state and territory (section 4.3). August 2023 data were used for section 4.1, which compares the individual sites as it included the latest set of results for the full suite of sites included in the Program. We recommend exercising caution when comparing results between sites as some plants provided samples for fewer days than others. It is not always possible to coordinate collection on 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 when broader comparisons at the state/territory or international level are undertaken. The uncertainties in population numbers may be particularly evident in smaller regional communities or sites where short-term population changes occur due to employment opportunities, tourism, or festival events.

4.1 INDIVIDUAL SITE COMPARISON OF DRUG USE IN AUGUST 2023

4.1.1 NICOTINE AND ALCOHOL

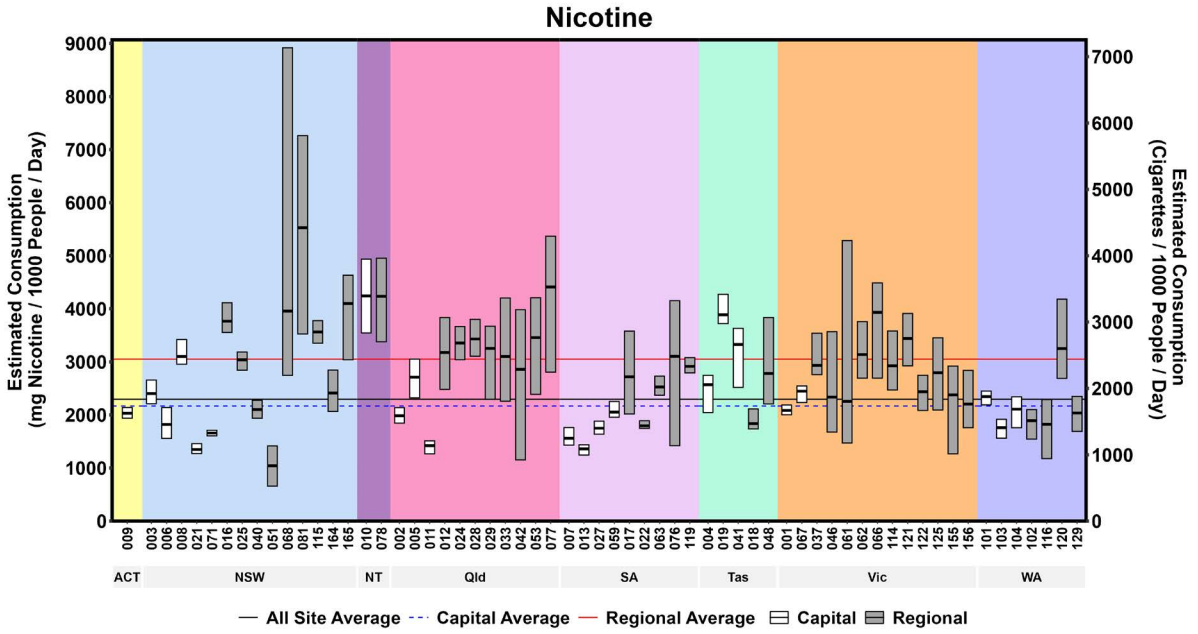
Nicotine is the main psychoactive substance present in tobacco leaves, some vaping products and treatments aimed at discouraging smoking behaviour. Two nicotine metabolites, cotinine and hydroxycotinine, were used to estimate the consumption of nicotine. The estimate is expressed as nicotine in this report as the method cannot distinguish between nicotine intake from tobacco, electronic cigarettes and nicotine replacement therapies such as patches and gums.

From a national perspective, Figure 8 shows the average nicotine consumption was higher in regional areas compared to capital cities (red horizontal and blue dotted lines, respectively). The highest consumption of nicotine was observed at sites in regional New South Wales.

The specific marker of ethanol consumption, ethyl sulphate, was used to determine the scale of alcohol use across the country. Collectively, regional average consumption of alcohol was slightly higher than the capital average (Figure 9). Sites in regional Queensland had among the highest and lowest consumption estimates of the regional sites.

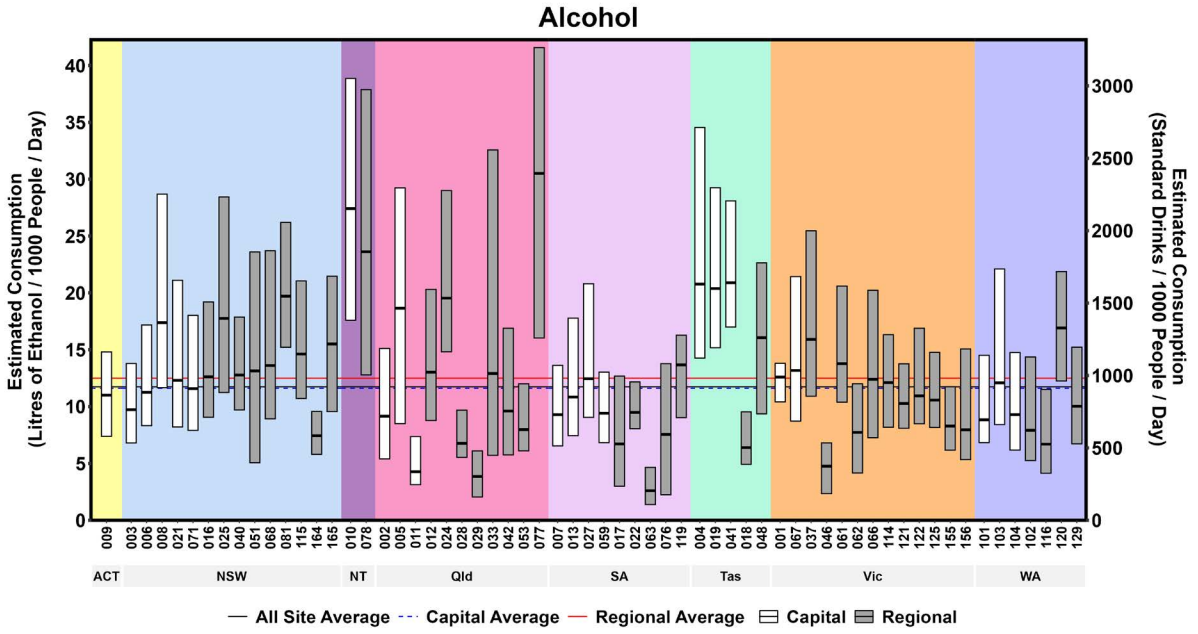
Geographic patterns of nicotine (Figure 10) and alcohol (Figure 11) consumption can be represented as scaled ‘bubbles’ for the capital city and regional areas within each state and territory. The Northern Territory had the highest nicotine and alcohol consumption in Australia in August 2023.

Figure 8: Estimated nicotine consumption for August 2023 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 varied from 5 to 7.



- High consumption in regional areas
- Large difference between sites

Figure 9: Estimated alcohol consumption for August 2023 in litres consumed per day (left axis) and standard drinks per day (right axis) per thousand people. The number of collection days varied from 5 to 7.



- Higher regional average
- Darwin the highest of state capitals

Figure 10: Estimated average nicotine consumption per jurisdiction for August 2023 in number of cigarettes per day per thousand people. The number of collection days varied from 5 to 7.

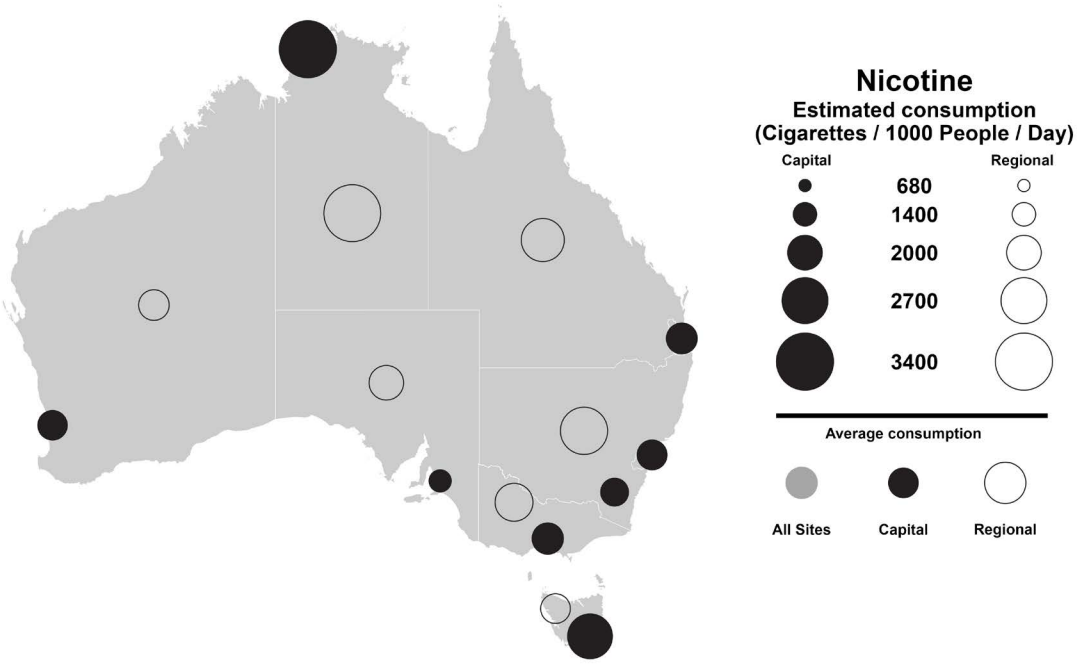
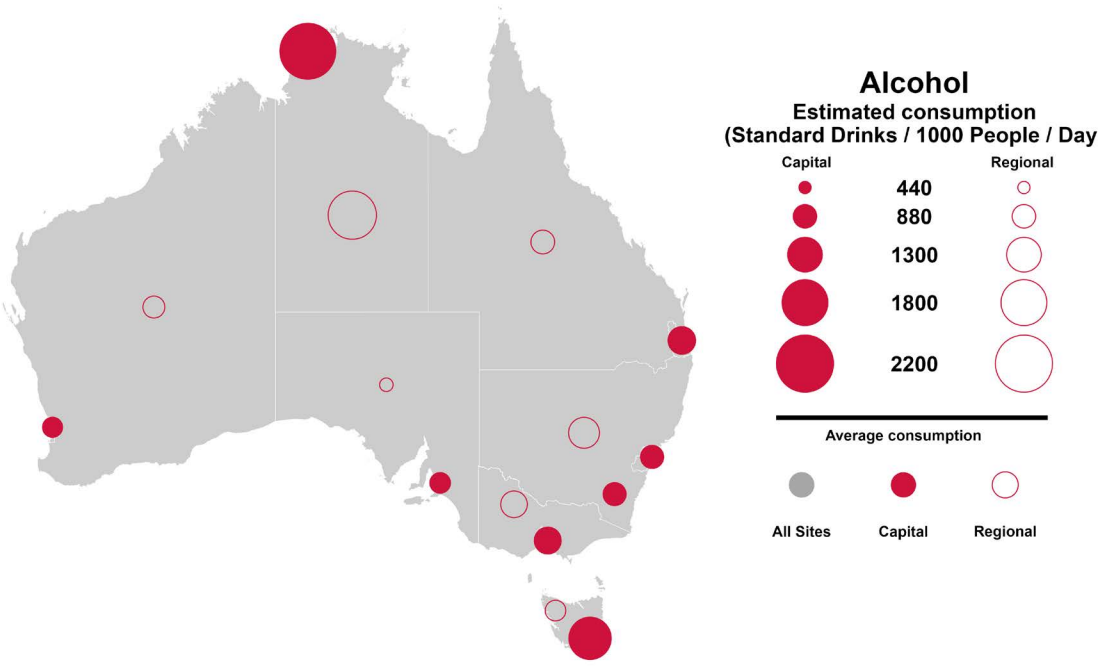


Figure 11: Estimated average alcohol consumption per jurisdiction for August 2023 in number of standard drinks per day per thousand people. The number of collection days varied from 5 to 7.



4.1.2 STIMULANTS

4.1.2.1 METHYLAMPHETAMINE

Nationally, average methylamphetamine consumption was higher in regional areas compared to capital cities (Figure 12). A regional site in New South Wales had the highest mean consumption, with similar mean consumption levels also seen at a regional site in Queensland, Victoria and Western Australia. Of the capital cities, sites in Adelaide had the highest mean consumption. There was considerable variation in methylamphetamine consumption within and between jurisdictions in August 2023.

4.1.2.2 AMPHETAMINE

The measured concentration of amphetamine in the August 2023 samples 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, the drug is also prescribed for some behavioural disorders and the method cannot differentiate between medical and illicit use. The high levels of methylamphetamine in most parts of the country means a firm conclusion is not possible.

4.1.2.3 COCAINE

Benzoylecgonine, the specific metabolite of cocaine, was used to estimate the consumption of the stimulant (Figure 13). Overall, the average consumption of cocaine was higher in capital cities compared to regional areas. Large variation in cocaine consumption was observed in both capital city and regional sites across the country, in particular New South Wales. A site in Sydney had the highest mean cocaine consumption nationally for August 2023, while sites in regional New South Wales and a site in regional Queensland also reported high cocaine consumption. All sites in South Australia, Western Australia, Tasmania and the Northern Territory reported below average cocaine consumption in August 2023.

4.1.2.4 MDMA (3,4-METHYLENEDIOXYMETHYLAMPHETAMINE)

The average consumption of MDMA in Australia was much lower than methylamphetamine and cocaine (Figure 14). The regional average consumption of MDMA was higher than the capital city average in August 2023. A site in Hobart had the highest mean MDMA consumption in the country, with the same site also displaying a large difference in consumption over the collection period.

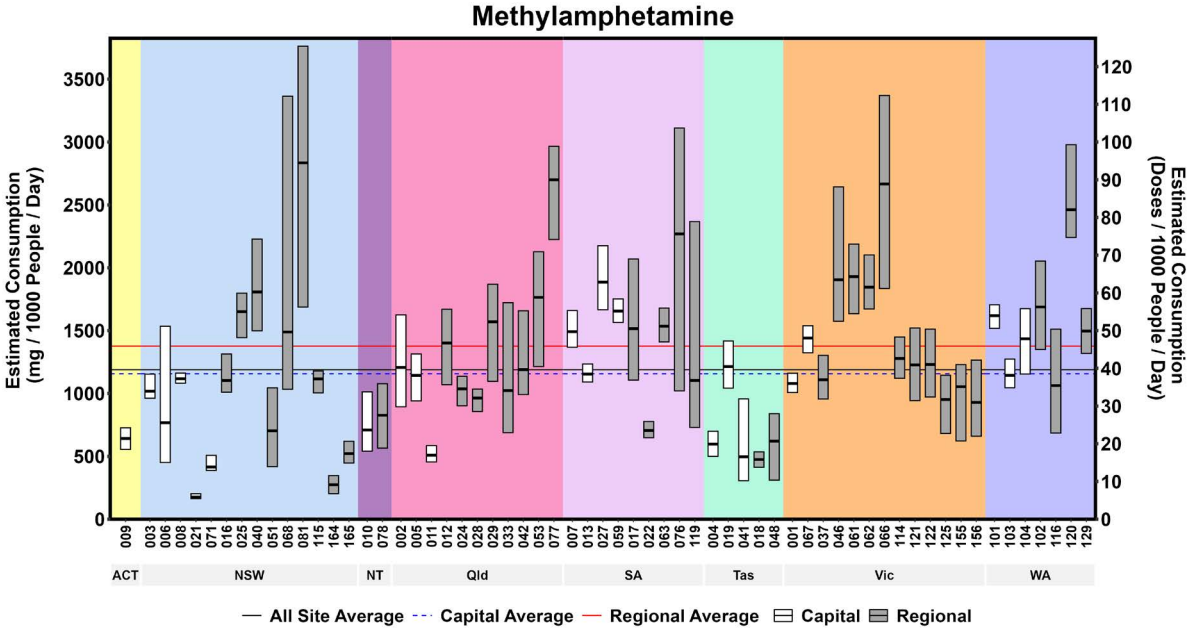
4.1.2.5 MDA (3,4-METHYLENEDIOXYAMPHETAMINE)

In contrast to the preceding drugs, the results for MDA are expressed as excreted amounts (Figure 15). Nationally, the average MDA excretion for capital city and regional areas was virtually identical. Sites in regional Western Australia and South Australia had excretion estimates well-above the national regional average. Sites in Perth, Hobart, Sydney and Darwin, were amongst the highest in terms of MDA excretion in the capital cities.

Geographic patterns were expressed as a bubble map to compare average regional and capital city consumption of methylamphetamine (Figure 16), cocaine (Figure 17), MDMA (Figure 18) and MDA (Figure 19). The highest average methylamphetamine consumption occurred in regional Western Australia. Smaller bubbles for the territories and Tasmania were evident for methylamphetamine,

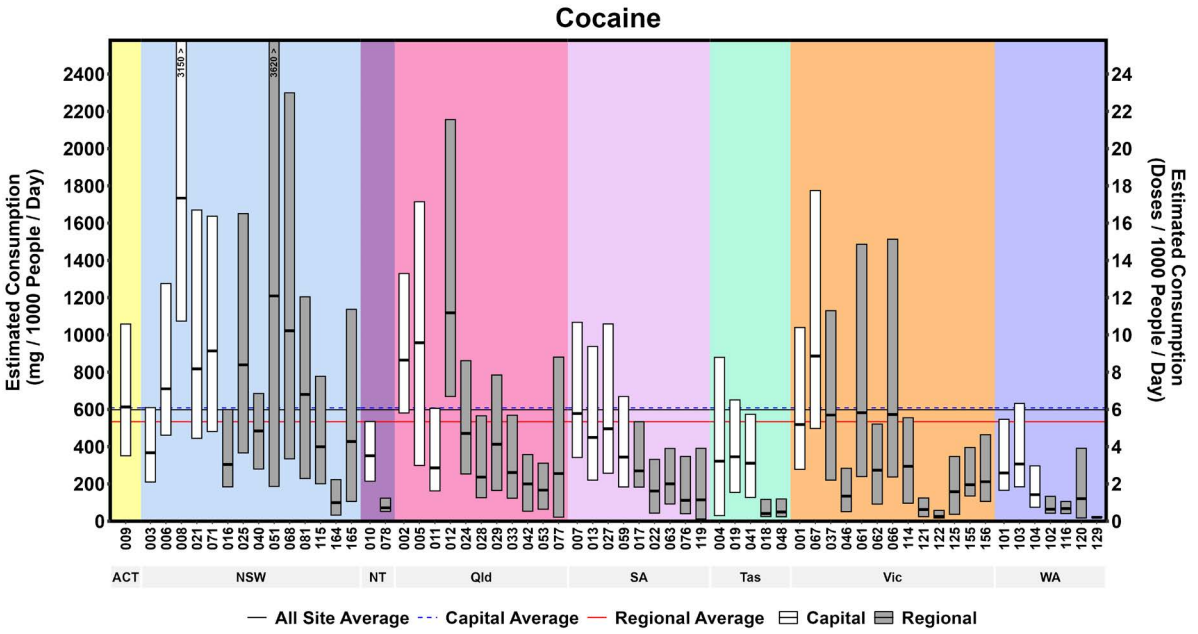
as well as slightly larger bubbles in regional jurisdictions. Cocaine use was generally highest in the eastern parts of mainland Australia, particularly Queensland, New South Wales, the Australian Capital Territory and Victoria. MDMA featured prominently in Hobart and Darwin sites. MDA use was centred more in Western Australia, regional South Australia, Darwin and Hobart.

Figure 12: Estimated methylamphetamine consumption for August 2023 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5 to 7.



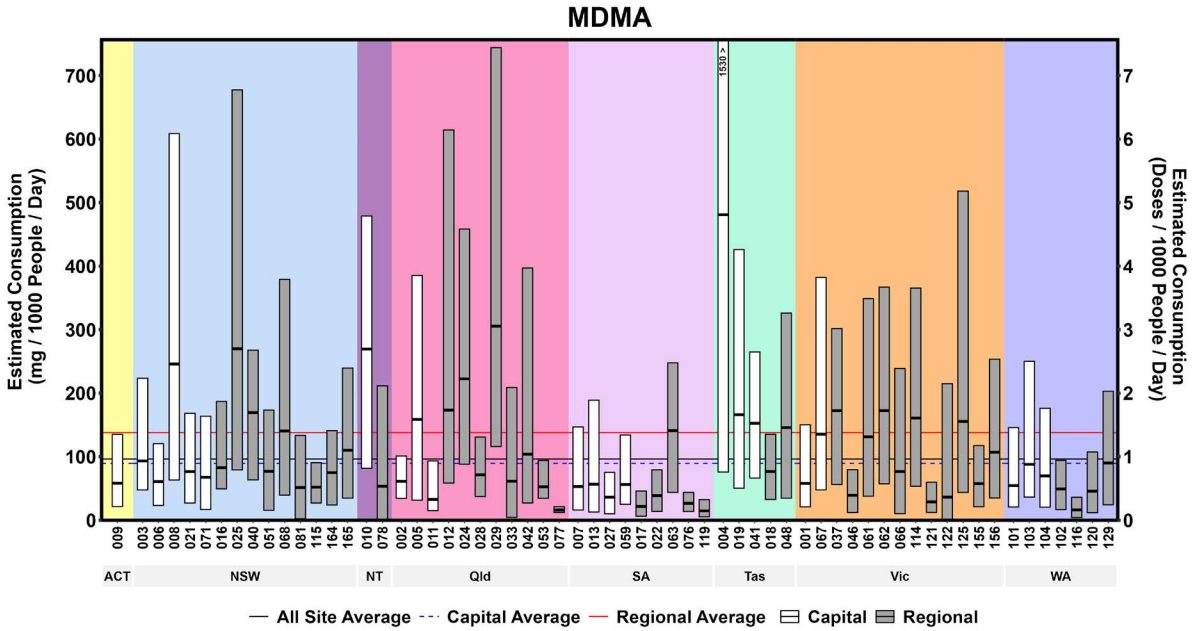
- Higher regional average consumption
- Substantial difference between sites

Figure 13: Estimated cocaine consumption for August 2023 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5 to 7. Text describing the extreme values shown above the graph are based on the left y axis.



