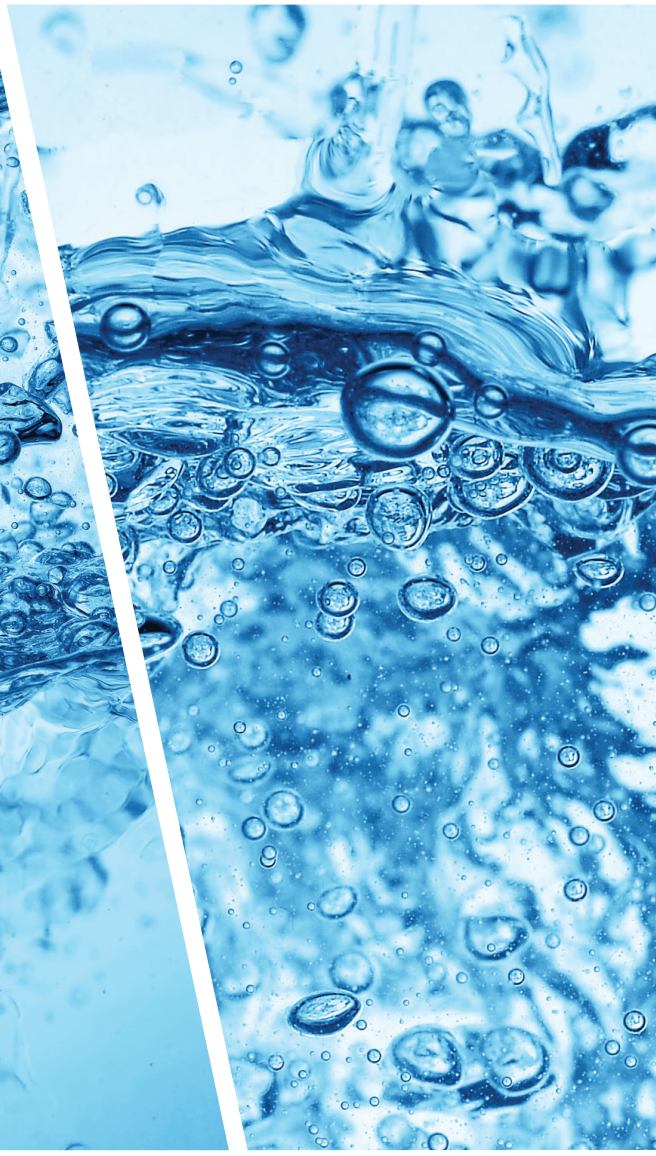
NATIONAL WASTEWATER DRUG MONITORING PROGRAM

REPORT 11, 2020

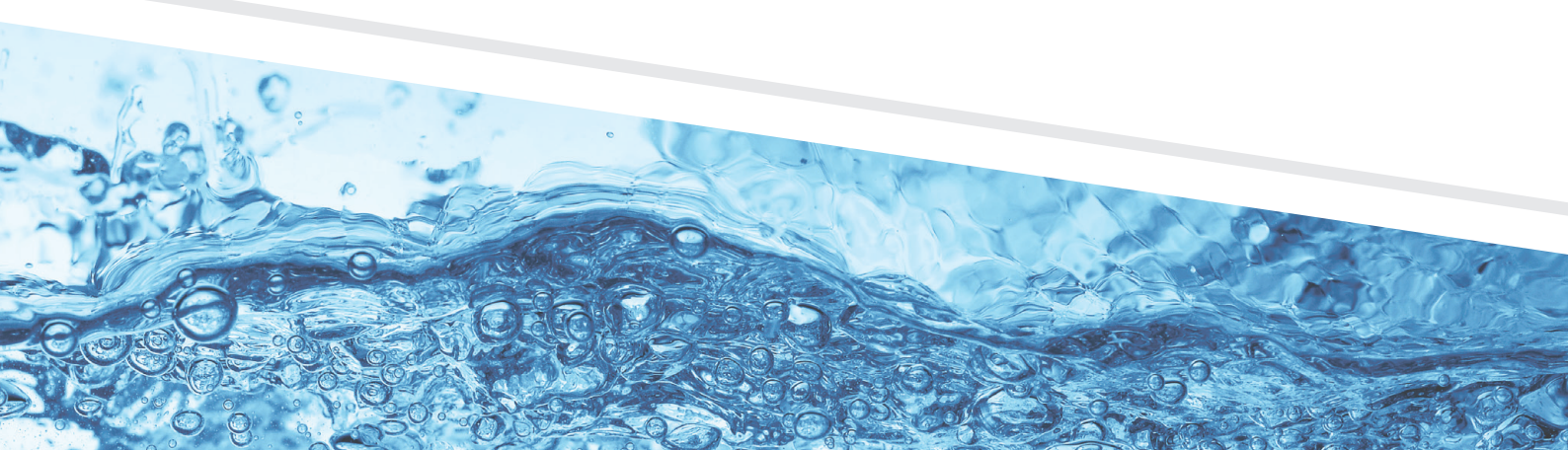


AUSTRALIAN CRIMINAL INTELLIGENCE COMMISSION

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

University of South Australia

CONTENTS



CEO FOREWORD

The Australian Criminal Intelligence Commission (ACIC) is responsible for providing information and intelligence on criminal activity to support Government in creating a safer Australia. Much of the harm that Australians suffer at the hands of organised crime is due to illicit drugs. Serious and organised crime groups profit from the importation, manufacture, trafficking and sale of drugs that cause harm to the community.

The National Wastewater Drug Monitoring Program (the Program) represents world best practice in its field. Work continues to consolidate the ACIC's collaboration with international partners in New Zealand, Asia, North America and Europe. Wastewater analysis assists in understanding drug use within populations, providing a measure of one important aspect of national health—the demand for a range of licit and illicit 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, because logically the level of harm to the community is a function of the quantity of the substance that is consumed. Understanding drug consumption at a population level supports effective allocation of resources to priority areas. It also allows for monitoring the progress of demand, supply and harm reduction strategies.

The Program is an Australian Government initiative. The ACIC has received an additional $4.8 million over four years as part of its annual appropriation to continue delivery of this important Program. This report is the second in a series of 12 reports that will be released publicly until early 2024. The ACIC will continue to provide an objective evidence base concerning illicit and licit drug use, and work with partners to exploit Program data by informing local and national response options and monitoring response effectiveness.

STEPPING UP—ASSESSING DRUG MARKETS DURING THE COVID-19 PERIOD