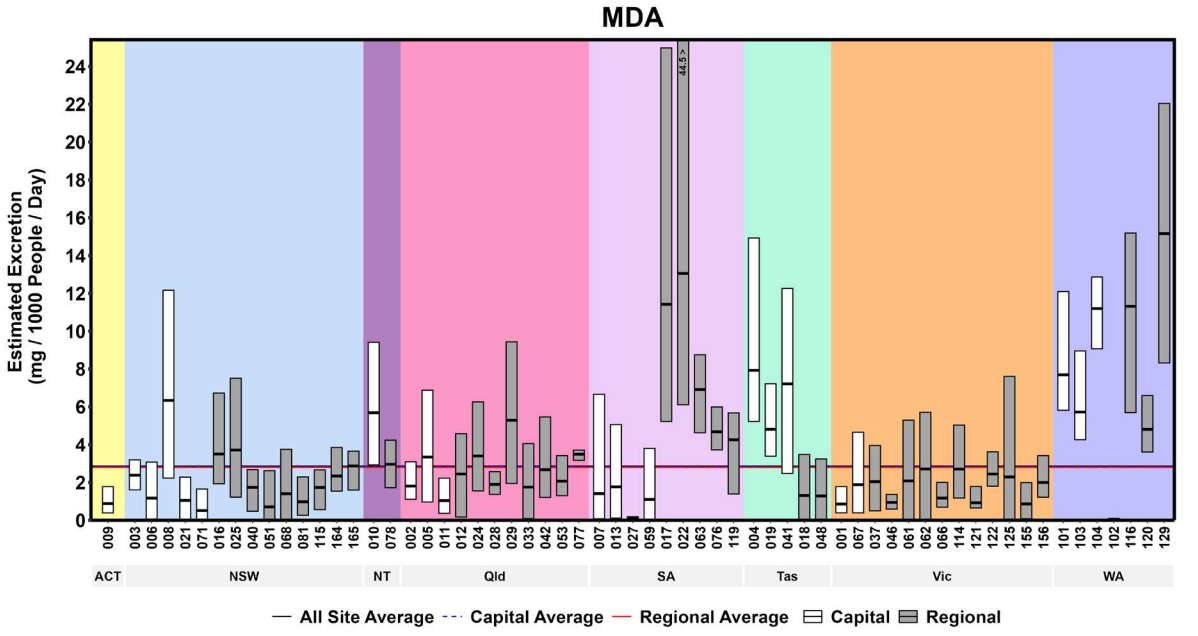
- Higher capital city consumption
- Longer bars represent larger difference between days of the week

Figure 14: Estimated MDMA consumption for August 2023 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5 to 7. Text describing the extreme values shown above the graph are based on the left y axis.



- Higher regional average consumption
- Longer bars represent larger difference between days of the week

Figure 15: Estimated MDA excretion for August 2023 in mass excreted per day per thousand people. The number of collection days varied from 5 to 7. Text describing the extreme values shown above the graph are based on the left y axis.



- Similar regional and capital city average excretion
- High excretion levels in regional sites in South Australia and Western Australia

Figure 16: Estimated average methylamphetamine consumption per jurisdiction for August 2023 in mg consumed per day per thousand people. The number of collection days varied from 5 to 7.

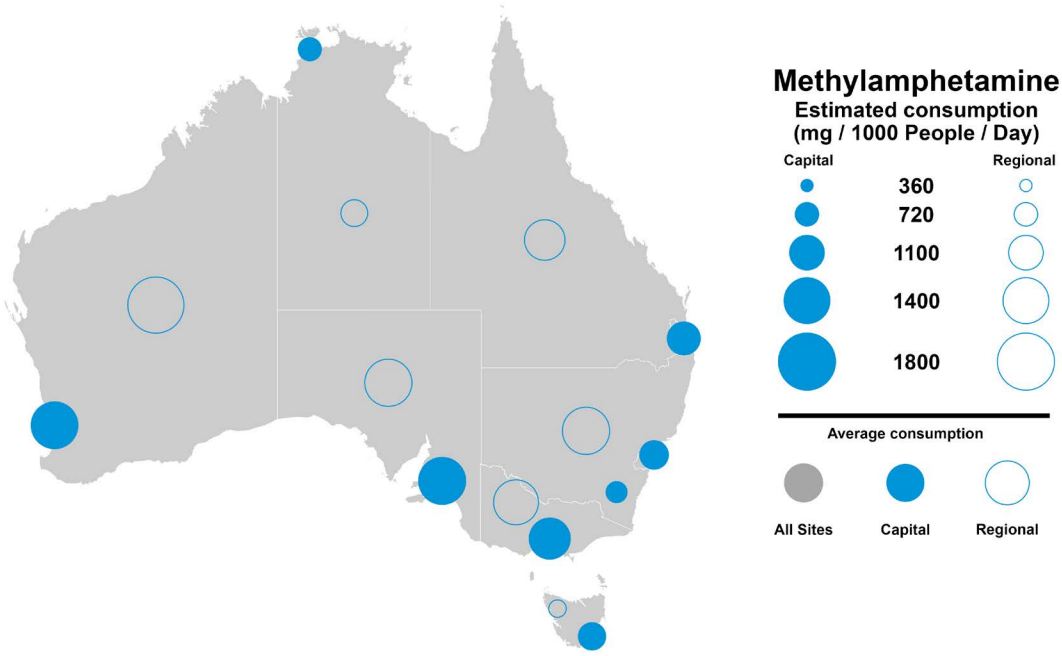


Figure 17: Estimated average cocaine consumption per jurisdiction for August 2023 in mg consumed per day per thousand people. The number of collection days varied from 5 to 7.

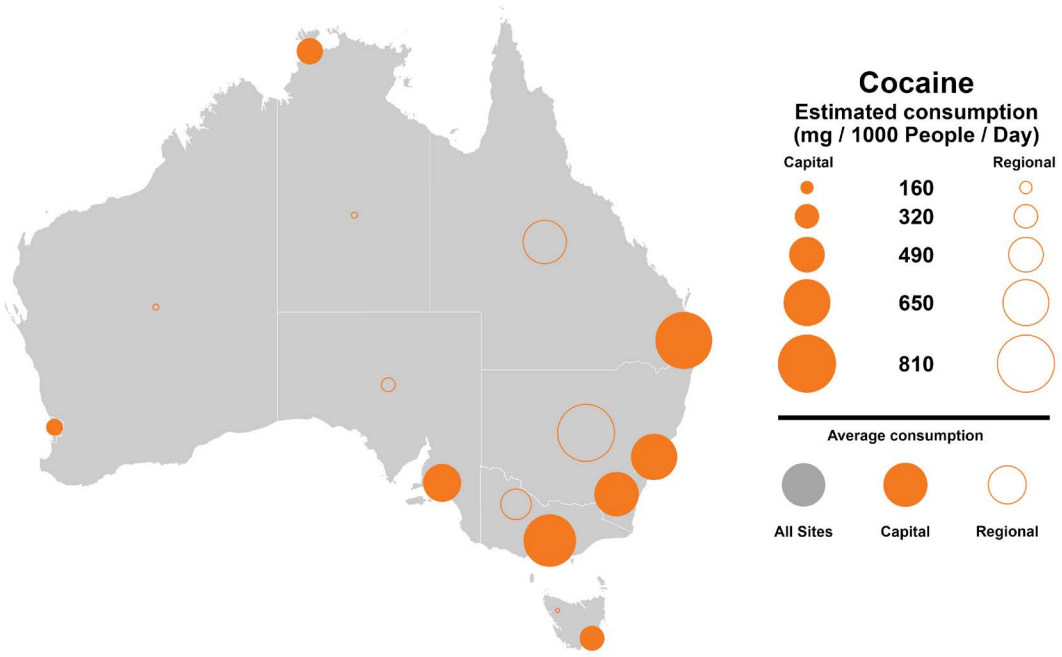


Figure 18: Estimated average MDMA consumption per jurisdiction for August 2023 in mg consumed per day per thousand people. The number of collection days varied from 5 to 7.

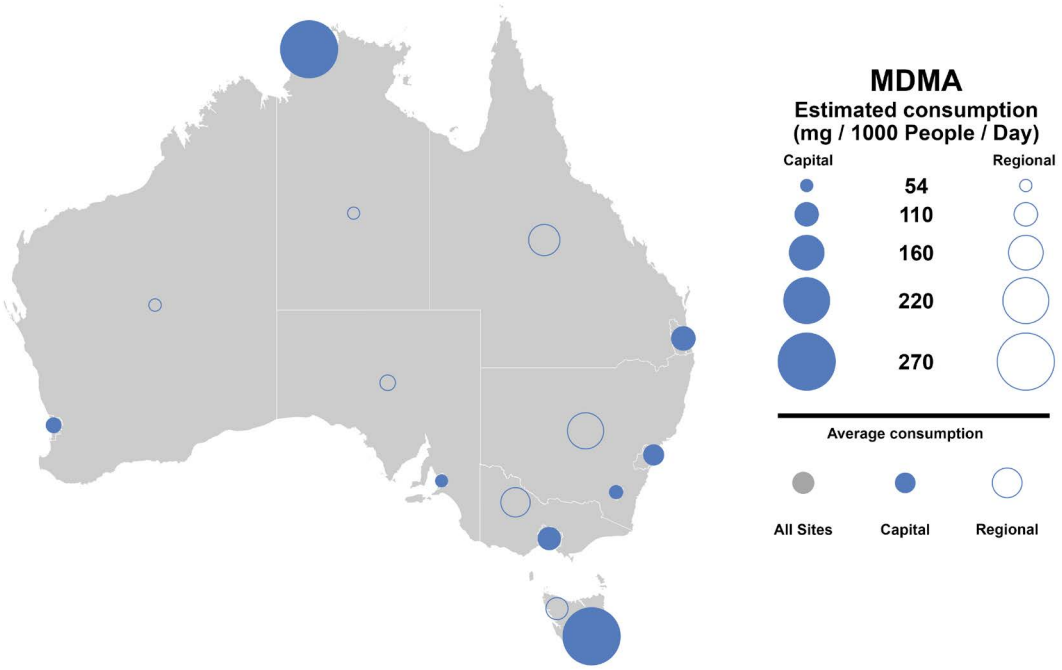
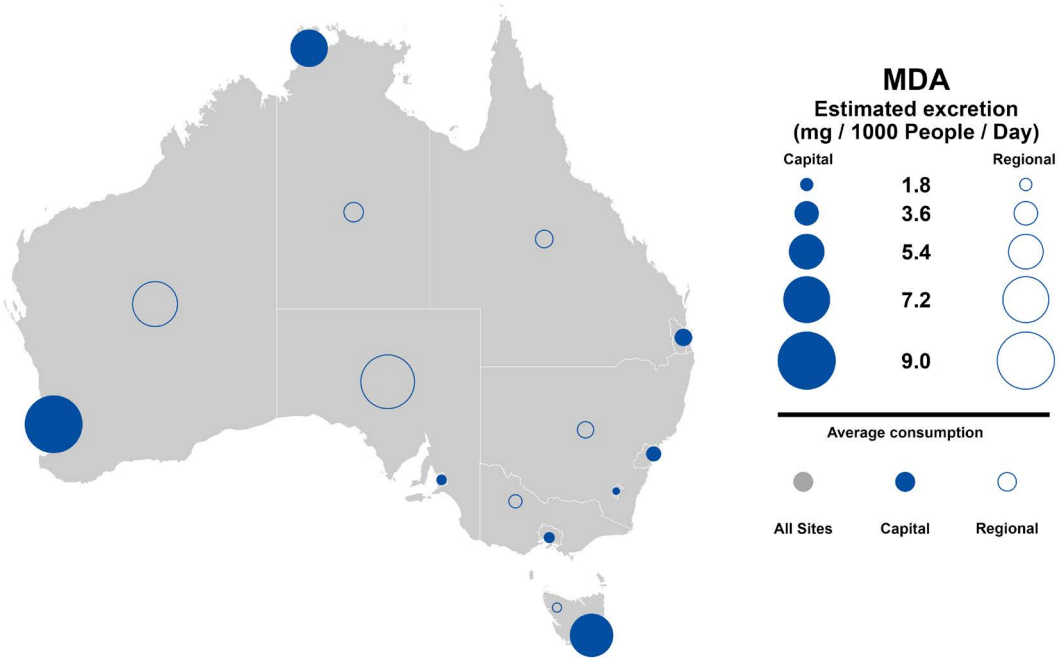


Figure 19: Estimated average MDA excretion per jurisdiction for August 2023 in mg excreted per day per thousand people. The number of collection days varied from 5 to 7.



4.1.3 OPIOIDS

Two prescription opioids are included in the report, as well as heroin, an illicit drug. Oxycodone and fentanyl are legally prescribed pharmaceuticals to alleviate pain. Although wastewater analysis cannot differentiate between prescribed use and consumption for non-medical purposes, these substances remain of interest due to their abuse potential.

4.1.3.1 PHARMACEUTICAL OPIOIDS

The metabolism and excretion profiles of oxycodone and fentanyl are well established. The main metabolites (noroxycodone and norfentanyl) were measured to estimate their consumption.

Consumption of oxycodone in the August 2023 collection week is shown in Figure 20. As indicated by the higher red horizontal line, the average consumption of oxycodone was higher in regional areas compared to capital cities. The highest average consumption was observed at a regional site in South Australia. Several sites had noticeably lower consumption estimates, well below the capital city average, the lowest at a site in Sydney, followed by a site in Brisbane.

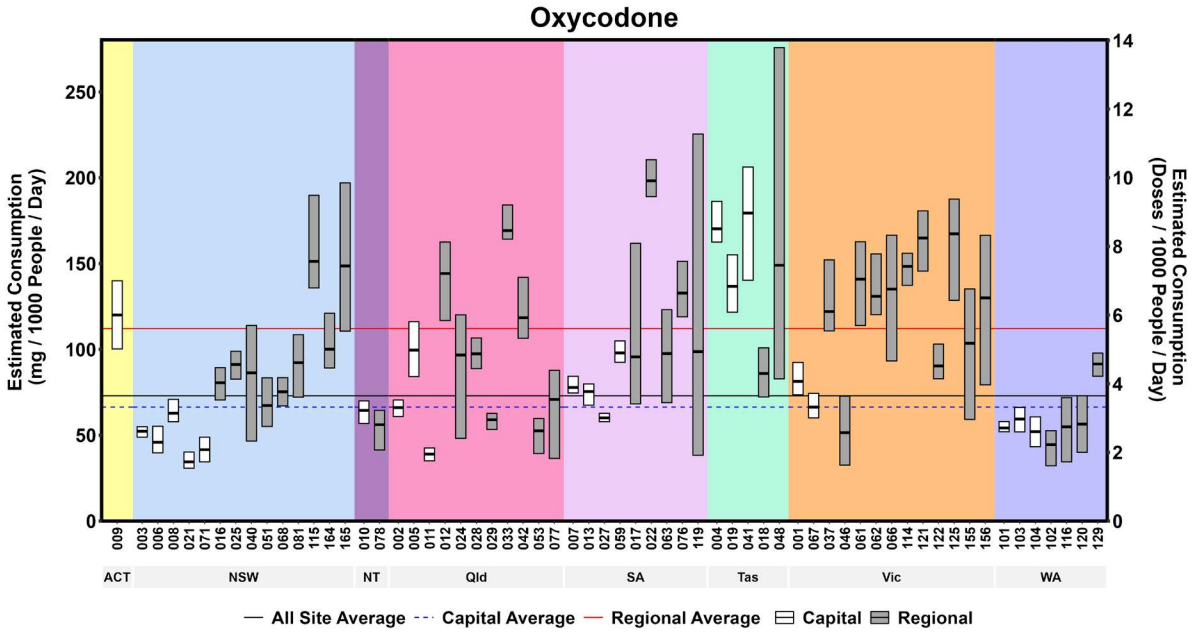
Fentanyl consumption showed a similar pattern, with a higher regional average compared to the capital cities (Figure 21). A site in regional New South Wales had remarkably high consumption with respect to other sites in August 2023, meanwhile sites in Hobart had the highest capital city consumption. Fentanyl levels fell below quantification limits in some sites, mostly in regional catchments, but also sites in Darwin, Sydney and Brisbane.

The geographic scale of consumption patterns for oxycodone and fentanyl are shown as bubble maps in Figure 22 and Figure 23, respectively. The pattern of pharmaceutical opioid consumption is similar for both substances, with regional areas spanning the south-eastern part of the country showing the highest levels. It is evident that capital city Tasmania represents the highest consumption for both oxycodone and fentanyl nationally.

4.1.3.2 HEROIN

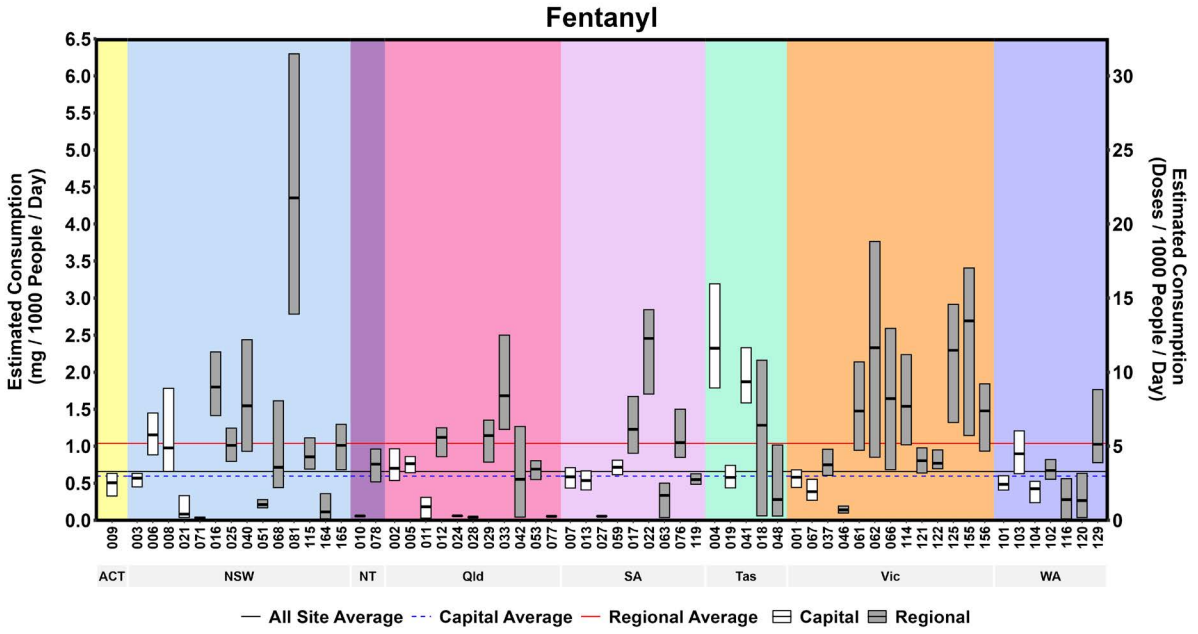
The heroin marker, 6-monoacetylmorphine (6-MAM), was used to determine consumption of the drug. Since the compound is characteristic of heroin metabolism, it can be used to distinguish heroin from other opioids such as morphine and codeine. (Figure 24). Nationally, regional consumption patterns for heroin are remarkably low compared to the national capital city averages. An exception is Site 46 in regional Victoria, which had the highest heroin consumption in the country in August 2023. Above average heroin consumption was reported in sites in Canberra, Sydney, Brisbane and Melbourne, as well as regional sites in New South Wales and Victoria. These consumption patterns are consistent with the bubble map shown in Figure 25.

Figure 20: Estimated oxycodone consumption for August 2023 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5 to 7.



- Higher regional average consumption
- Hobart highest capital city consumption

Figure 21: Estimated fentanyl consumption for August 2023 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5 to 7.



- Higher regional average consumption
- Consumption levels below quantification limits in some sites

Figure 22: Estimated average oxycodone consumption per jurisdiction for August 2023 in mg consumed per day per thousand people. The number of collection days varied from 5 to 7.

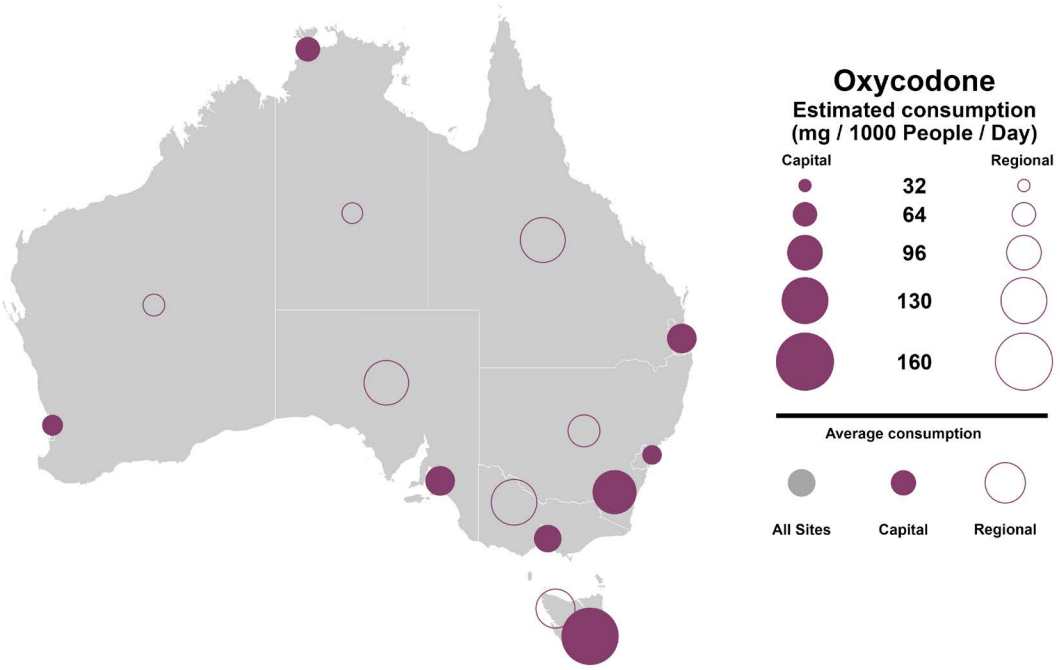


Figure 23: Estimated average fentanyl consumption per jurisdiction for August 2023 in mg consumed per day per thousand people. The number of collection days varied from 5 to 7.