The most pleasing aspect of the Program is its increasing flexibility and ongoing evolution. One new focus during this reporting period is the detection of SARS-CoV-2 (COVID-19) in wastewater for advice to health and policy stakeholders, and another is reporting the positive results of sampling using new technology at sites away from wastewater treatments plants. In addition, the core program has leveraged its broad and sometimes unique geographic reach, years of accumulated longitudinal data, and the regularity of sample collection and reporting to brief law enforcement agencies and policy departments on the impact on illicit drug markets of the COVID-19 crisis and the national response. We are also making additional Program material available on the ACIC website for the first time. We hope these figures, which make it easier to view drug consumption for individual states and territories, will be a useful complementary resource to the reports.

The ACIC is now routinely engaging with academic institutions and the private and public sectors to merge our respective data holdings and insights to answer key questions concerning the size of illicit markets, the characteristics of particular locations that exhibit high levels of use of some drugs and the nature and extent of drug-related harms suffered by the community.

TRENDS IDENTIFIED DURING THIS REPORTING PERIOD

This Program report is the eleventh in a series of public reports that present Program findings. The Program provides statistically valid datasets of drug use and distribution patterns across a large number of sites in capital cities and regional Australia. In April 2020, 55 wastewater sites were

monitored nationally. Based on 2016 Census data, these sites cover approximately 56 per cent of the Australian population. The number and diversity of regional sites provide unique drug data that facilitate analysis of drug trends outside of the capital cities, while also informing local responses to the different circumstances that apply in each location. With the exception of cocaine and heroin, the per capita consumption of all drugs tested by the Program is higher in regional sites than in the capital cities, making the search for bespoke data to inform regional responses an ongoing priority for the Program. Of the drugs measured by the Program with available dose data, alcohol and nicotine continue to be the most consumed substances, with methylamphetamine the most consumed illicit drug.