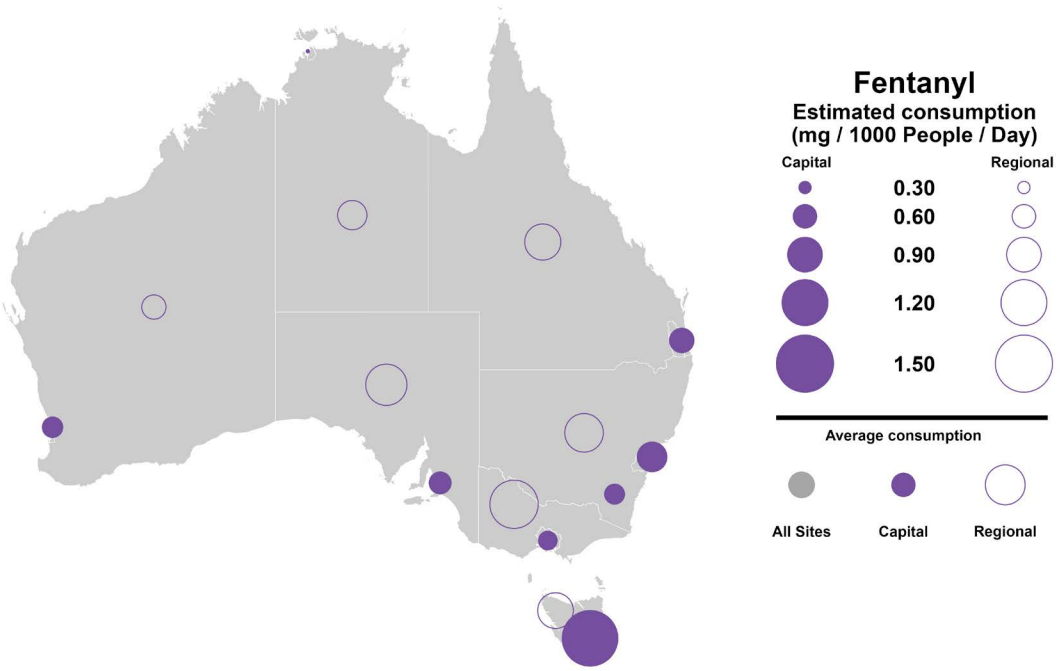
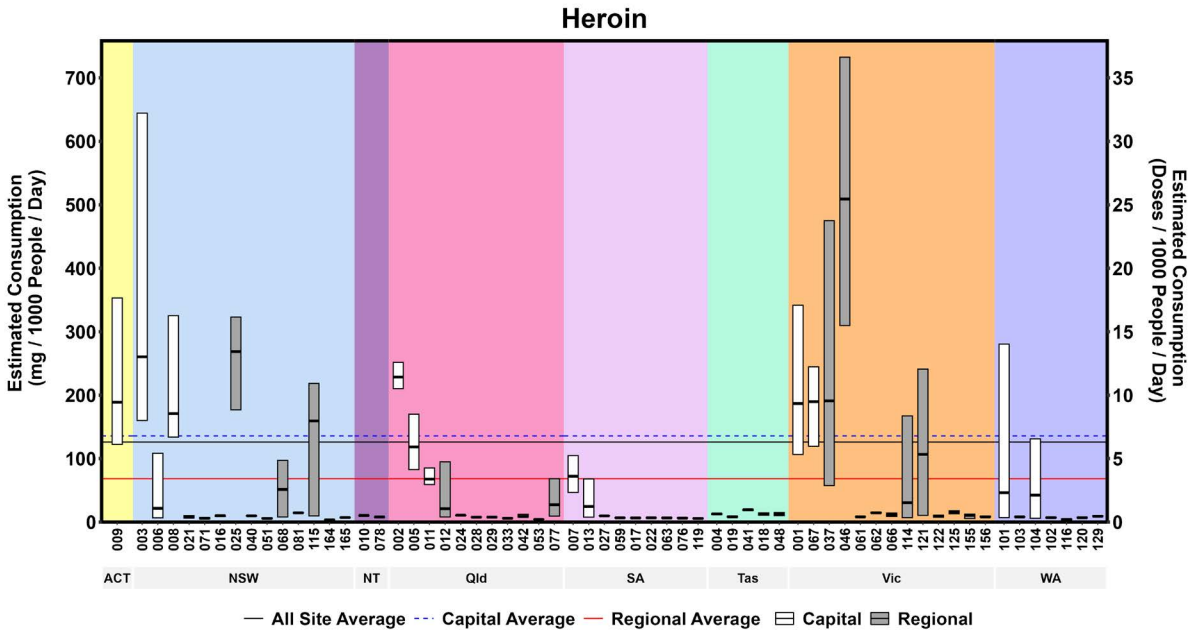
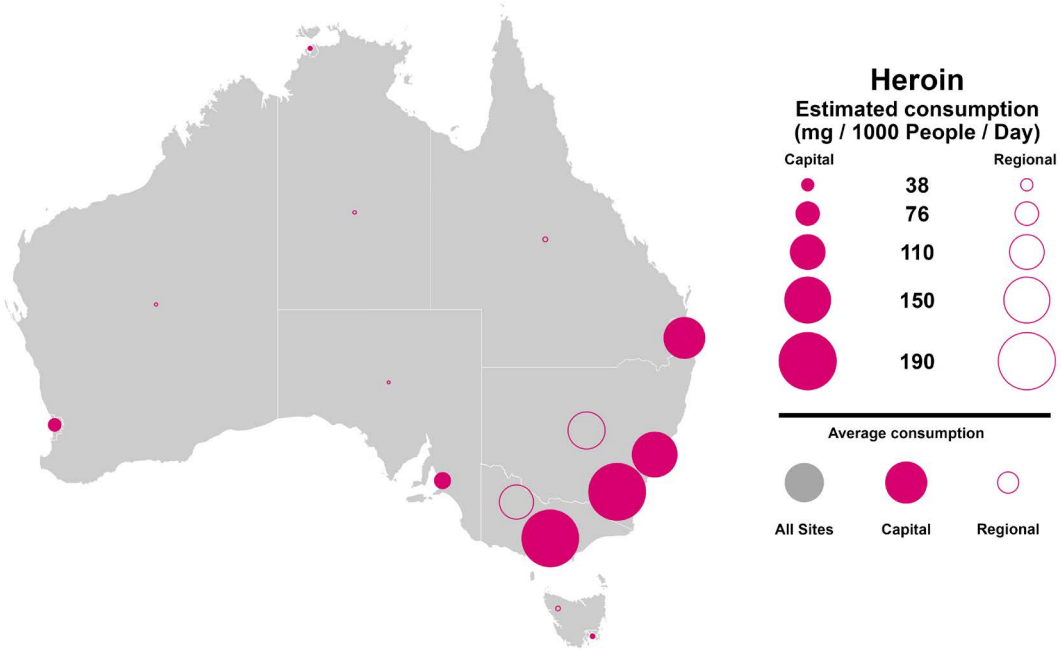


Figure 24: Estimated heroin consumption for August 2023 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5 to 7.



- Low regional consumption, often too low to detect
- High consumption in sites in Victoria and New South Wales

Figure 25: Estimated average heroin consumption per jurisdiction for August 2023 in mg consumed per day per thousand people. The number of collection days varied from 5 to 7.



4.1.4 CANNABIS

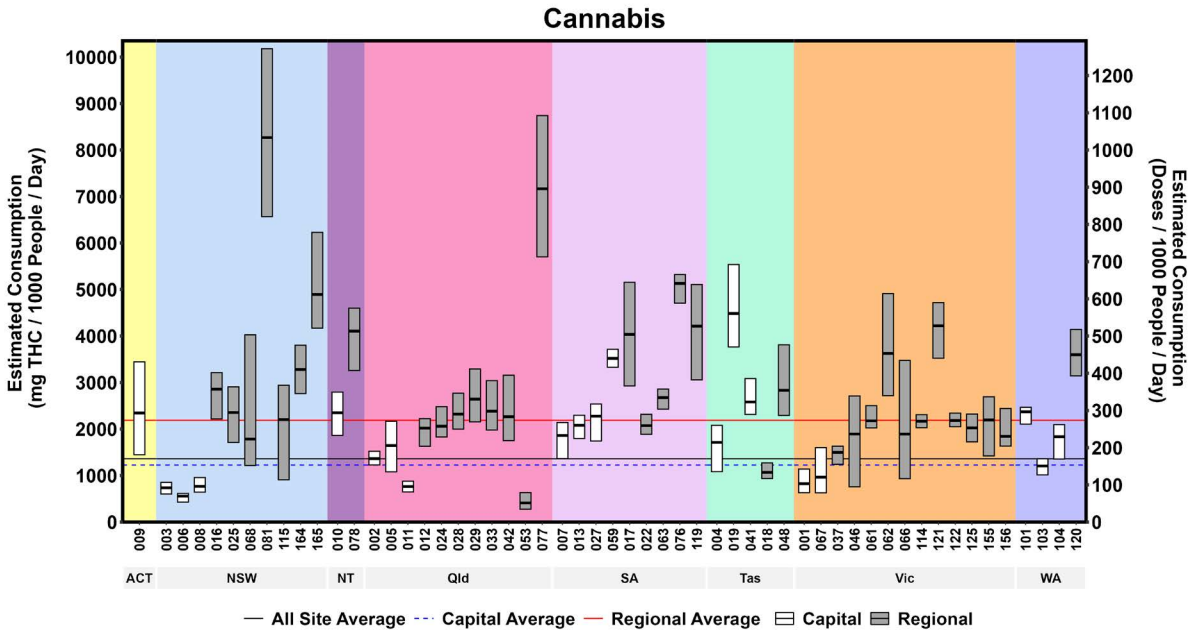
Tetrahydrocannabinol (THC) is the main psychoactive compound found in cannabis. The compound is metabolised and mostly cleared through the gastrointestinal tract. A small proportion is excreted through the kidneys as 11-nor-9-carboxy-tetrahydrocannabinol (THC-COOH). The latter is known to adsorb to various surfaces, including sewer infrastructure and particulates suspended in the wastewater (e.g. Pandopulos et al. 2022 and Campos-Manas et al. 2022). Therefore, in terms of wastewater analysis, the sewer design and collection method may play a part in the reportable levels of the target metabolite used for the purposes of the NWDMP. Accordingly, any spatial comparisons should be made with caution. Upon collection, samples require preservation to avoid degradation of THC-COOH, without using acidification (McCall et al. 2016). This is one reason why cannabis consumption is not reported on a regular basis in other countries where wastewater analysis is routinely conducted, as acidification is a common preservation technique.

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 and 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).

The spatial comparison for cannabis consumption in August 2023 is shown in Figure 26. Regional cannabis consumption was substantially higher than in the capital cities. A large range in consumption was observed between sites. All sites in Sydney and Melbourne had relatively low cannabis consumption, with averages well below the capital city average. While sites in New South Wales and Queensland reported the lowest cannabis consumption in the country, they were also the 2 states to report the highest consumption nationally, with the 2 regional sites highest by some margin.

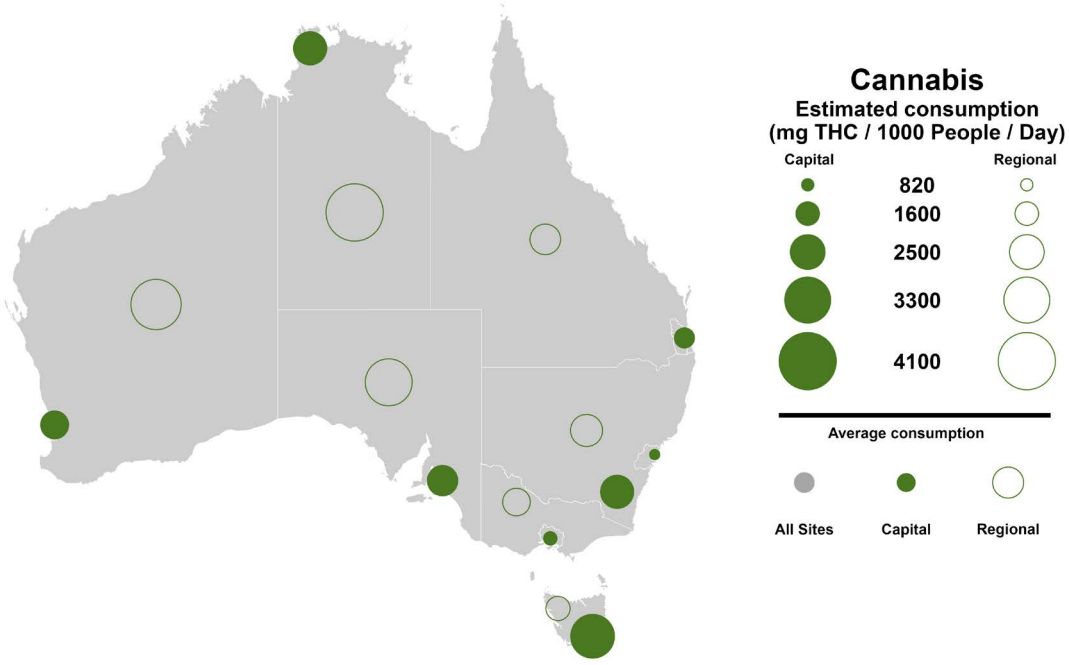
The bubble map reflects the general observation of higher cannabis consumption in regional areas, in particular, of the Northern Territory, Western Australia and South Australia (Figure 27).

Figure 26: Estimated cannabis consumption for August 2023 in mass consumed per day (left axis) and doses per day (right axis). The number of collection days varied from 5 to 7.



- Higher regional consumption
- Variable consumption within jurisdictions and across the country

Figure 27: Estimated average cannabis consumption per jurisdiction for August 2023 in mg consumed per day per thousand people. The number of collection days varied from 5 to 7.

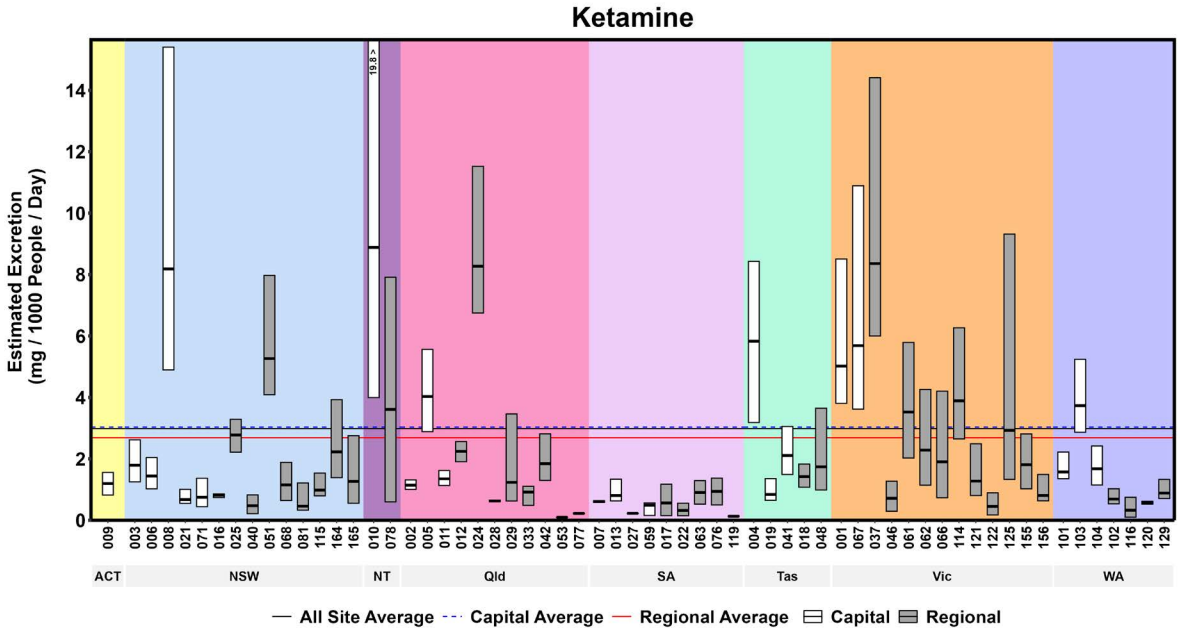


4.1.5 KETAMINE

Ketamine, measured as its metabolite, norketamine, is used medically for the management of acute pain, often associated with surgery or trauma. Ketamine has veterinary applications as well, although this may have less relevance in terms of wastewater monitoring due to the separation of stormwater and agricultural run-off from the sewer network in most Australian catchments. Due to its sedative and hallucinogenic effects, the drug has been associated with illicit substance abuse 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, similar to the case of the stimulant, MDA.

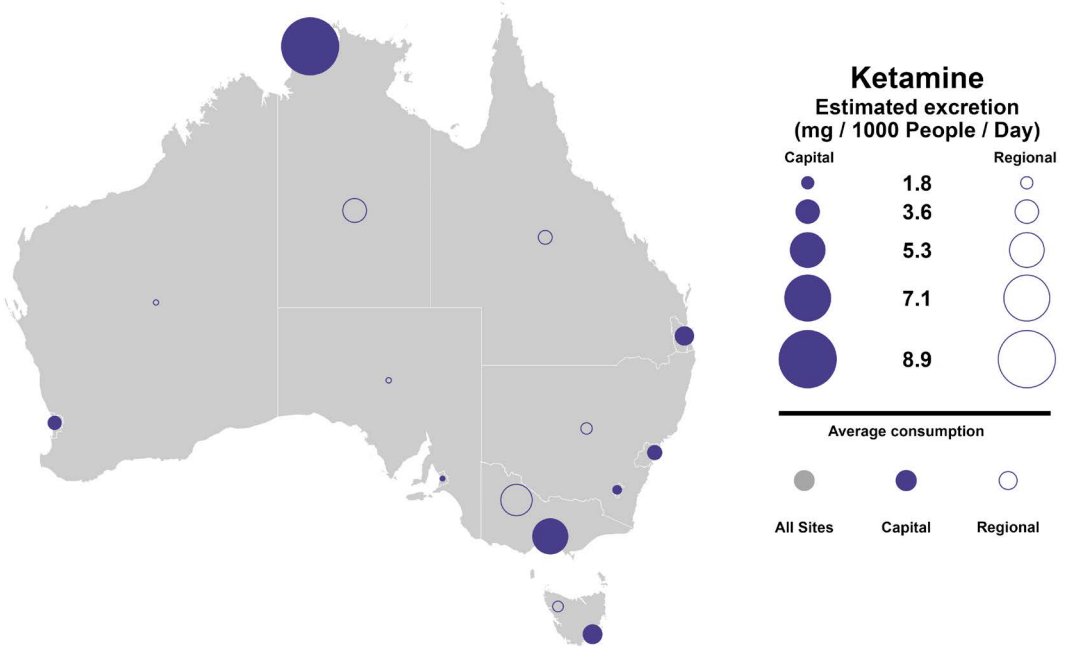
Ketamine excretion in August 2023 was slightly higher across the nation in capital cities compared to regional sites (Figure 28). The site in Darwin had the highest mean excretion nationally. A large daily variation was also apparent at many sites, indicated by longer bars. Many sites in capital and regional areas had excretion levels below the national average. Apart from Canberra and Adelaide, one site in each capital was substantially higher than the others (except Melbourne, where both sites were elevated). It is evident from the bubble map that Darwin was the most prominent site in terms of ketamine excretion in August 2023 (Figure 29).

Figure 28 : Estimated ketamine excretion for August 2023 in mass excreted per day (left axis) per thousand people. The number of collection days varied from 5 to 7. Text describing the extreme values shown above the graph are based on the left y axis.



- Higher capital city excretion
- Low excretion levels in the majority of sites

Figure 29: Estimated average ketamine excretion per jurisdiction for August 2023 in mg excreted per day per thousand people. The number of collection days varied from 5 to 7.



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 August and October 2023 collections, while regional areas were updated for August 2023. This needs to be considered when comparing results between sections 4.1 and 4.2. Ketamine was included in the Program for the first time in Report 13 and so has fewer data points than the other substances.

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 would be most evident for the regional averages, which had more variation in participation between each period, while capital city site participation is much more consistent (see Appendix 2 and Appendix 3, Report 6 and Appendix 2 in this report). 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 temporal graph which represent the averages are the cumulative average across all sampling time points and all samples analysed for each substance. This is different to section 4.1 where the lines represent the averages of August 2023 samples. Updated changes to the graphs relating to this report are the 2 most recent bars consisting of capital cities (August and October 2023) and the single most recent bar for regional areas (August 2023). 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

All sources of nicotine contribute to the measured consumption, including tobacco and nicotine-replacement therapies such as gums, patches, and vapes. The lines across the graphs indicate the cumulative average for all samples back to 2016 when the Program commenced, highlighting the high relative use of nicotine in regional Australia (Figure 30). Compared to the previous reporting period, nicotine consumption remained largely steady, with a few exceptions. An increase was apparent in regional New South Wales and Queensland, while consumption declined in regional Tasmania and Western Australia. Over the past 2 years, consumption has been increasing in Melbourne and Perth. Regional Northern Territory had the highest nicotine consumption in the country.

Alcohol consumption has been declining in several jurisdictions over the past 2 years (Figure 31). Long-term average alcohol consumption is slightly higher in regional Australia compared to the capital cities. This difference is not reflected in all jurisdictions, for example South Australia and Tasmania, where regional alcohol consumption is below that in the capital city. In terms of capital city alcohol consumption, sites in Darwin and Hobart had the highest consumption nationally, while for regional Australia, the Northern Territory and New South Wales were the highest. Alcohol consumption has been consistently low in regional South Australia.