Restrictions imposed in response to the COVID-19 pandemic have impacted illicit drug markets and shaped results in this report, but in ways that offer unprecedented insights into Australian drug markets. The results show, for example, that all drugs monitored by the Program continue to be available within Australia. Drug consumption across Australia during the COVID-19 period is characterised by diversity between and within jurisdictions and across drug types. Price variations are not a reliable indicator of consumption levels—prices for many drugs have increased, albeit unevenly and not always to levels outside historical ranges. Even in locations where considerable price increases have been reported, consumption of some drugs has also increased.

While low levels of consumption for some drugs during COVID-19 are perhaps of little surprise, record high consumption levels are also recorded. For example, average regional consumption of methylamphetamine increased to the highest level recorded by the Program in April 2020, average capital city cocaine consumption increased to a record level in June 2020, there was record average regional heroin consumption in April 2020, and cannabis consumption increased to a record high level in capital cities in June 2020. Average regional consumption of fentanyl and capital city consumption of oxycodone decreased to record low levels in April 2020.

STRATEGIC TRENDS

Record consumption levels for some drugs are consistent with operational activity in which the ACIC has been involved with its partners. Observed organised criminal activity indicates that the more sophisticated component of the supply side of major drug markets continues to operate on a ‘business as usual’ basis at an importation and wholesale drug trafficking level.

Results from this report underline the resilience and variety of regional drug markets in Australia. The ACIC is working with its partners to gain a more granular understanding of regional drug markets and drive appropriate responses.

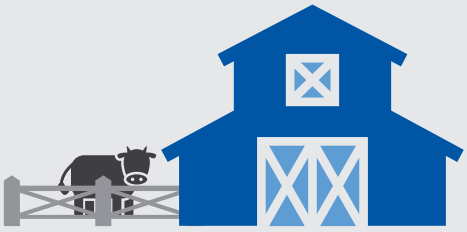
I would like to acknowledge the valuable support and expertise of the Universities of Queensland and South Australia, which undertook the data collection and analysis which underpins this report, and the Australian Criminal Intelligence Commission officers who contributed to the project.

Michael Phelan APM
Chief Executive Officer
Australian Criminal Intelligence Commission

SNAPSHOT

The April 2020 collection covers around **56 per cent** of Australia's population—about **13.1 million Australians.**

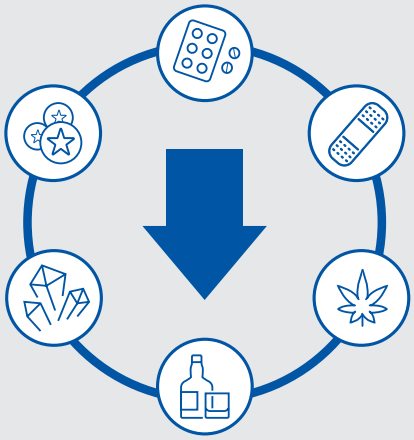
Capital city **cocaine** and **heroin** average consumption exceeded regional consumption.



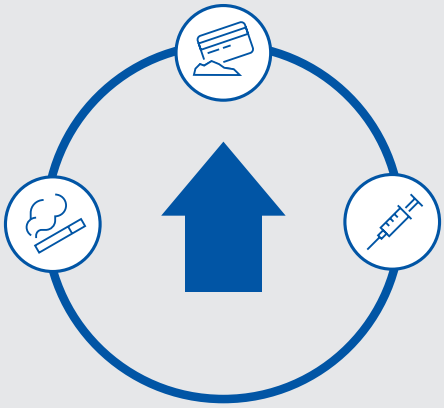
Regional **nicotine, alcohol, methylamphetamine, MDMA, MDA, oxycodone, fentanyl** and **cannabis** average consumption exceeded capital city consumption.

Of the drugs measured with available dose data, **alcohol** and **nicotine** remain the most consumed, with **methylamphetamine** the most consumed illicit drug.

Between December 2019 and April 2020, the population-weighted average capital city consumption of:

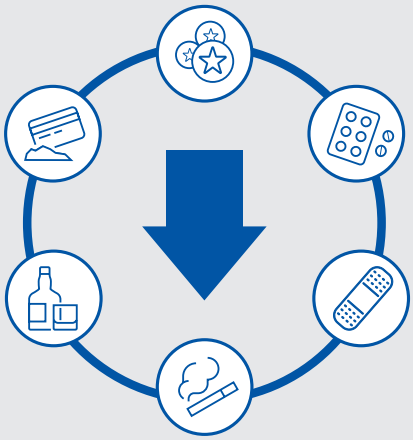


alcohol, methylamphetamine, MDMA, oxycodone, fentanyl and cannabis **decreased**

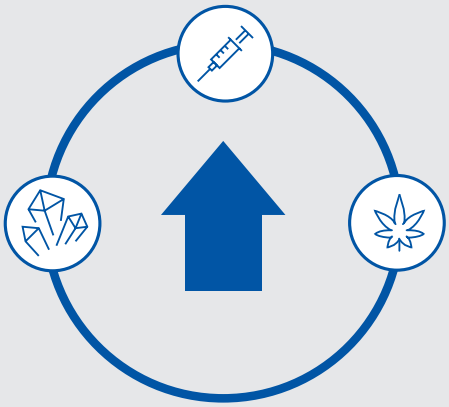


nicotine, cocaine and heroin **increased**

Between December 2019 and April 2020, the population-weighted average regional consumption of:

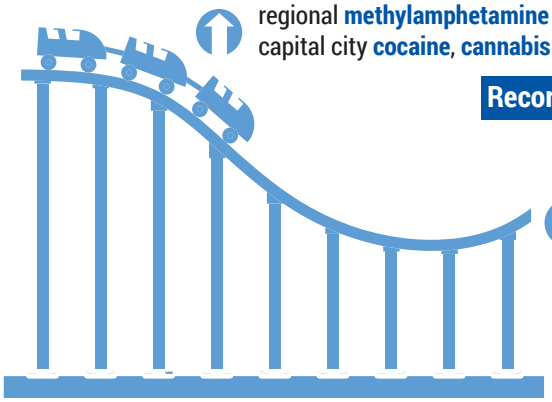


nicotine, alcohol, cocaine, MDMA, oxycodone and fentanyl **decreased**



methylamphetamine, heroin and cannabis **increased**

IMPACT OF COVID-19



regional **methylamphetamine** and **heroin**
capital city **cocaine**, **cannabis** and **nicotine**

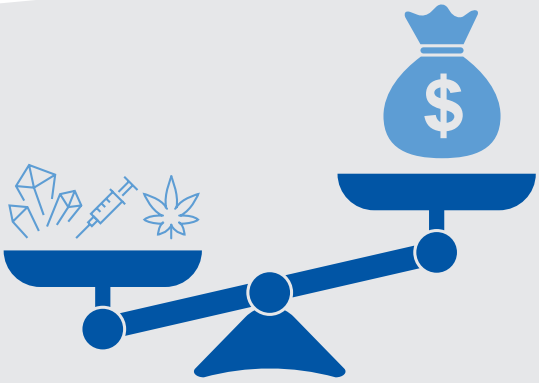
Record high drug consumption

regional **fentanyl**
capital city **oxycodone** and **alcohol**

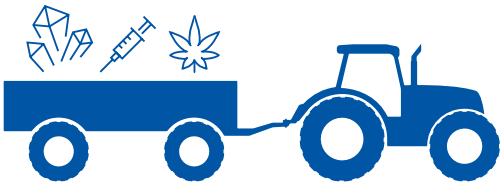
Record low drug consumption

Price increases have not been a reliable indicator that consumption will decrease—in some places consumption has risen with prices.

Variations exist in drug prices across jurisdictions and drug types, with some wholesale prices changing more than street prices.



Many of the price variations are still within historical ranges



Major regional drug markets, such as those for **methylamphetamine**, **heroin** and **cannabis**, have actually seen increases in consumption during the COVID-19 period.

In one jurisdiction in June 2020, average **MDMA** capital city consumption exceeded methylamphetamine consumption for the first time anywhere in Australia since the Program commenced.

There is no evidence in the wastewater data that the mooted significant decrease in **heroin** consumption actually occurred, and hence there was no tangible displacement to the **illicit pharmaceutical opioids** market.

The **cannabis** market was not negatively impacted during the COVID period to the extent of other major drug markets, despite highly inflated prices in some areas.

This is likely because almost all of the market is supplied from domestic sources and cultivation occurs nationally.

INTRODUCTION

This is the eleventh in a series of National Wastewater Drug Monitoring Program reports to be publicly released by the Australian Criminal Intelligence Commission, and the second of twelve reports to be delivered under new budgetary arrangements that will see reports delivered until the early months of 2024. The program provides a measure, rather than an estimate, of the consumption of a number of illicit drugs, as well as licit drugs including nicotine, alcohol and some pharmaceuticals. It gives us valuable insight into the trends and emerging issues in drug consumption across Australia and can identify new sources of threat.

The eleventh report presents data on Australia's drug consumption for 13 substances and includes data for April (capital city and regional sites) and June 2020 (capital city sites). Longitudinal data captured by the program increases our understanding of drug use nationally, in specific jurisdictions and regions, and over time. This has never been more important than the present, with the impact of the COVID-19 virus on drug markets being felt differently in the respective jurisdictions, and even within jurisdictions. Findings presented in the reports provide law enforcement, policy, regulatory and health agencies with additional, objective data on the use of methylamphetamine and other drugs. These data create opportunities to shape the response to the demand and supply sides of the illicit drug market, particularly in high-use areas, and inform harm reduction strategies. They permit priorities to be set and modified in a manner that is consistent with constantly evolving drug markets and broader world circumstances.

IMPLEMENTATION

The Australian Criminal Intelligence Commission 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, wastewater analysis from the National Wastewater Drug Monitoring Program measured the presence[1] of the following substances:

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

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.

The Australian Criminal Intelligence Commission continues to review the appropriateness of monitored substances and sampling sites with its partners, stakeholders and the universities.

Both contracted universities monitor wastewater across Australia, covering all state and territory capital cities and a range of regional cities and towns. In April 2020, 55 wastewater treatment plants participated nationally.[2] Sites were selected to permit the Australian Criminal Intelligence Commission 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 two universities.

The breakdown of sites by jurisdiction for April 2020 is as follows:

Participation from all states and territories is vital to informing our understanding of the national picture of drug use and demand. In the event that one or more states and territories decides not to participate in the national program in the future, the Australian Criminal Intelligence Commission will identify replacement sites from participating states and territories to ensure that the largest possible segment of the national population is sampled. Accordingly, the location of sites within and between states and territories may change over the life of the program.

2 Sampling also occurred in June 2020 in capital city sites, with 20 participating wastewater sites nationally, covering approximately 48 per cent of the Australian population.

REPORTING

National Wastewater Drug Monitoring Program reports are completed three times a year and made public. In accordance with current wastewater analysis conventions, the terms of the contract, and to protect the integrity of the program, the exact locations of wastewater treatment plants sampled are not publicly released by the Australian Criminal Intelligence Commission. Stakeholders in law enforcement, health and other relevant policy agencies are provided with classified information identifying actual sampling locations to inform appropriate responses. This has particularly been the case during the COVID-19 period.

Reported results reflect per capita use in all locations and, with the exception of MDA and cannabis (for which reliable dose figures are not available), 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 THE NATIONAL WASTEWATER DRUG MONITORING PROGRAM DATA

The National Wastewater Drug Monitoring Program is based on a well-established and internationally recognised methodology. The Australian Criminal Intelligence Commission considers that National Wastewater Drug Monitoring 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. The eleventh National Wastewater Drug Monitoring Program report measures the drug use of approximately 56 per cent of the Australian population.[3]

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 the different dynamics that apply to both capital city and regional markets and also illustrate drug preference variation that exists both 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. The number and diversity of regional sites that participate in the program permits confident assessments to be made of drug trends outside of the capital cities and facilitates local responses to the different circumstances that apply in each location. This is important because it permits wastewater data to complement a number of other sources of drug data in Australia which have very limited regional coverage, or are confined to capital cities.

STRATEGIC INSIGHTS DURING THE COVID PERIOD

The diversity of Australian drug markets, and the variety of local characteristics and participants that shape them, has been amply demonstrated since COVID-19 restrictions were first implemented in March 2020. Over a few short months we have seen:

- the variation in consumption that continues to exist, both within and between jurisdictions
- regional methylamphetamine consumption in April 2020 increase to the highest level reported by the program, while capital city methylamphetamine consumption decreased considerably from April to June 2020

3 The December 2019 population estimate is based on the Australian Bureau of Statistics 2016 Census data and catchment data supplied by the operators of the wastewater facilities and service providers.

- capital city cocaine consumption increase to a record level in June 2020
- record regional heroin consumption in April 2020
- record or near record low levels of fentanyl and oxycodone consumption
- alcohol consumption decreasing then recovering
- cannabis consumption increasing to record and near record highs
- MDMA consumption exceeding methylamphetamine consumption in one capital city for the first time since the program commenced.