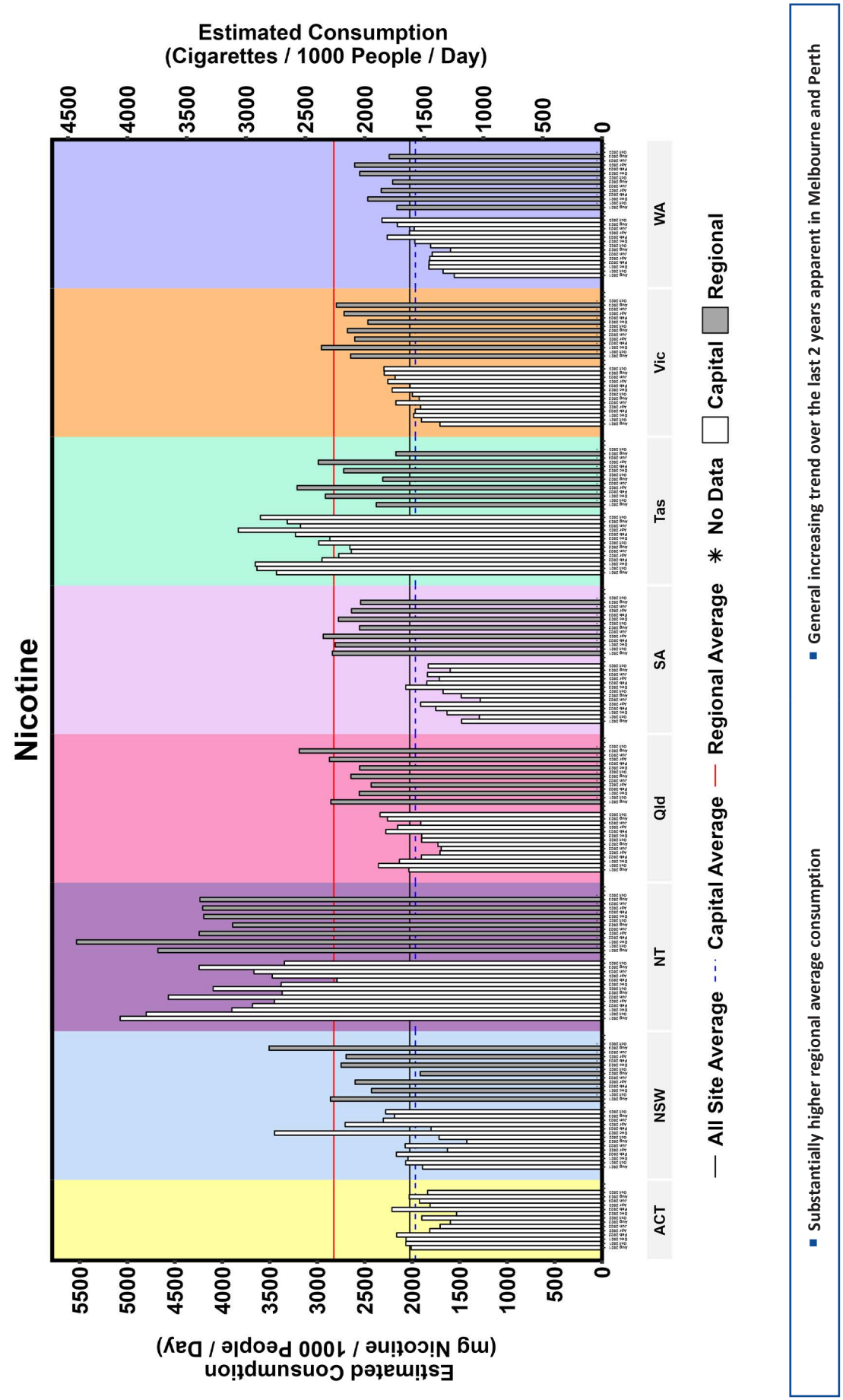


Figure 30: Estimated average consumption of nicotine by state/territory, August 2021 to October 2023, where 1 cigarette provides 1.25 mg of nicotine.

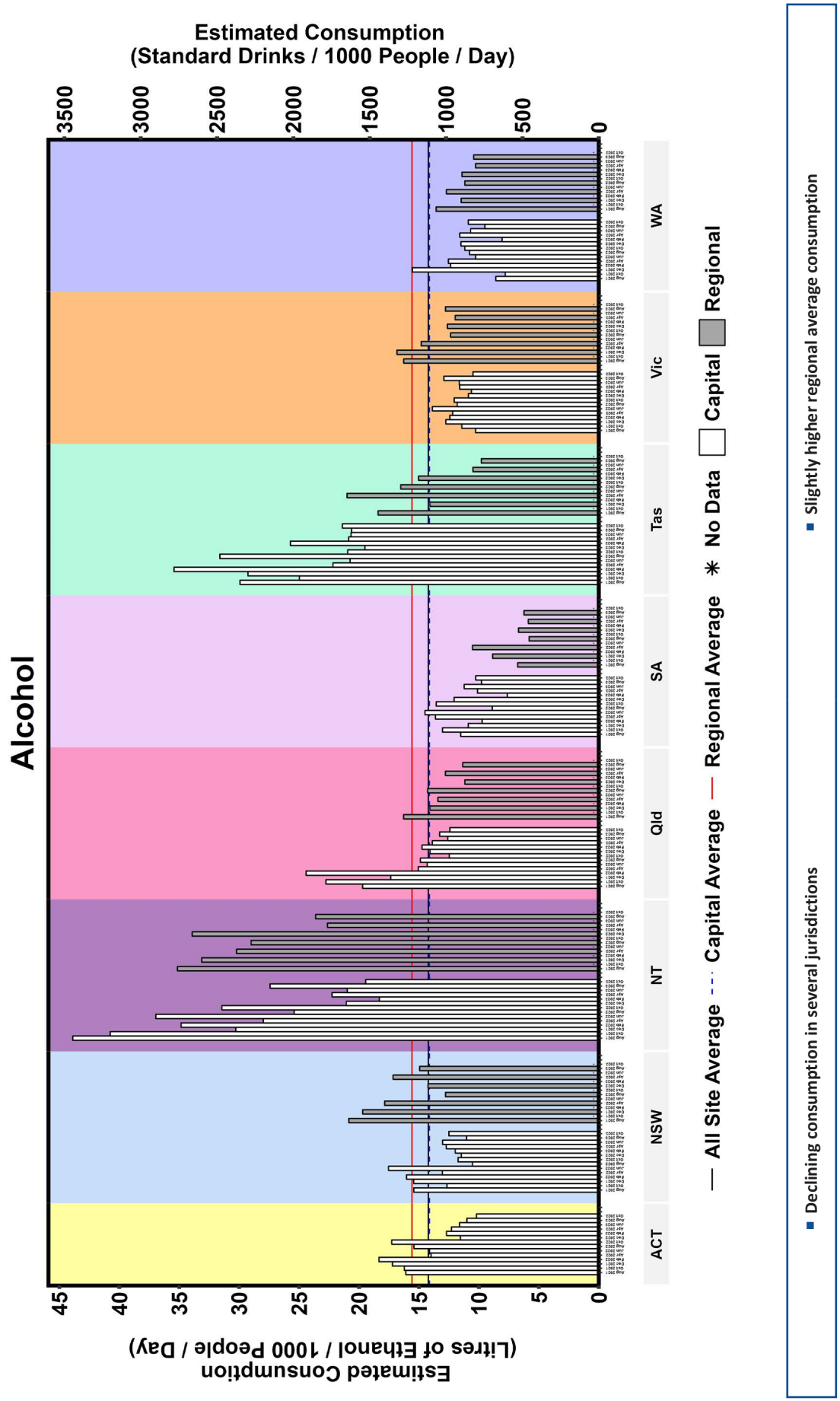


Figure 31: Estimated average consumption of alcohol by state/territory, August 2021 to October 2023. A standard drink is 10.0 g, or 12.6 mL.

4.2.2 STIMULANTS

Temporal changes in the consumption of methylamphetamine are shown in Figure 32. Regional Western Australia had the highest consumption nationally in August 2023, while the Perth and Adelaide sites also reported high consumption. The long-term averages suggest higher methylamphetamine consumption in regional parts of the country. An upward trajectory is apparent over the past 2 years in several jurisdictions, particularly regional parts of Western Australia and Victoria, as well as in Hobart.

Historical levels of methylamphetamine consumption predating the NWDMP have been available for some sites. When these are added to the current dataset, present use of the drug is lower in Queensland and South Australia compared to the historical high levels (Figure 33). Methylamphetamine use in Victoria has been fluctuating at high levels, while levels in Western Australia are increasing again after substantial declines dating back to August 2020 (Figure 34).

Cocaine consumption has consistently been highest in Sydney (Figure 35). In the current reporting period, regional parts of New South Wales, as well as the capital cities of the Australian Capital Territory, Queensland and Victoria also showed relatively high cocaine consumption compared to the national average. Increased consumption over the past year is evident in several jurisdictions. Regional consumption of cocaine on average is below that in the capital cities.

MDMA consumption is shown in Figure 36. A few jurisdictions have shown substantial changes in consumption over the last 2 years, particularly sites in Darwin and Hobart. Other jurisdictions have varied, but to a lesser extent. Over the life of the Program, average consumption is generally higher in regional areas. However, recent results have reversed this trend, with capital city consumption higher than the respective regional areas in most jurisdictions.

MDA is expressed in daily excreted amounts due to the absence of metabolic information on this drug. Excretion of MDA is low and levels tend to fluctuate substantially in most jurisdictions (Figure 37). On average, regional MDA excretion is substantially higher than in the capital cities.

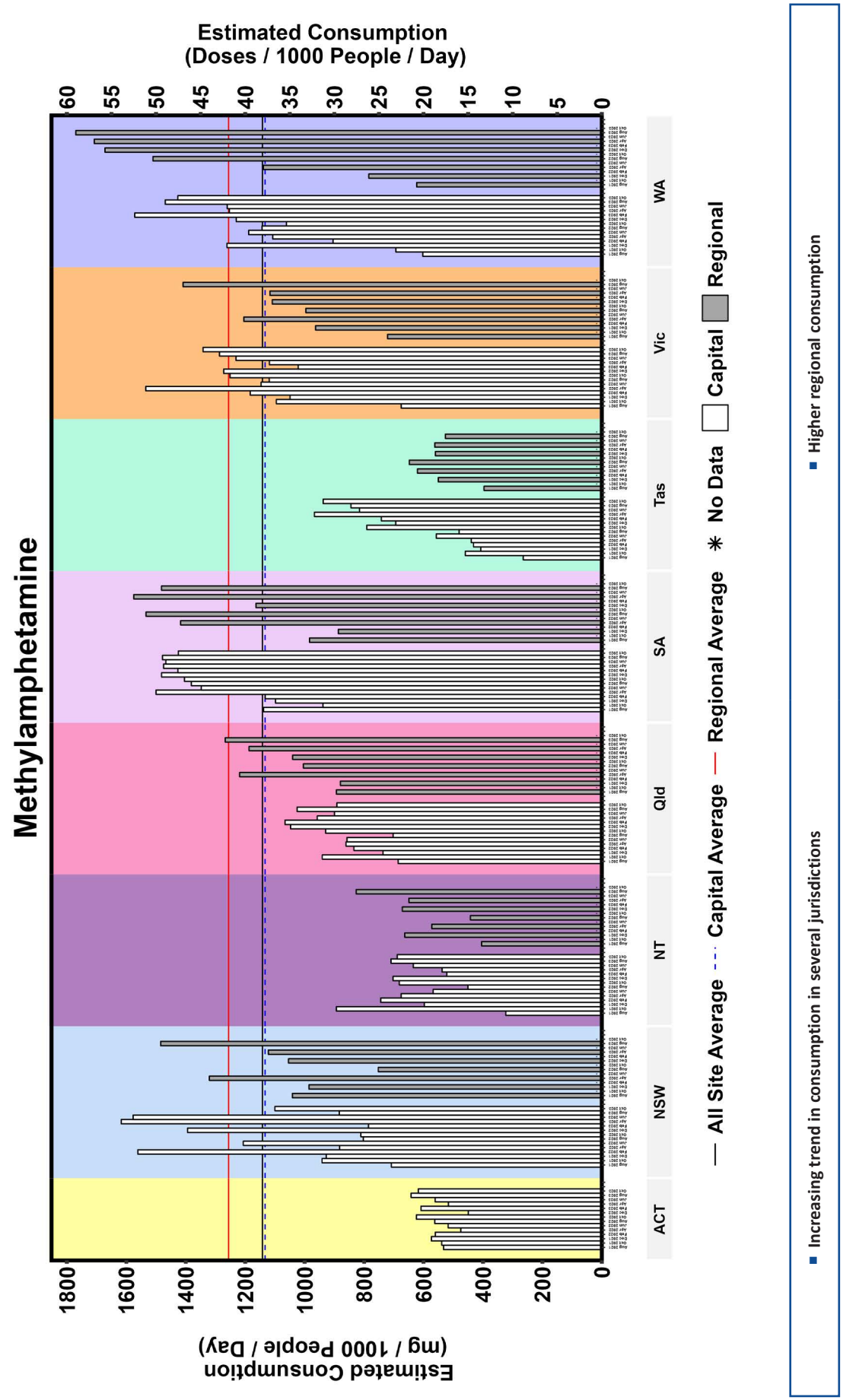


Figure 32: Estimated average consumption of methylamphetamine by state/territory, August 2021 to October 2023.

Figure 33: Change in methylamphetamine consumption for sites in Queensland and South Australia with historical data.

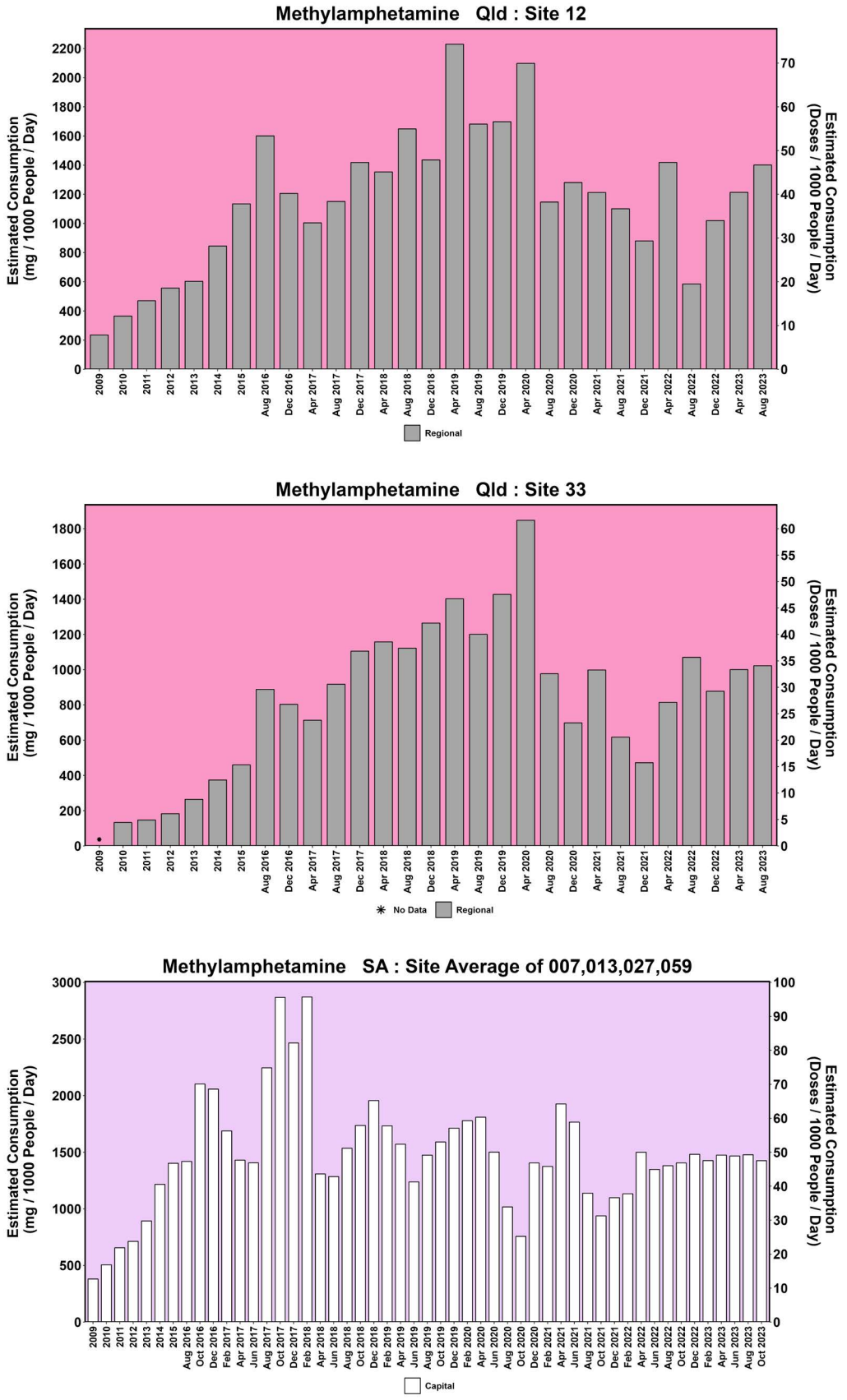
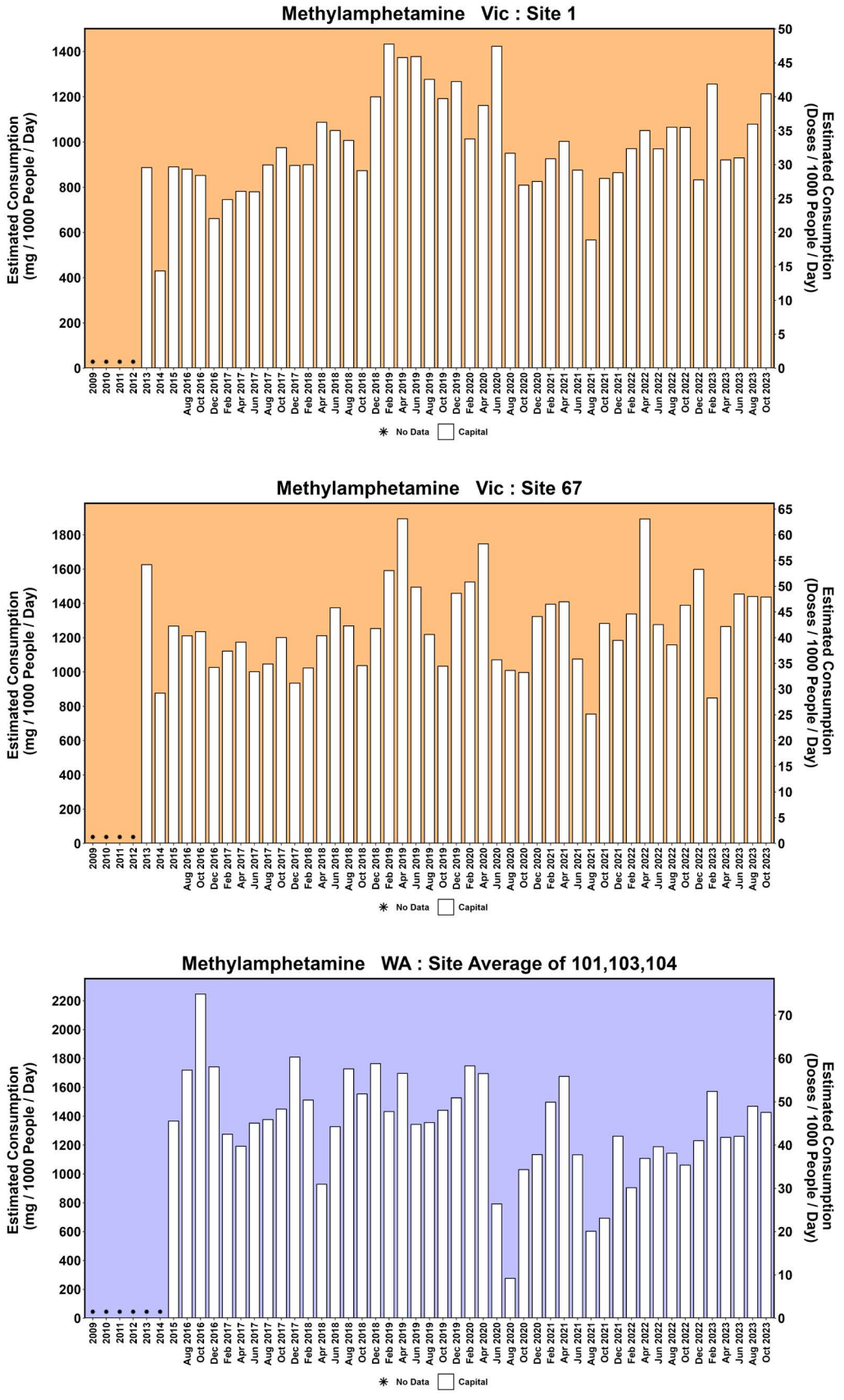


Figure 34: Change in methylamphetamine consumption for sites in Victoria and Western Australia with historical data. Both Victorian sites were the average of one week per year in 2013, 2014 and 2015.