Wastewater data are used with other available data sources to develop a comprehensive and accurate understanding of drug markets nationally and in the states and territories. One interesting insight which has been developed from drug price data supplied by two jurisdictions in relation to the COVID period is that in those jurisdictions, price increases appear to have had little or no dampening effects on the level of consumption of a number of illicit drugs. Wastewater data collected by the National Wastewater Drug Monitoring Program have also been used to estimate the quantity and value of methylamphetamine, cocaine, MDMA and heroin consumed annually in Australia; to explore the relationship between drug consumption and different types of crime; and to assess the impact of law enforcement and health initiatives aimed at reducing drug supply and demand. A number of partners are using wastewater data as the basis of their operational decision making.

The program has successfully tested novel sampling techniques and equipment that allow for the monitoring of drug consumption at additional sites, including sites that are not treatment plants. Work continues on the practical application of this sampling strategy. Over the past 12 months wastewater data have also been obtained by the Australian Criminal Intelligence Commission and its partners in relation to a broader range of substances and for a series of different purposes than is currently the case with the National Wastewater Drug Monitoring Program. The universities contracted by the Australian Criminal Intelligence Commission and the Commonwealth Scientific and Industrial Research Organisation have also successfully identified COVID-19 in wastewater. These applications underline the flexibility and value of wastewater analysis, not just for the Australian Criminal Intelligence Commission, but also for other public and private sector clients.

The Australian Criminal Intelligence Commission engages with academic institutions, industry and public sector agencies to identify further data applications. Opportunities identified include 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. Advantages of the National Wastewater Drug Monitoring Program are that the data are collected on an ongoing basis and are reported regularly, which has proven to be a significant advantage during COVID-19. The Program is sufficiently flexible to allow for focusing collection activity in different geographic locations and at more regular intervals in response to identified need. Increasingly, Program data are being triangulated with other data sources to generate a more granular appreciation of drug markets.

THE IMPACT OF COVID-19 ON AUSTRALIAN DRUG MARKETS

All illicit drug types continue to be available within Australia. Drug consumption across Australia during the COVID period has been characterised by diversity between and within jurisdictions and across drug types.

The Australian Criminal Intelligence Commission is able to compare jurisdictional price data with consumption data from the National Wastewater Drug Monitoring Program, providing the Commission with a unique perspective on the impact of price on illicit drug markets. This analysis demonstrates that variations exist in drug prices across the country, across drug types and jurisdictions. However, many of the price variations have still fallen between historical ranges so it is still too early to make definitive statements about the impact of COVID on Australian drug prices. As a general statement, reported wholesale prices have changed more than reported street prices. Price variations have not been a reliable indicator of consumption levels—in at least two jurisdictions, considerable price increases have been reported in areas where drug consumption has increased.

Apart from cocaine and heroin, per capita regional consumption of drugs monitored by the program continues to exceed capital city consumption. This has implications for the level of harm posed by drug markets and also for response options. It is interesting to note that regional consumption of a number of key drugs monitored by the program appear relatively unaffected by COVID-19 restrictions. Examples include methylamphetamine and heroin.