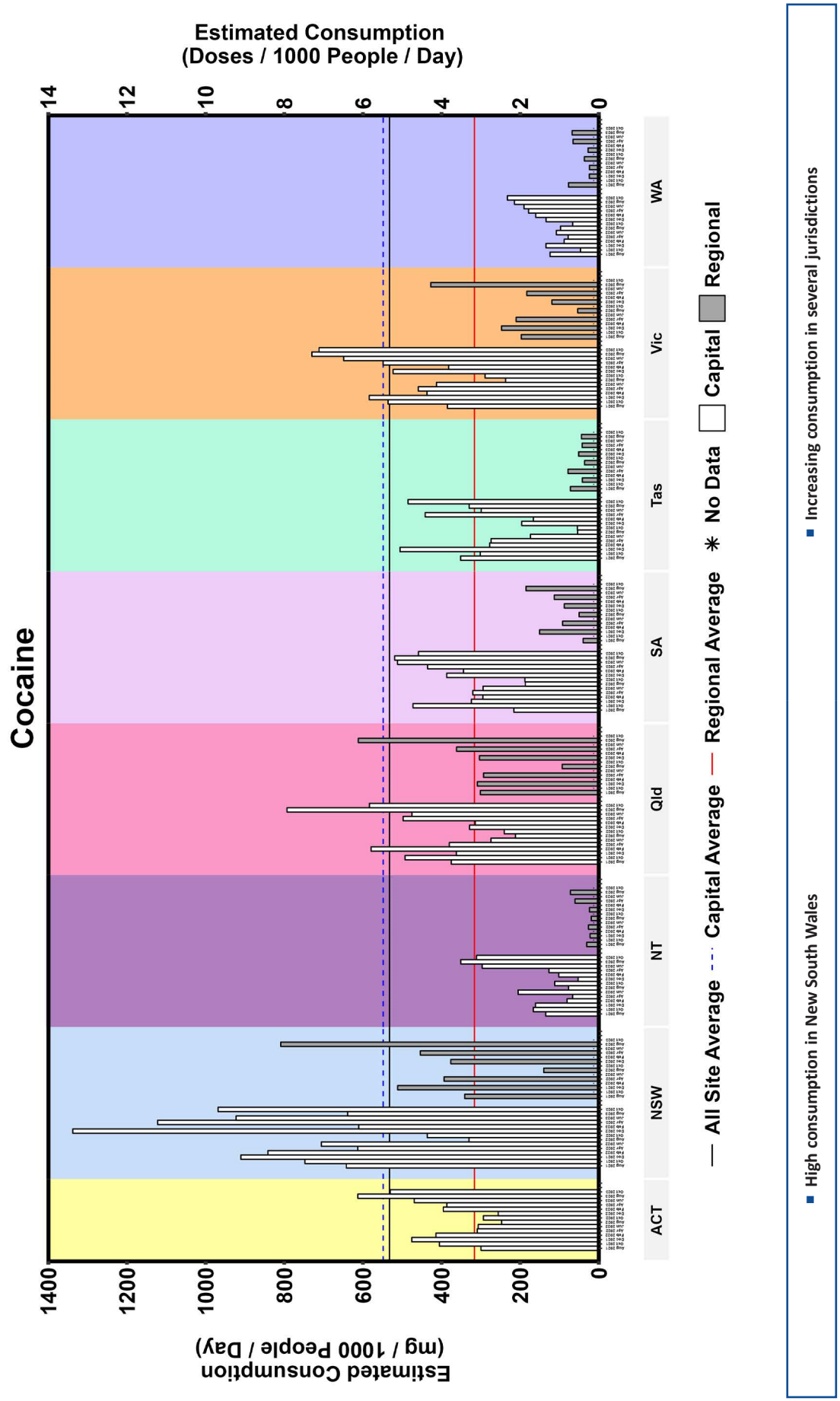


Figure 35: Estimated average consumption of cocaine by state/territory, August 2021 to October 2023.

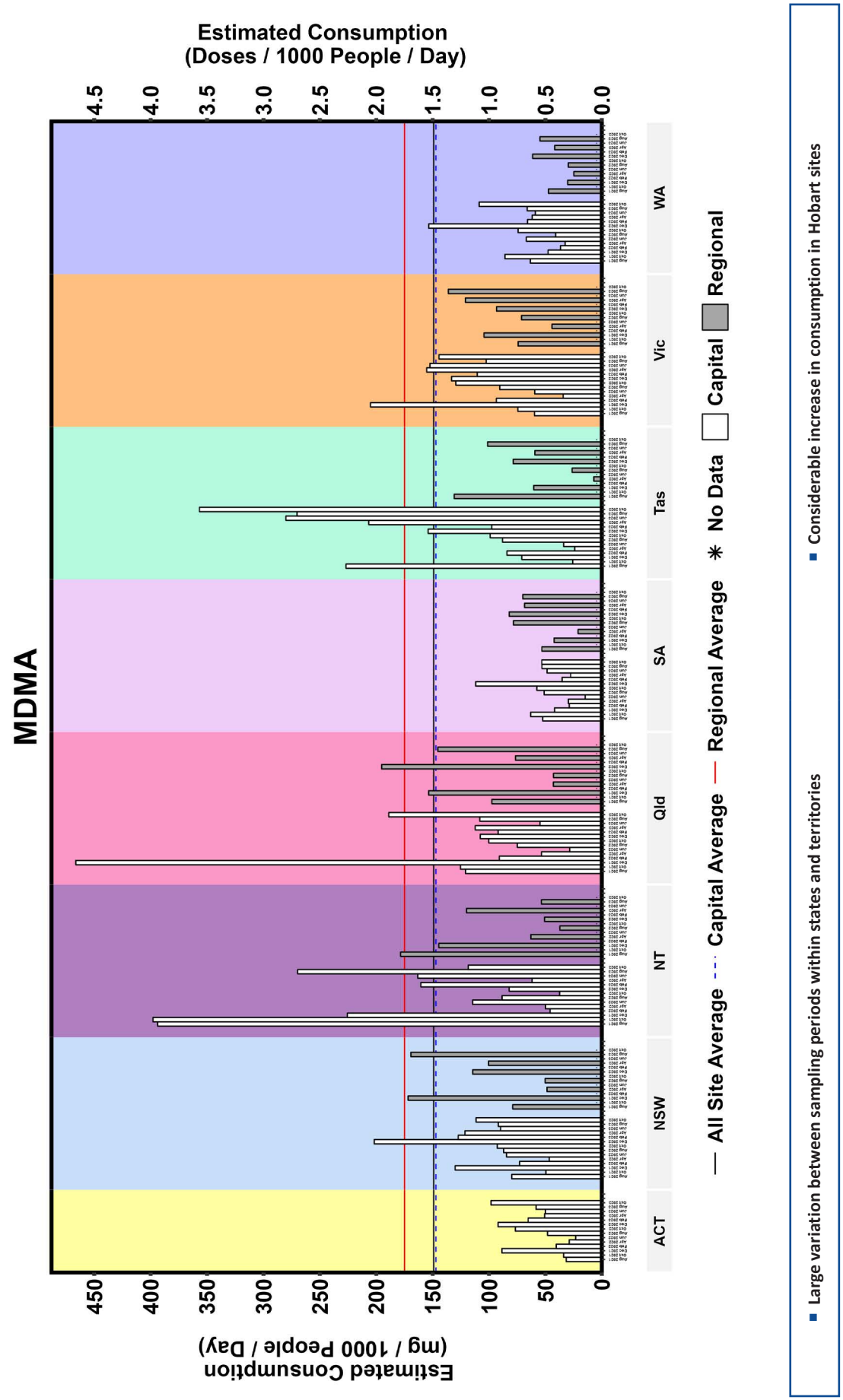


Figure 36: Estimated average consumption of MDMA by state/territory, August 2021 to October 2023.

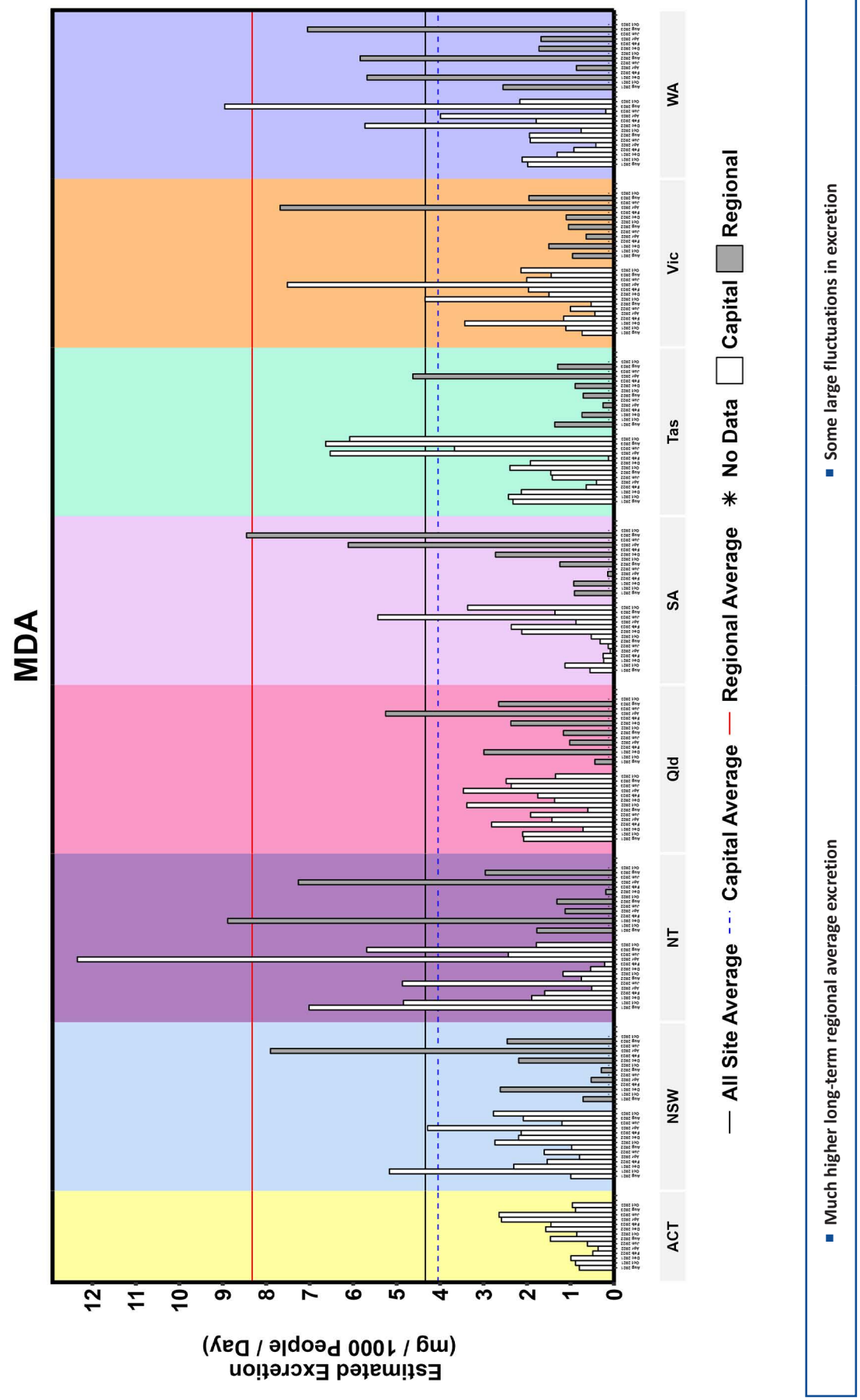


Figure 37: Estimated average excretion of MDA by state/territory, August 2021 to October 2023.

4.2.3 OPIOIDS

Changes in oxycodone consumption are shown in Figure 38. In most instances, oxycodone consumption has fluctuated within previous levels for each jurisdiction, with no clear temporal patterns evident. The long-term average consumption of oxycodone remains much higher in regional Australia than in the capital cities. When comparing capital city to regional consumption within each jurisdiction, Tasmania is the only jurisdiction where capital city consumption is higher than in regional areas.

Fentanyl, another pharmaceutical opioid, also has higher regional consumption compared to the capital cities (Figure 39). The latest results indicate that fentanyl consumption increased in several parts of the country, most notably in sites in regional Queensland and Tasmania.

Heroin consumption has tended to be highest in sites in Melbourne (Figure 40). The latest results confirm the finding. Heroin levels have been highly variable in the Australian Capital Territory and New South Wales. Over the past 2 years, sites in the Northern Territory, Tasmania, and regional Queensland, regional South Australia and regional Western Australia had very low heroin consumption. Heroin consumption remains highest in Melbourne, Sydney and Canberra, and to a lesser extent in Brisbane, Adelaide and Perth. Of the regional areas, New South Wales and Victoria had much higher heroin consumption than regional areas of the other jurisdictions.

Historical data from before the establishment of the Program are available for Adelaide. Combined with recent results, it shows that heroin consumption estimates have declined over the past decade (Figure 41). Apart from lower consumption estimates in June 2023, no significant changes were evident over the past year.

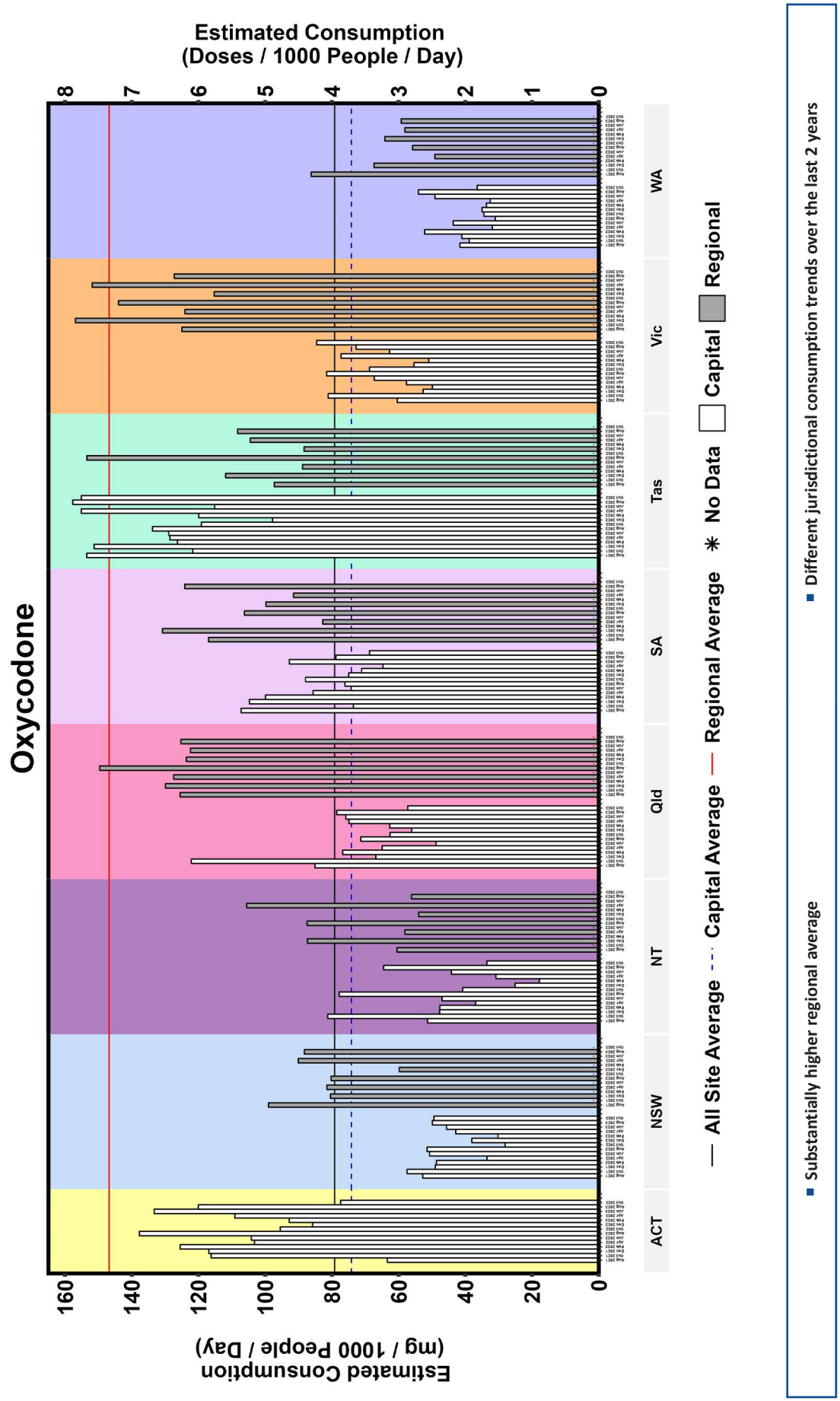


Figure 38: Estimated average consumption of oxycodone by state/territory, August 2021 to October 2023.

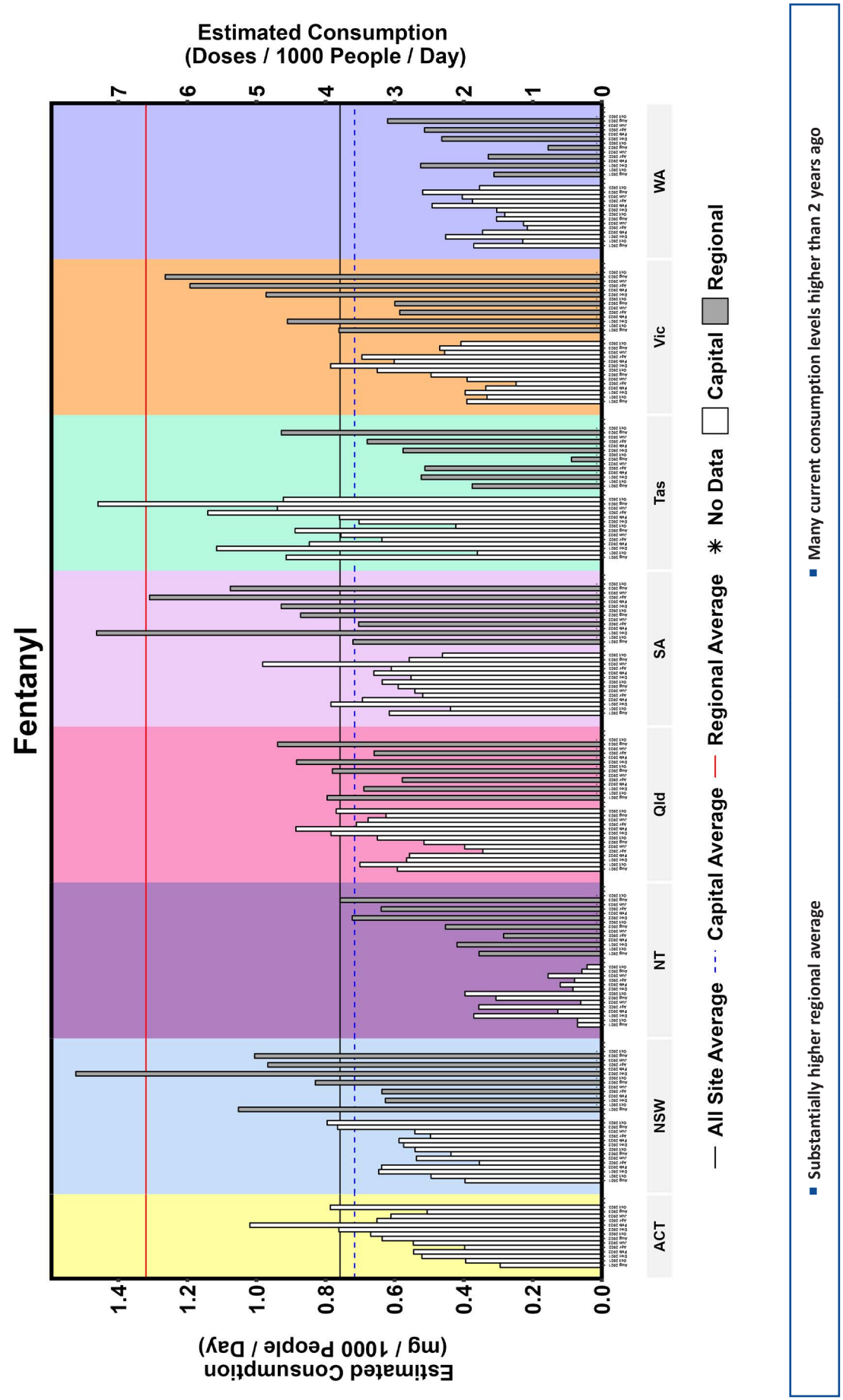


Figure 39: Estimated average consumption of fentanyl by state/territory, August 2021 to October 2023.

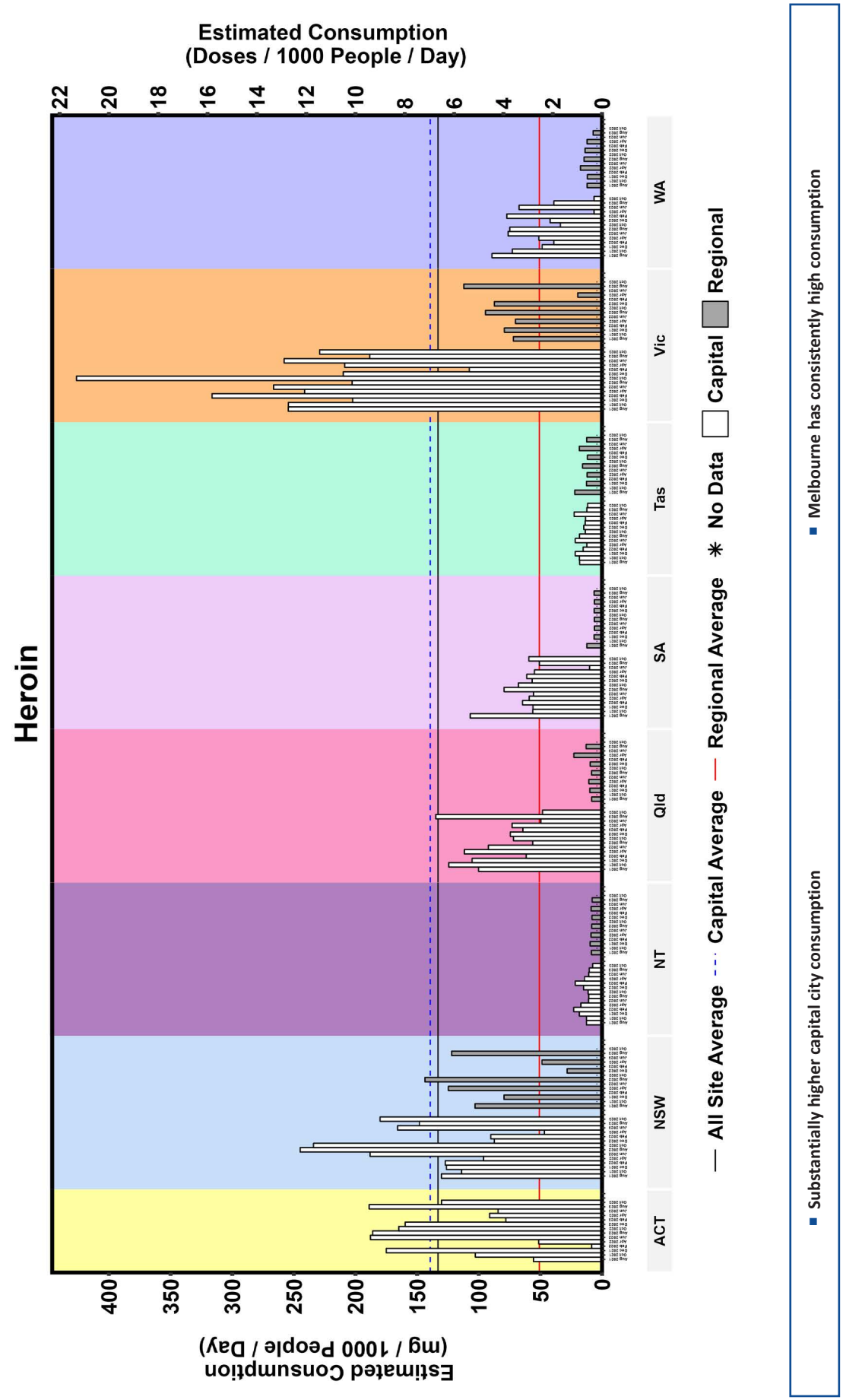
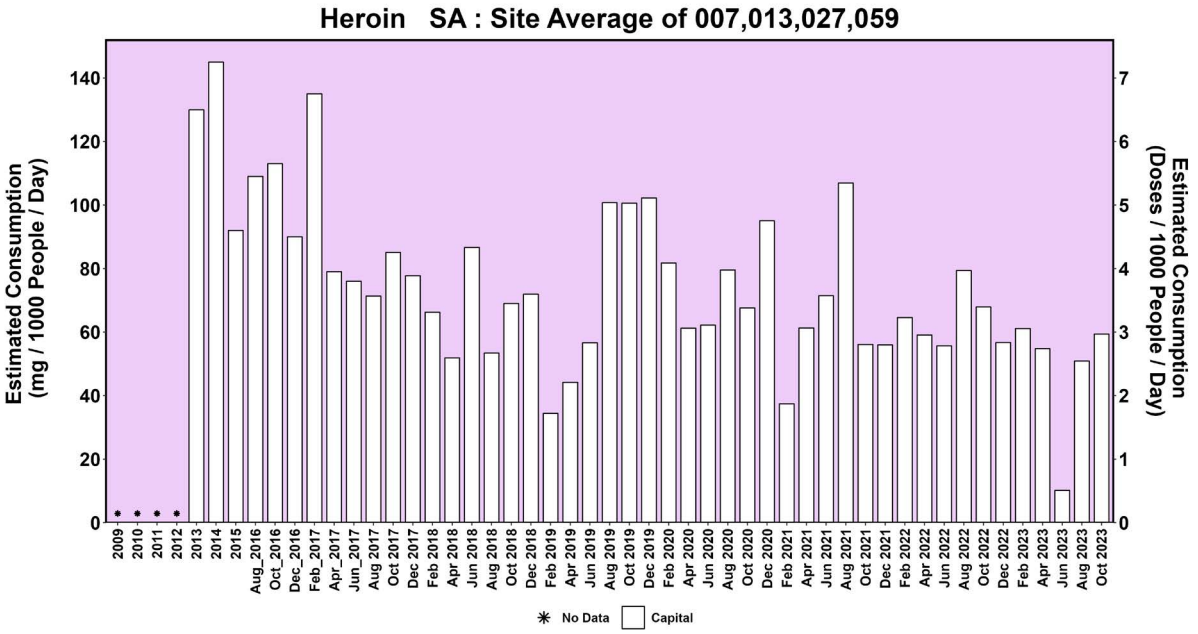


Figure 40: Estimated average consumption of heroin by state/territory, August 2021 to October 2023.