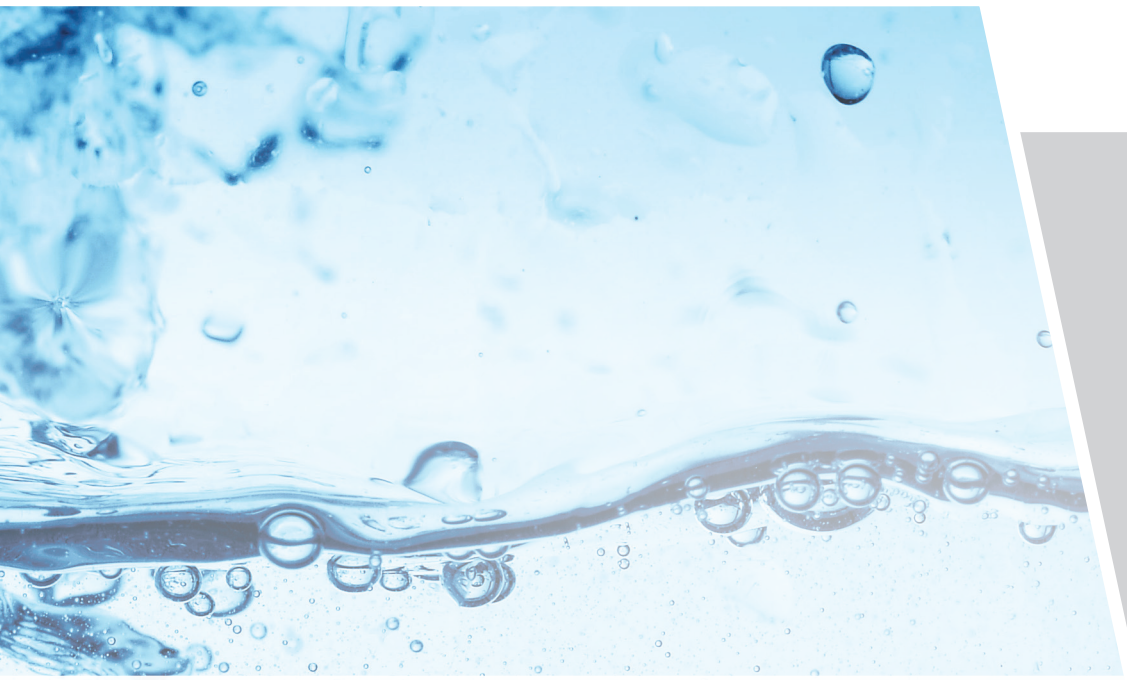
One hypothesis that was tested during the COVID-19 period was that there would be a considerable decrease in heroin consumption, leading to a displacement of heroin users to the illicit market for pharmaceutical opioids. There is no evidence in the wastewater data to date to indicate that there has been a notable change of this kind. While per capita consumption of heroin in capital city sites increased from December 2019 to April 2020, it decreased considerably to June 2020. At the same time, perhaps paradoxically and for reasons yet to be determined, heroin consumption in regional Australia increased to record levels in April 2020. Per capita consumption of fentanyl and oxycodone continued a relatively consistent decrease that has been evident for over 12 months. The ACIC is engaged in ongoing work to distinguish between trends in the licit and illicit components of the fentanyl and oxycodone markets.

Per capita cannabis consumption in capital city sites increased to the highest level on record in June 2020, with regional consumption in April 2020 the second highest level on record. In some cases these consumption levels occurred during a period when cannabis prices were at inflated levels. The likely reason for the level of consumption of cannabis during the COVID period is that almost all of the market is supplied from domestic sources and cultivation occurs nationally.