Figure 41: Change in heroin consumption for South Australia.



4.2.4 CANNABIS

The long-term average cannabis consumption in regional Australia is substantially higher than in the capital cities (Figure 42). In most parts of the country, recent results were similar to those observed over the previous two-year period. Cannabis consumption in the regional Northern Territory site in August 2023 was the highest in the country. Cannabis consumption in sites in Sydney and Melbourne are consistently at lower levels than the other capital cities.

Long-term cannabis data are available for Adelaide (Figure 43). The latest collection period showed historically high cannabis consumption levels for August 2023.

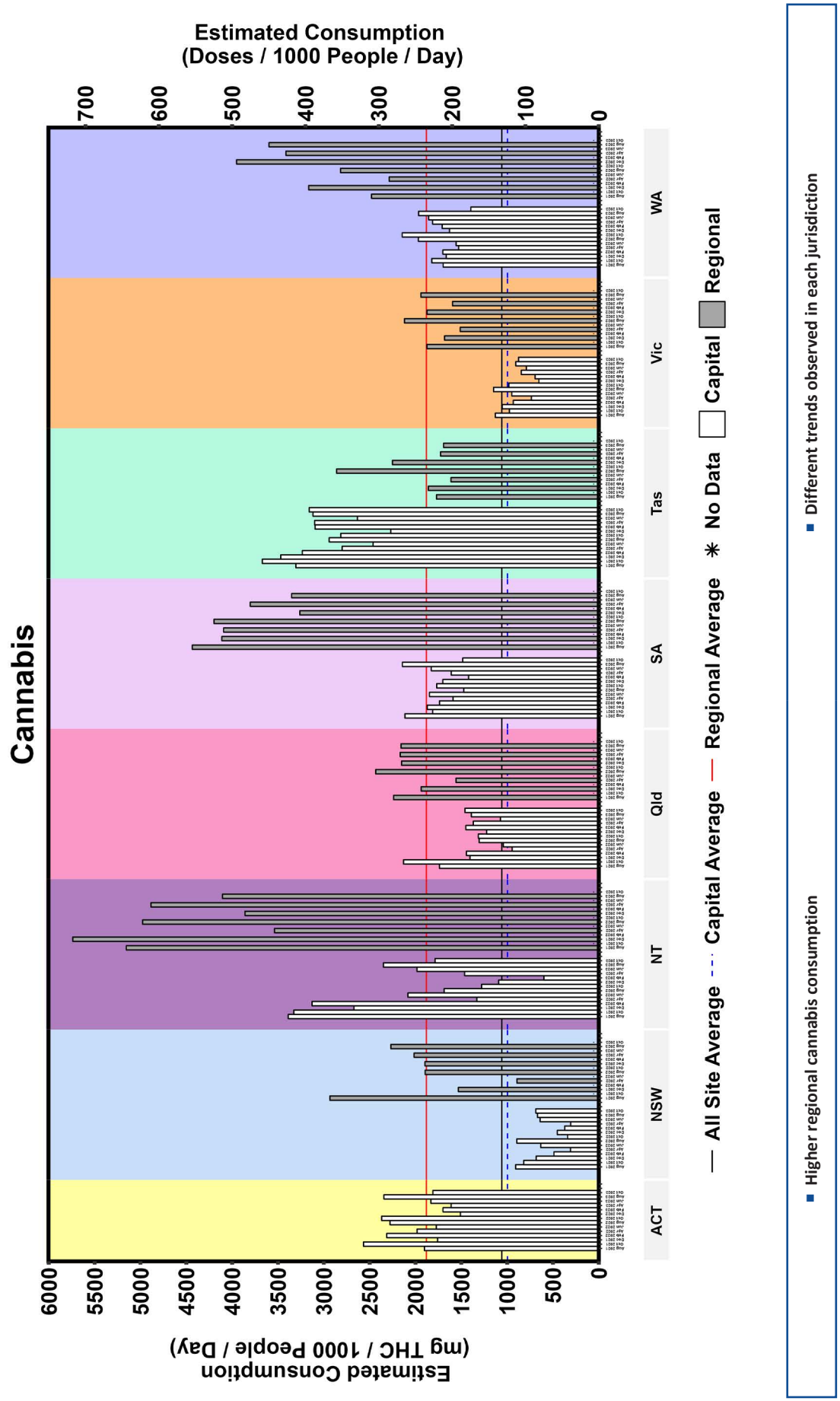
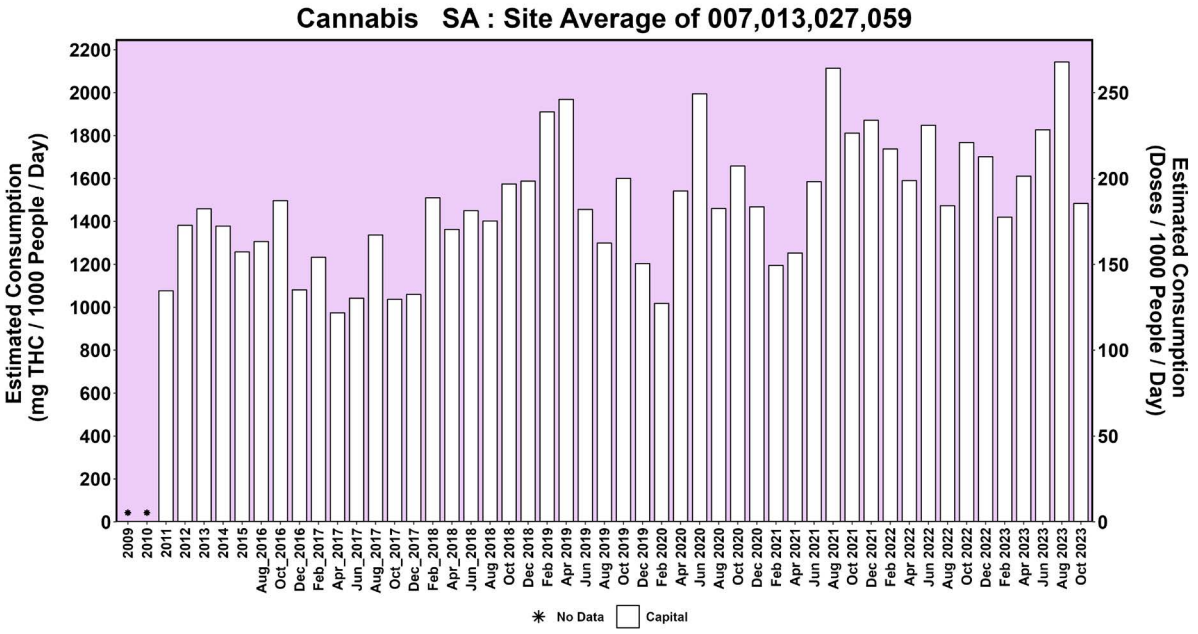


Figure 42: Estimated average consumption of cannabis by state/territory, August 2021 to October 2023.

Figure 43: Change in cannabis consumption for sites in capital city South Australia with historical data. Cannabis is detected via the THC metabolite, THC-COOH.



4.2.5 KETAMINE

Ketamine excretion is relatively low and it is currently highest in Victoria (Figure 44). Ketamine use has generally been highest in the Northern Territory, although it is variable, changing from being the highest nationally to amongst the lowest, depending on the period. Overall, ketamine excretion has been lower in regional Australia.

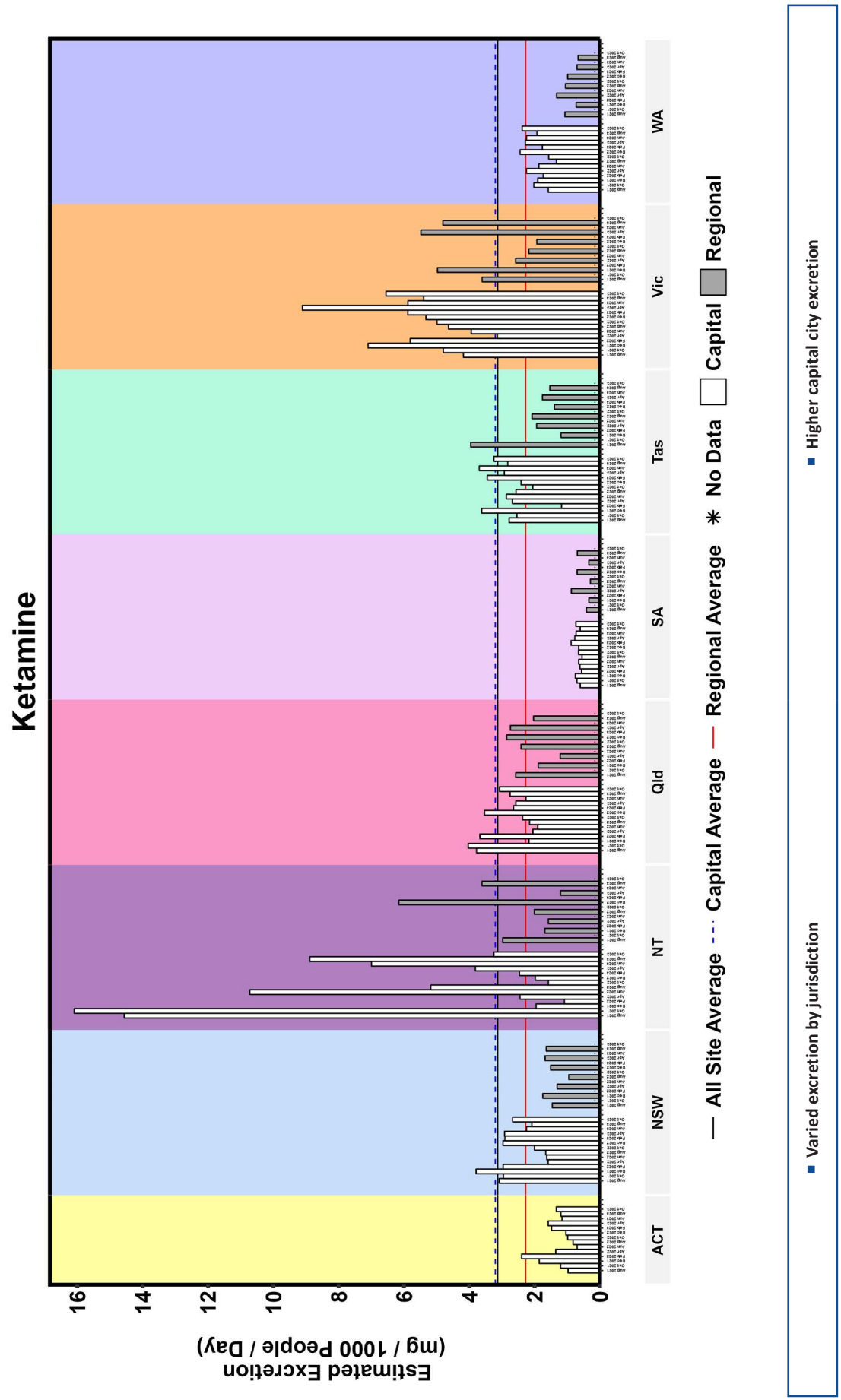


Figure 44: Estimated average excretion of ketamine by state/territory, August 2021 to October 2023.

4.3 NATIONAL CAPITAL CITY AND REGIONAL AVERAGES

In order to show national trends for the individual substances, all capital city and regional sites were combined for each substance (Figure 45 to Figure 50). 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 estimate. Regional sites are collected every second sampling period.

National nicotine consumption is shown in Figure 45. A short-term increasing trend in nicotine consumption is emerging, beginning in August 2022 for both capital city and regional national averages. In the capital cities and regional areas fluctuations have been a feature in previous results, so more data are required to evaluate this trend. Regional averages of nicotine have been higher than capital city averages for the life of the Program.

Alcohol consumption has also fluctuated over the life of the Program (Figure 45). Current consumption levels are lower than at the beginning of the Program in 2016. Regional alcohol consumption has been above that of the capital cities in most periods.

National methylamphetamine consumption trends are shown in Figure 46. Average national regional consumption was higher than capital cities in August 2023. Regional methylamphetamine consumption has been increasing since August 2022.

National average MDMA consumption in regional areas was higher than capital cities in August 2023 (Figure 46). A clear peak in MDMA consumption was evident in December 2019, after which consumption declined to April 2022. Since then, MDMA consumption has slightly increased and remained relatively steady. Similar to methylamphetamine, MDMA consumption in regional and capital city areas is relatively similar in most of the periods of the Program.

At the national level, cocaine consumption has generally been substantially higher in capital city areas compared to regional areas in all periods of the Program (Figure 47). August 2023 had a smaller difference between capital city and regional consumption. Cocaine consumption gradually increased from August 2016, peaked in 2020 and began to decline from December 2020 to historical low levels in August 2022. Since then, cocaine consumption has increased tangibly and regional consumption levels in August 2023 were the highest recorded since the Program commenced in 2016.

National MDA excretion showed very similar levels between the capital cities and regional areas in August 2023 (Figure 47). Prior to August 2020, the excretion of MDA in regional Australia was well above capital city areas in most periods. Following that time, excretion levels in capital cities and regional areas have become more similar. Excretion levels remain low, with sporadic highs observed before August 2020.

In line with previous reporting, national average oxycodone consumption was higher in regional areas than in the capital cities (Figure 48). Oxycodone consumption peaked in the 6 months between December 2018 and August 2019, followed by a gradual decline in consumption in regional areas and a relatively steadier trend in consumption for capital cities since then.

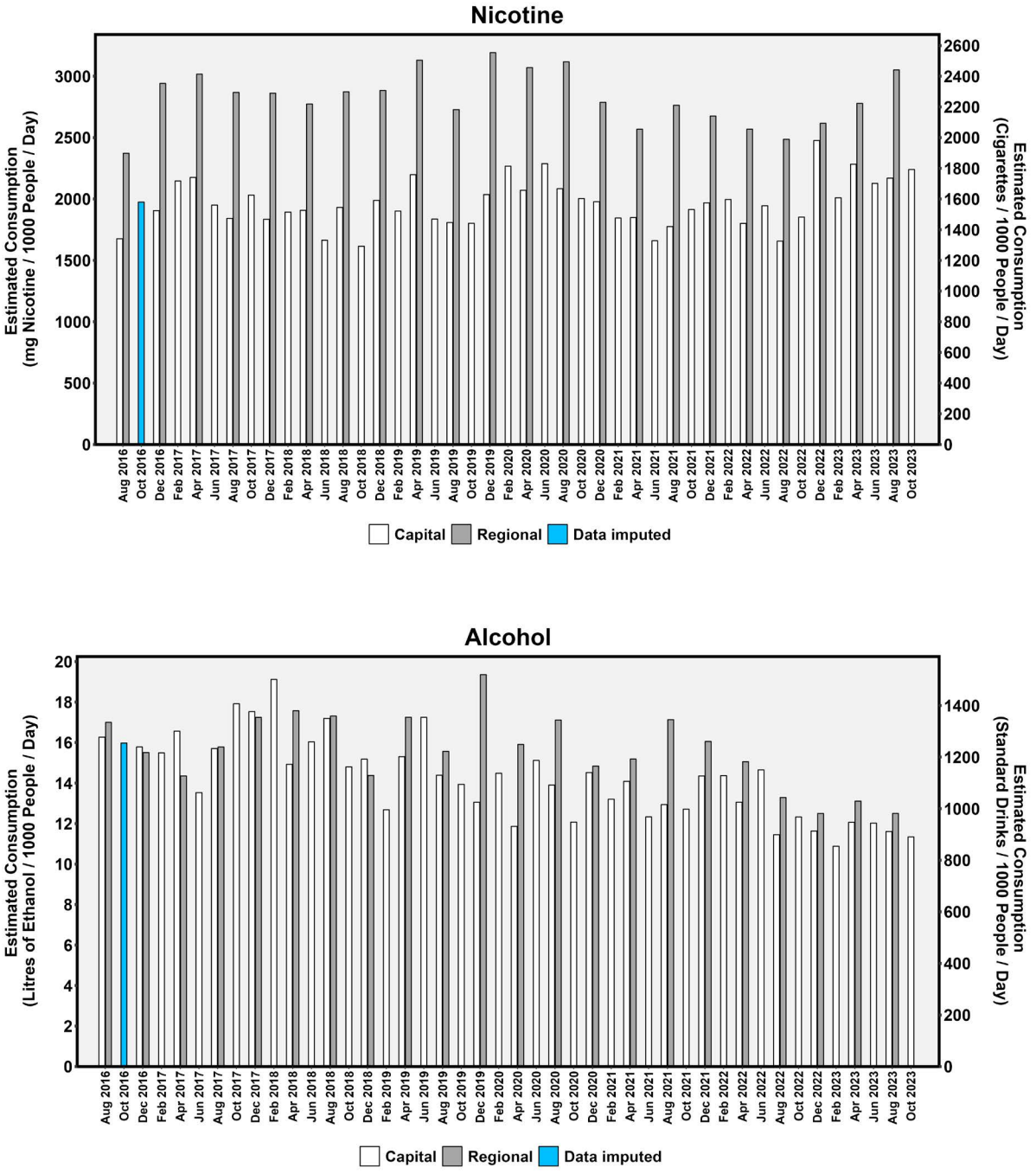
The pattern of fentanyl consumption mirrors that of oxycodone, whereby regional consumption exceeds the capital cities (Figure 48). Fentanyl consumption has mostly followed a similar temporal trend to oxycodone, although peaking in a different timeframe, around April to December 2018, followed by a decline to historic lows in April 2022, and increasing slightly since then, particularly in regional areas.

At the national level, heroin consumption in capital cities exceeds that of regional areas (Figure 49). The consumption of heroin has fluctuated over the life of the Program. The regional average consumption of heroin increased in August 2023 (as did capital city consumption) and is similar to levels observed in August 2020 and August 2022.

Ketamine excretion in regional parts of Australia was slightly lower than capital cities for August 2023 (Figure 49). Ketamine has been measured since December 2020, a smaller timeframe than the other substances. Excretion levels decreased from record high capital city and regional levels during the previous reporting period.

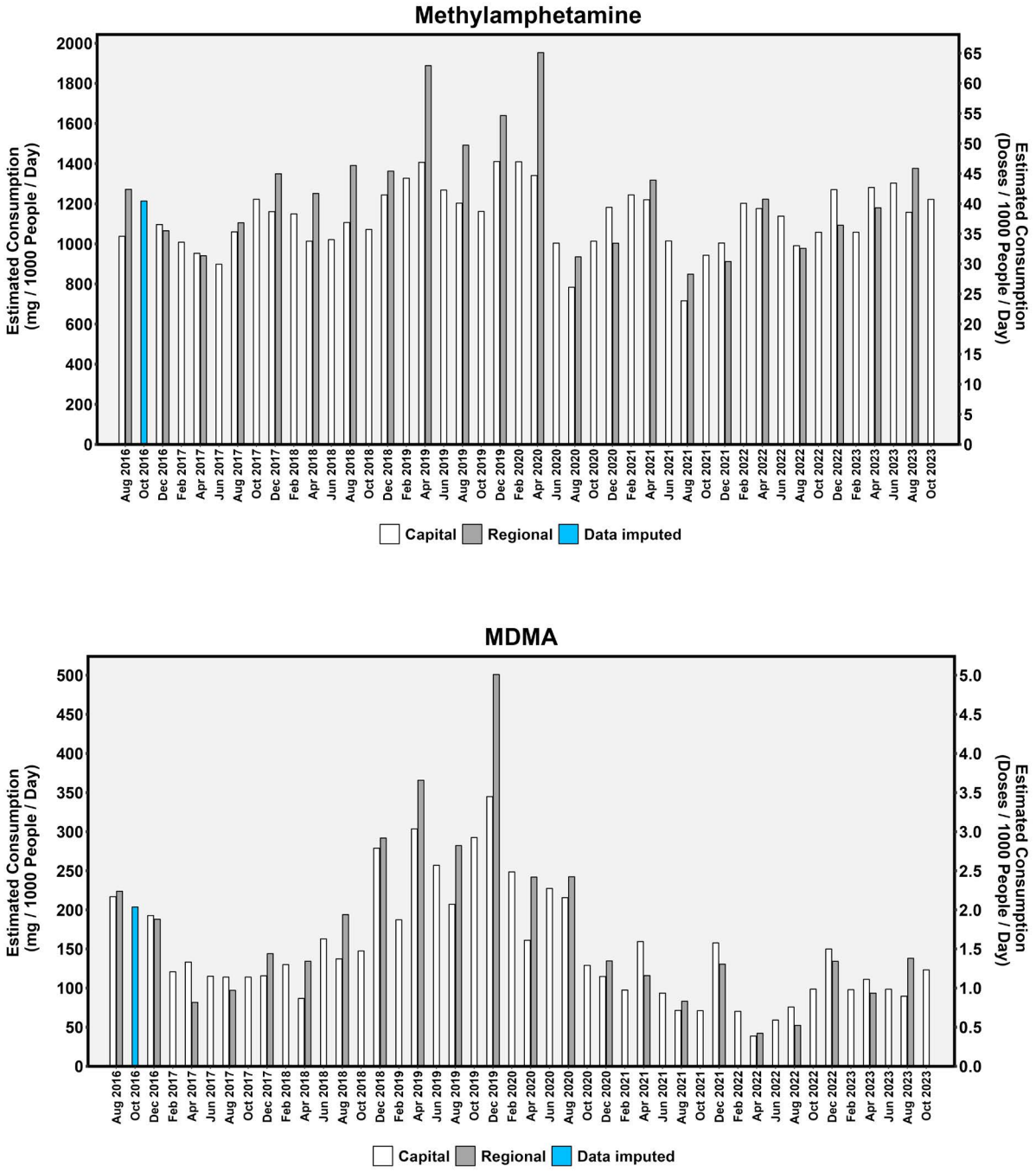
Cannabis consumption is substantially higher in regional areas, nearly double that of the capital cities, and has fluctuated with no clear patterns (Figure 50). Although cannabis consumption has fluctuated over time, current national consumption estimates are higher than when it was first measured for the Program in August 2018.

Figure 45: The population-weighted average of all sites for nicotine and alcohol.



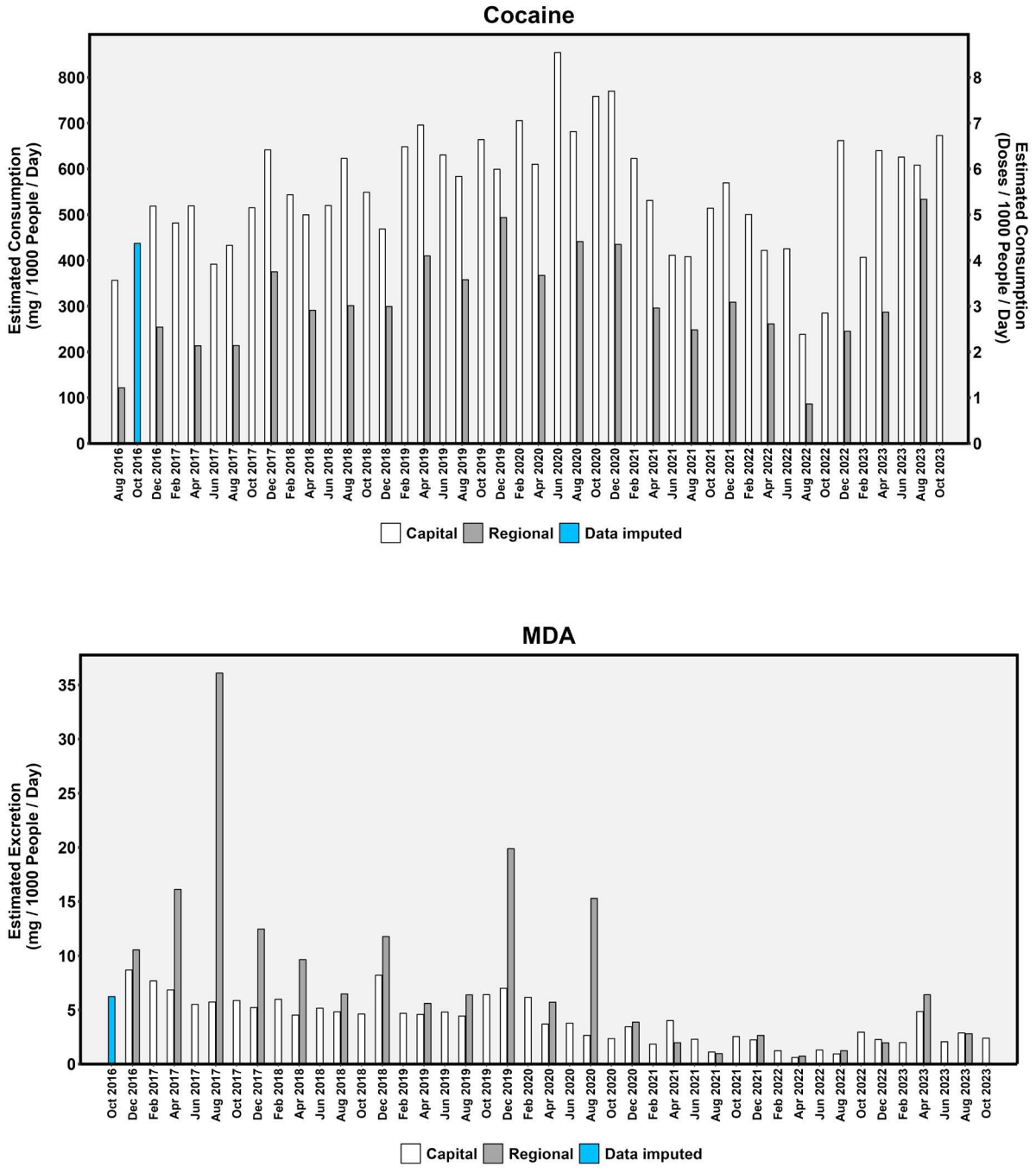
As Queensland and New South Wales capital city sites were not sampled in October 2016, their average consumption in August and December 2016 was used to provide the overall October estimate.

Figure 46: The population-weighted average of all sites for methylamphetamine and MDMA.



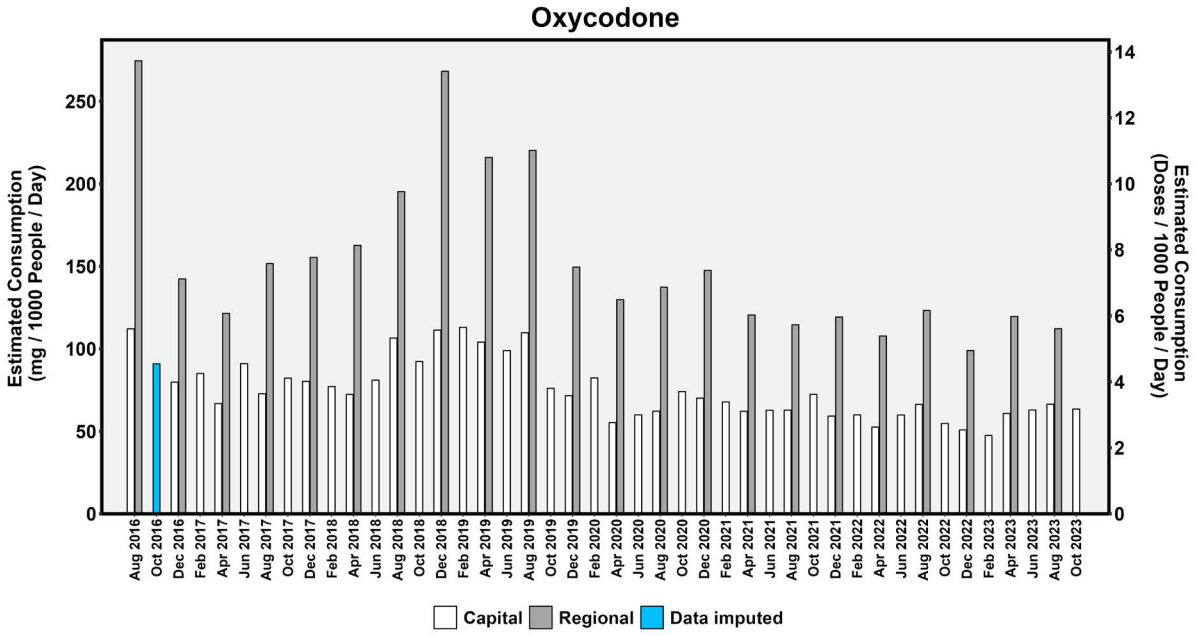
As Queensland and New South Wales capital city sites were not sampled in October 2016, their average consumption in August and December 2016 was used to provide the overall October estimate.

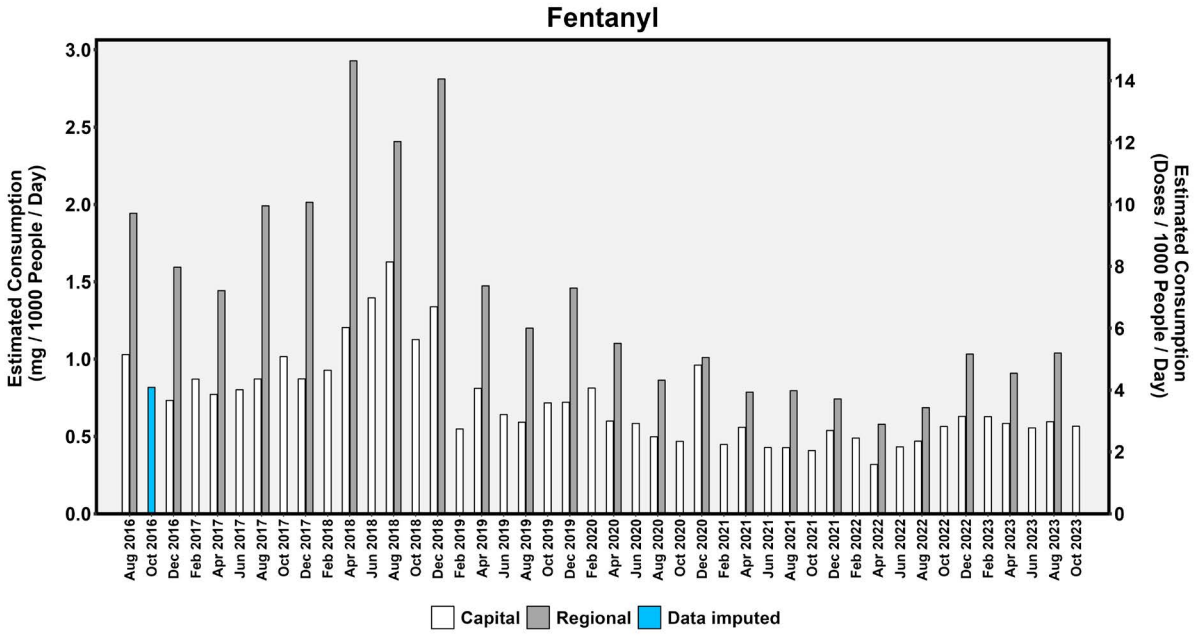
Figure 47: The population-weighted average of all sites for cocaine and MDA.



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 48: 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 49: The population-weighted average of all sites for heroin and ketamine.

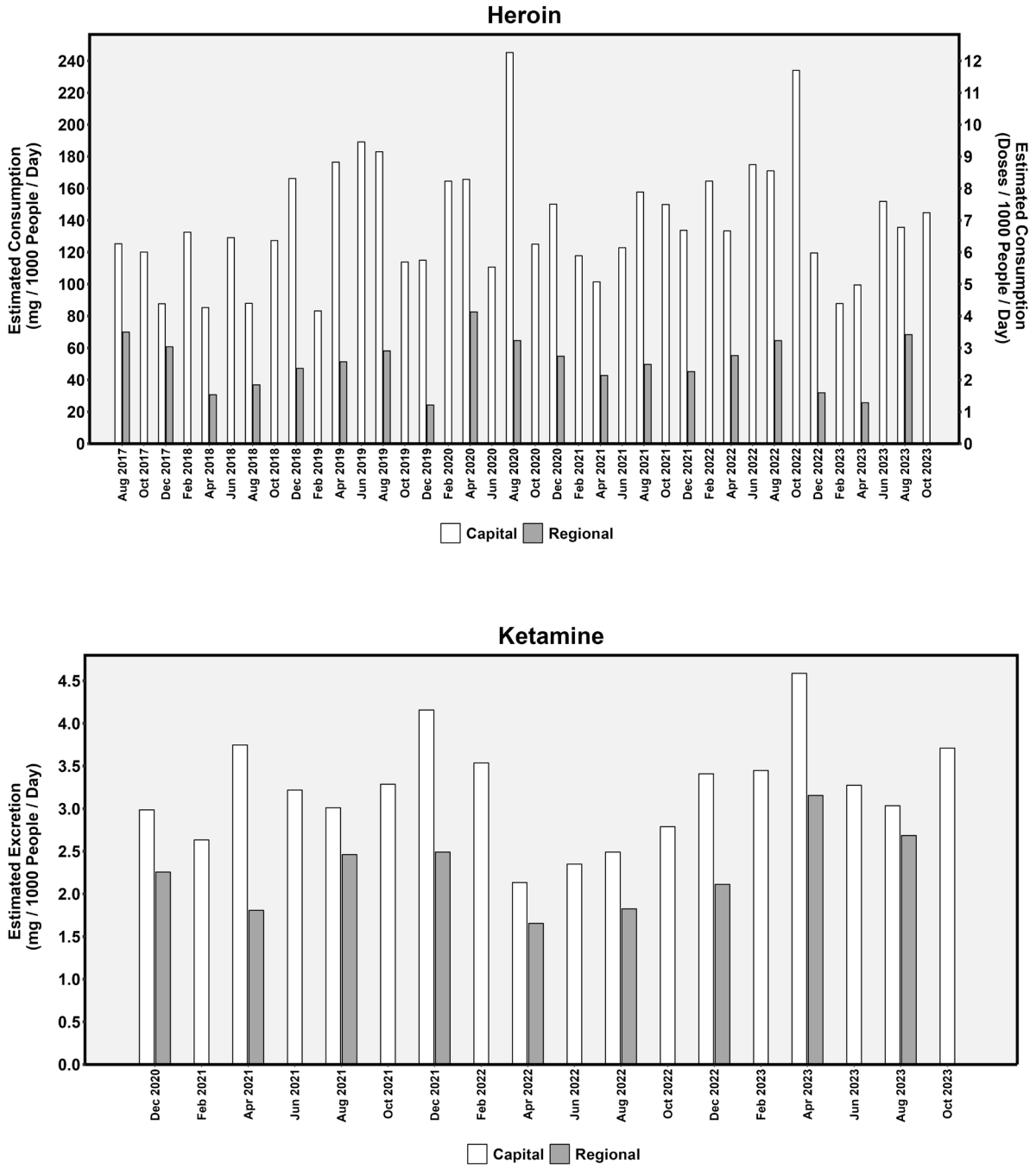
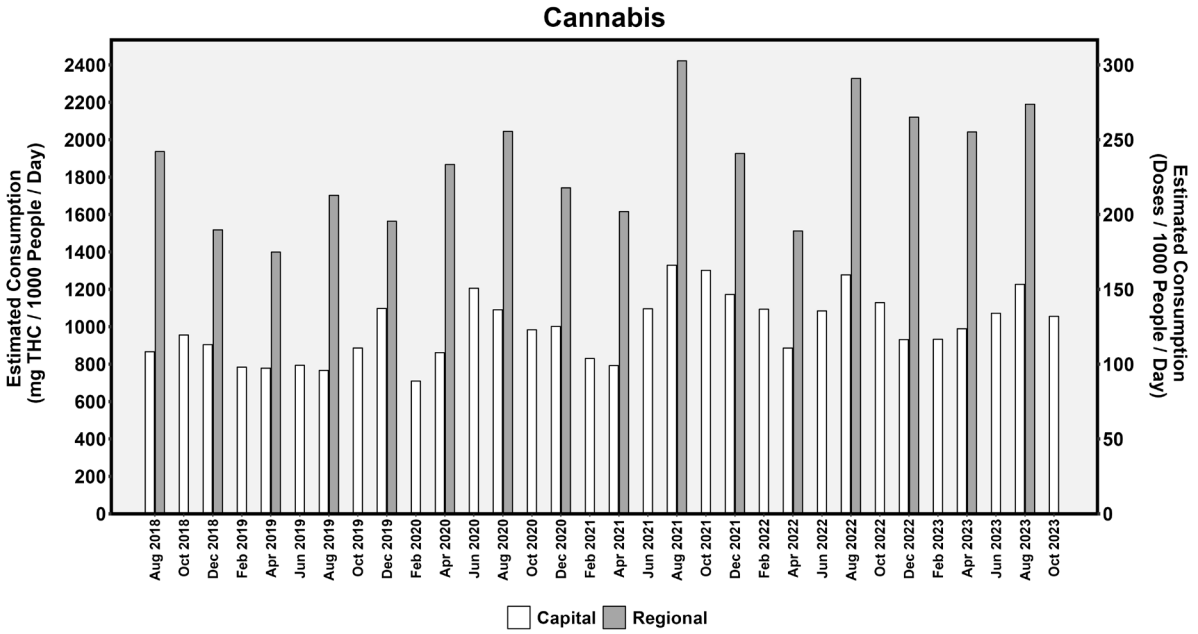


Figure 50: The population-weighted average of all sites for cannabis.



4.4 DRUG PROFILE FOR EACH STATE AND TERRITORY

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

When the amount of drug measured in wastewater was normalised for population size and average dose consumed (excretion factors listed in Appendix 1), 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 (Figure 51 to Figure 54). The scale of use of cannabis is substantially higher than the other substances included in the figures. Due to this, the graphs have been split into 2 parts so all drugs remain visible. Following cannabis, methylamphetamine is by far the next highest ranking drug included in the Program. Subsequent rankings differ by jurisdiction.

Figure 51: Profile of average drug consumption by state or territory, August 2021 to October 2023 for capital sites and to August 2023 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.

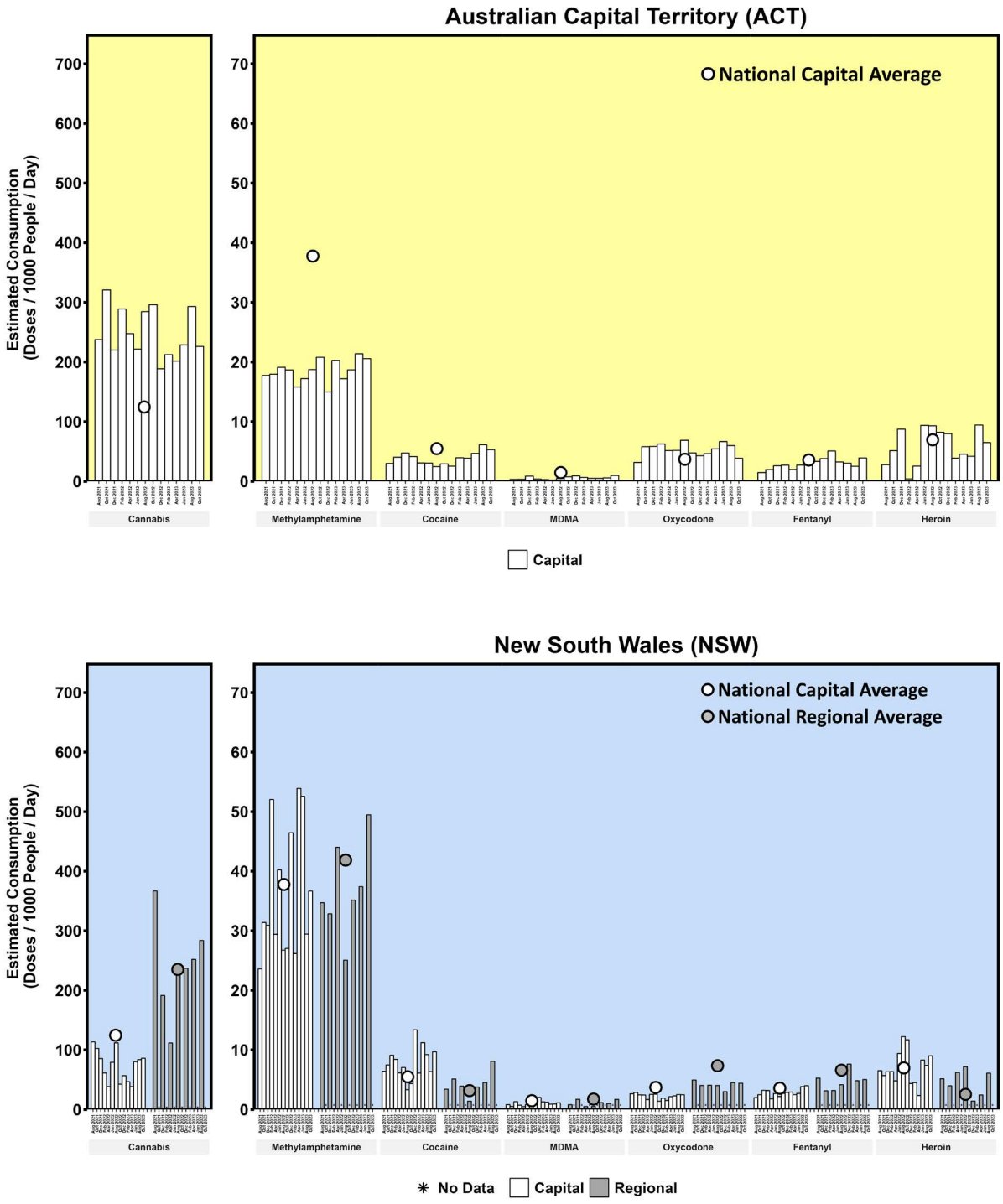
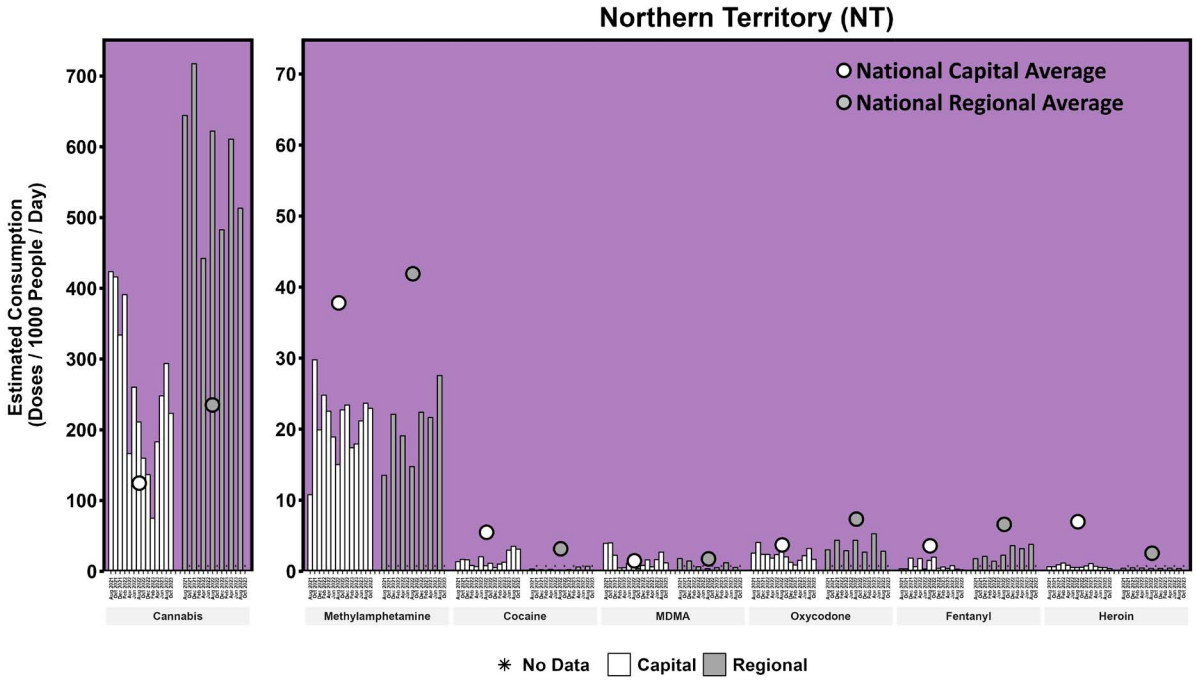


Figure 52: Profile of average drug consumption by state or territory, August 2021 to October 2023 for capital sites and to August 2023 for regional sites, Northern Territory and Queensland.



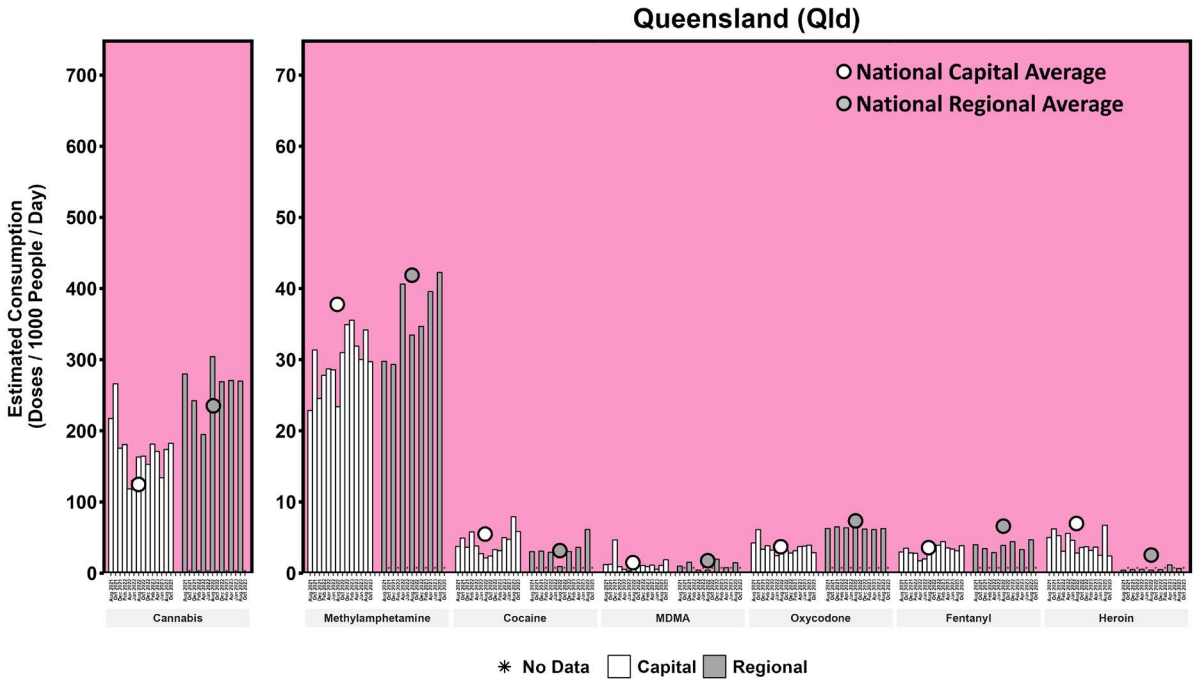


Figure 53: Profile of average drug consumption by state or territory, August 2021 to October 2023 for capital sites and to August 2023 for regional sites, South Australia and Tasmania.

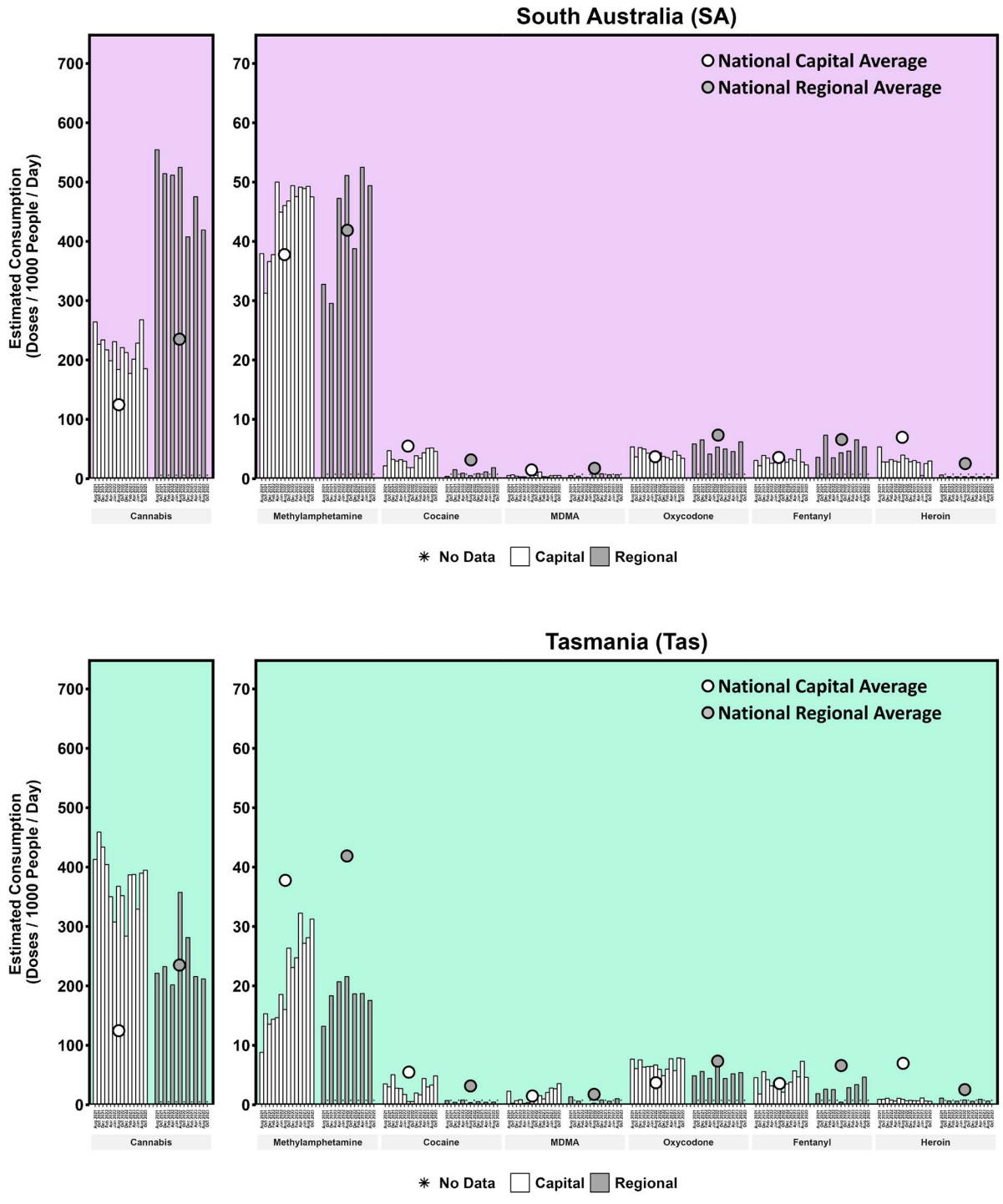
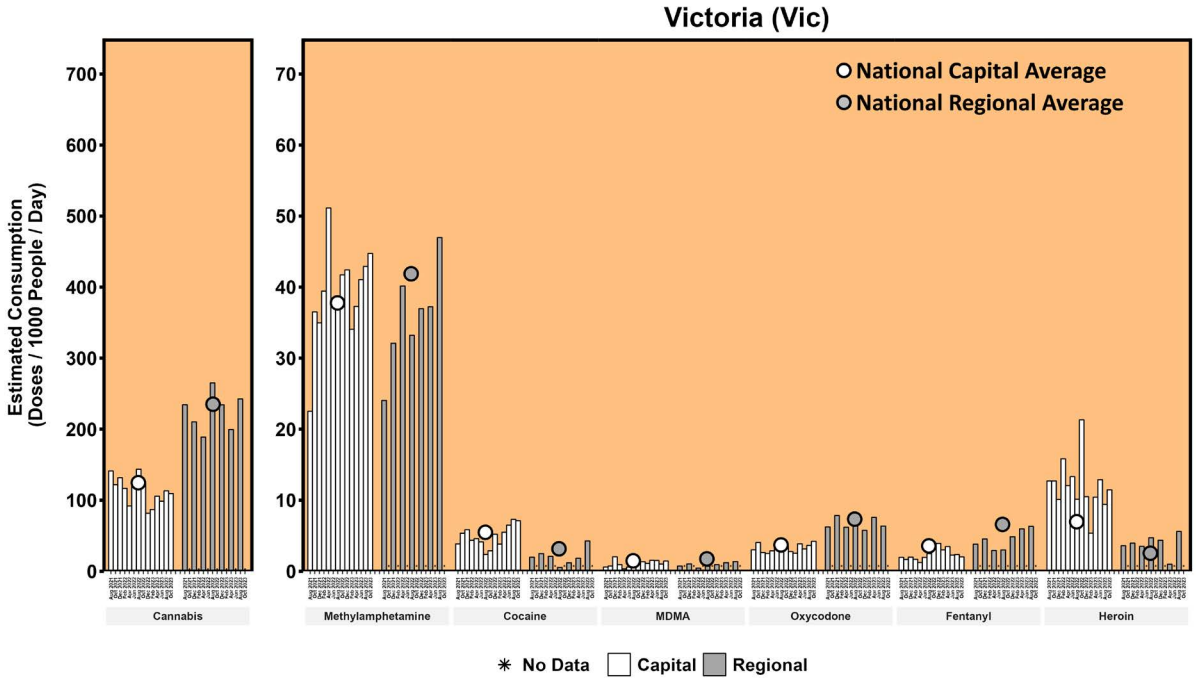
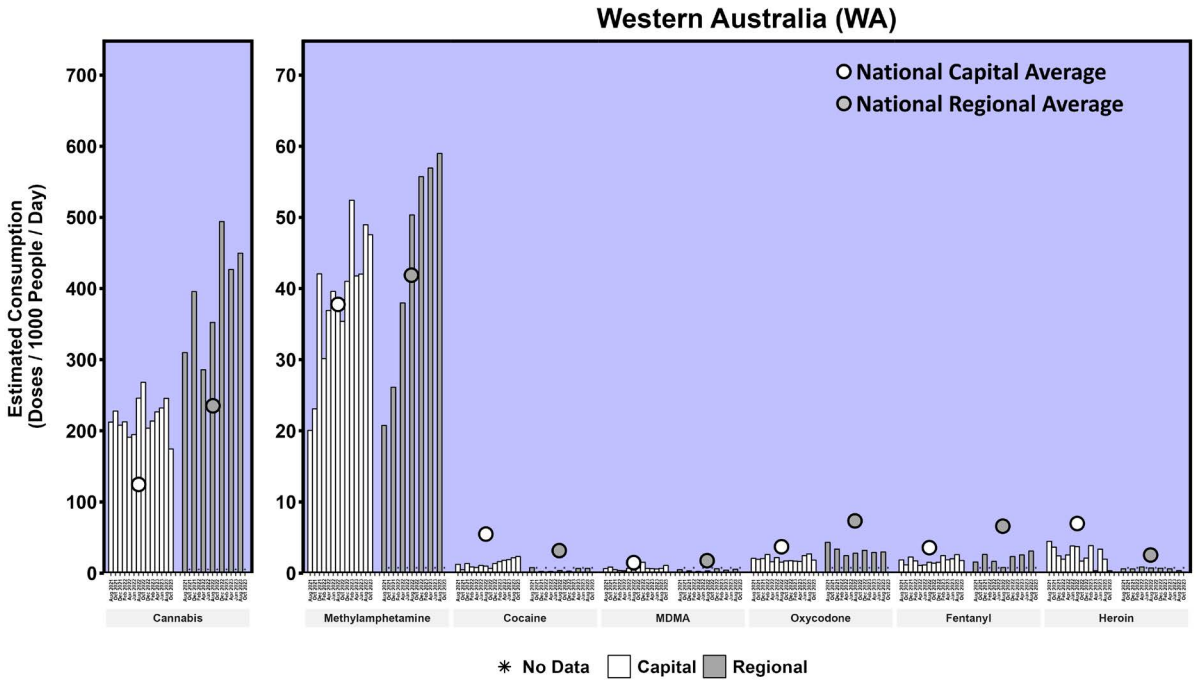


Figure 54: Profile of average drug consumption by state or territory, August 2021 to October 2023 for capital sites and to August 2023 for regional sites, Victoria and Western Australia.





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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 comes to light. 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 AUGUST AND OCTOBER 2023

Sites	Capital or regional	Aug 2023	Oct 2023	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: 021	Capital	7	–	30,000 to 150,000
NSW: 071	Capital	7	–	> 150,000
NSW: 016	Regional	7	–	30,000 to 150,000
NSW: 025	Regional	7	–	30,000 to 150,000
NSW: 040	Regional	7	–	< 30,000
NSW: 051	Regional	7	–	< 30,000
NSW: 068	Regional	7	–	> 150,000
NSW: 081	Regional	7	–	< 30,000
NSW: 115	Regional	7	–	30,000 to 150,000
NSW: 164	Regional	7	–	< 30,000
NSW: 165	Regional	7	–	< 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: 042	Regional	7	–	30,000 to 150,000
Qld: 053	Regional	6	–	< 30,000
Qld: 077	Regional	5	–	< 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
Tas: 004	Capital	7	5	< 30,000
Tas: 019	Capital	7	5	< 30,000
Tas: 041	Capital	7	5	< 30,000
Tas: 018	Regional	7	–	< 30,000
Tas: 048	Regional	7	–	< 30,000

APPENDIX 2 (CONTINUED)

Sites	Capital or regional	Aug 2023	Oct 2023	Population
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: 062	Regional	7	–	< 30,000
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	6	–	< 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 to 150,000
WA: 129	Regional	7	–	< 30,000
Regional Sites		40	–	
Capital Sites		22	**20**	
Total Sites		**62**	**20**	
Regional Samples		276	–	
Capital Samples		154	134	
Total Samples		**430**	**134**	
Cumulative Samples		**10,541**	**10,675**	

APPENDIX 3: PROPORTION OF SAMPLES ABOVE LOD (%) FOR EACH DRUG AND PERIOD ASSESSED[5]

Drug	Capital or regional	Aug 2023	Oct 2023
Alcohol	Capital	100	100
Alcohol	Regional	100	–
Cannabis	Capital	100	100
Cannabis	Regional	100	–
Cocaine	Capital	99	100
Cocaine	Regional	88	–
Fentanyl	Capital	81	90
Fentanyl	Regional	84	–
Heroin	Capital	45	47
Heroin	Regional	14	–
Ketamine	Capital	95	99
Ketamine	Regional	86	–
MDA	Capital	75	90
MDA	Regional	85	–
MDMA	Capital	100	100
MDMA	Regional	97	–
Methylamphetamine	Capital	100	100
Methylamphetamine	Regional	100	–
Nicotine	Capital	100	100
Nicotine	Regional	100	–
Oxycodone	Capital	100	100
Oxycodone	Regional	100	–

5 Percentage detections for previous collection periods are available in Appendix 4 of Report 6 and Appendix 3 of Reports 7 to 20.

CONCLUSIONS

CONCLUSIONS

For the 21st report of the NWDMP, wastewater analysis was conducted in August (capital city and regional sites) and October 2023 (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.[6]

METHYLAMPHETAMINE

When comparing data for April and August 2023, the population-weighted average consumption of methylamphetamine decreased in capital city sites and increased in regional sites. Average capital city methylamphetamine consumption then increased from August to October 2023. In August 2023, average regional methylamphetamine consumption exceeded capital city consumption. In August 2023, South Australia had the highest estimated average capital city consumption of methylamphetamine, while Western Australia had the highest average regional consumption.

COCAINE

When comparing data for April and August 2023, the population-weighted average consumption of cocaine decreased in capital city sites and increased in regional sites to the highest level recorded by the Program. Average capital city cocaine consumption then increased from August to October 2023. Average capital city cocaine consumption continued to exceed average regional consumption. In August 2023, Queensland had the highest estimated average capital city consumption of cocaine, while New South Wales had the highest average regional consumption.

3,4-METHYLENEDIOXYMETHYLAMPHETAMINE (MDMA)

When comparing data for April and August 2023, the population-weighted average consumption of MDMA decreased in capital city sites and increased in regional sites. Average capital city MDMA consumption then increased from August to October 2023. Average regional MDMA consumption exceeded capital city consumption. In August 2023, Tasmania had the highest estimated average capital city MDMA consumption, while New South Wales 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 April and August 2023, MDA excretion[7] decreased in both capital city and regional sites. Average capital city MDA excretion further decreased from August to October 2023. In August 2023, average capital city MDA excretion exceeded average regional excretion. In August 2023, Western Australia had the highest estimated average capital city excretion of MDA, while South Australia the highest average regional excretion.

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

7 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 April and August 2023, the population-weighted average consumption of heroin increased in both capital city and regional sites. Average capital city heroin consumption further increased from August to October 2023. Average capital city heroin consumption continued to exceed average regional consumption. In August 2023, the Australian Capital Territory had the highest estimated average capital city heroin consumption, while New South Wales had the highest average regional consumption.

CANNABIS

When comparing data for April and August 2023, the population-weighted average consumption of cannabis increased in both capital city and regional sites. Average capital city cannabis consumption then decreased from August to October 2023. Average regional cannabis consumption continued to exceed average capital city consumption. In August 2023, Tasmania had the highest estimated average capital city consumption of cannabis, while the Northern Territory[8] had the highest average regional consumption.

KETAMINE

When comparing data for April and August 2023, the population-weighted average excretion of ketamine decreased in both capital city and regional sites. Average capital city ketamine excretion then increased from August to October 2023. Average capital city ketamine excretion continued to exceed regional ketamine excretion. In August 2023, the Northern Territory had the highest average capital city ketamine excretion, while Victoria had the highest average regional excretion.

OXYCODONE

When comparing data for April and August 2023, average consumption of oxycodone increased in capital city sites and decreased in regional sites. Average capital city oxycodone consumption then decreased from August to October 2023. Average regional oxycodone consumption exceeded average capital city consumption. In August 2023, Tasmania had the highest estimated average capital city consumption of oxycodone, while Victoria had the highest average regional consumption.

FENTANYL

When comparing data for April and August 2023, average consumption of fentanyl increased in both capital city and regional sites. Average capital city fentanyl consumption then decreased from August to October 2023. Average regional fentanyl consumption continued to exceed average capital city consumption. In August 2023, Tasmania had the highest estimated average capital city consumption of fentanyl, while Victoria had the highest average regional consumption.

8 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.

NICOTINE

When comparing data for April and August 2023, the population-weighted average consumption of nicotine decreased in capital city sites and increased in regional sites. Average capital city nicotine consumption then increased from August to October 2023. Average regional nicotine consumption continued to exceed average capital city consumption. In August 2023, the Northern Territory[9] had the highest average capital city and regional consumption of nicotine.

ALCOHOL

When comparing data for April and August 2023, the population-weighted average consumption of alcohol decreased in both capital city and regional sites, with the regional level a record low, tied with December 2022. Average capital city consumption further decreased from August to October 2023. Average regional alcohol consumption exceeded average capital city consumption. In August 2023, the Northern Territory[10] had the highest estimated average capital city and regional consumption of alcohol.

NEXT REPORT

The 22nd report of the NWDMP is scheduled for public release in June 2024.

9 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.

10 Ibid.