POLICY AND OPERATIONAL CONSIDERATIONS

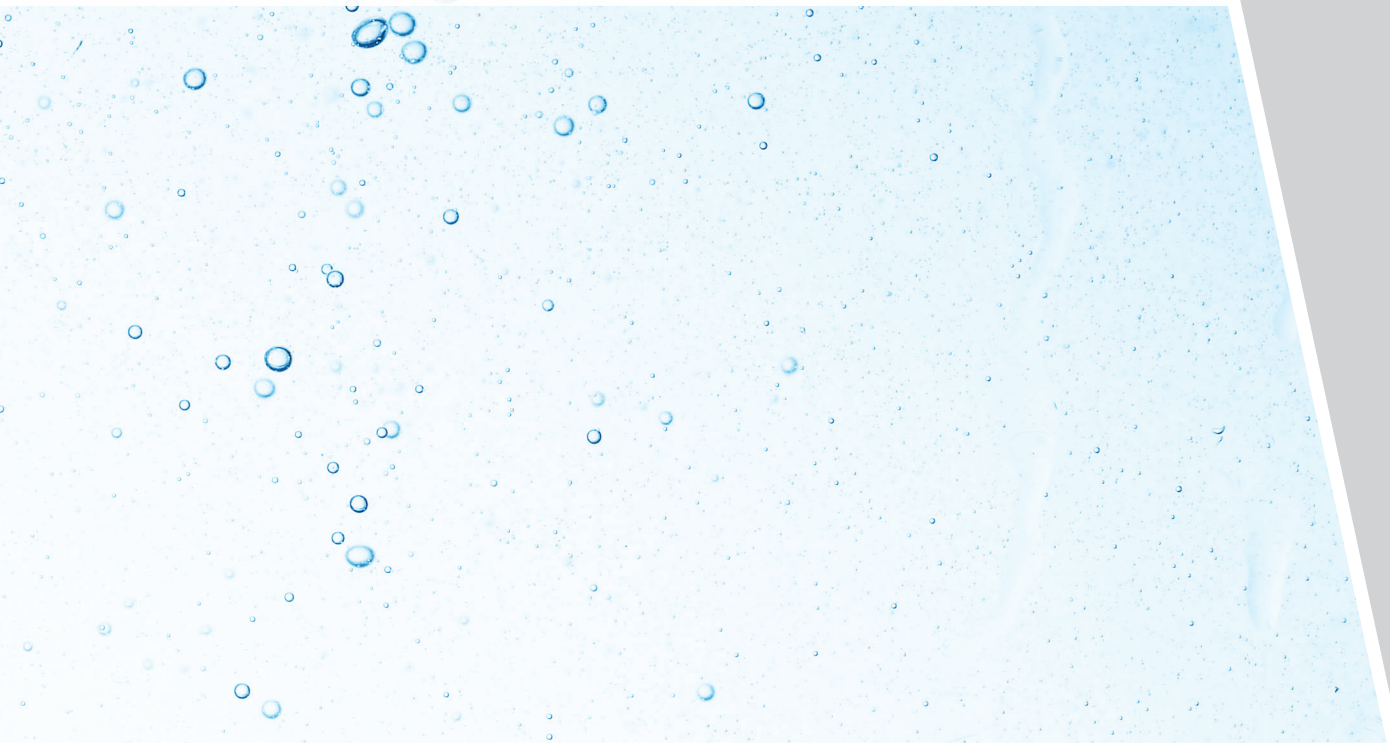
It is evident that a multi-dimensional approach that targets supply, demand and harm reduction is critical to addressing drug use in Australia. Drug consumption estimates derived from wastewater data, when used in combination with other data—such as seizure, arrest, price, purity, health and availability data—provide insight into related markets and the potential impact of supply, demand and harm reduction strategies.

Wastewater data are an important part of the suite of datasets available to increase our understanding of drug consumption, demand and supply in Australia. Making data from the program publicly available assists to enrich understanding and inform the national conversation on drug trends and related demand. This eleventh report of the National Wastewater Drug Monitoring Program builds on national drug consumption data contained in preceding reports to identify temporal drug use trends across states, territories and the nation. It provides data on capital city and regional drug use and, where possible, comparisons with previous levels of use in sites across Australia and internationally. This, and future reports, continue to build and shape understanding on trends and changes in patterns of use, creating an increasingly detailed picture of drug consumption in Australia.



RESEARCH FINDINGS

Prepared by the University of Queensland (B Tscharke, J O'Brien, T Reeks, G Elisei, J Lin, S Grant, J Mueller, K Thomas) and University of South Australia (M Ghetia, R Bade, J Chen, L Nguyen, C Gerber, J White)



LIST OF ABBREVIATIONS

ABS	Australian Bureau of Statistics
ACIC	Australian Criminal Intelligence Commission
ACT	Australian Capital Territory
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
NPS	New psychoactive substances
NSW	New South Wales
NT	Northern Territory
NWDMP	National Wastewater Drug Monitoring Program
Qld	Queensland
SA	South Australia
SPE	Solid phase extraction
Tas	Tasmania
THC	Tetrahydrocannabinol
THC-COOH	11-nor-9-carboxy-tetrahydrocannabinol (THC-COOH)
Vic	Victoria
WA	Western Australia
WWTP	Wastewater treatment plant

TERMINOLOGY

Methylamphetamine is also commonly known as methamphetamine. In this report, consistent with the preferences of the Australian Criminal Intelligence Commission, methylamphetamine is used.

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 in this report 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-Δ9-tetrahydrocannabinol (THC-COOH).

1: EXECUTIVE SUMMARY

The Australian Criminal Intelligence Commission (ACIC)'s National Wastewater Drug Monitoring Program (NWDMP) has been reporting on selected substances of concern in most populated regions of Australia since August 2016. Estimates of drug usage in a population were determined from measured concentrations of drug metabolites (excreted into the sewer system after consumption) in wastewater samples. The current version of the NWDMP focuses on thirteen licit and illicit drugs, including nicotine, alcohol, methylamphetamine, cocaine and MDMA (ecstasy), with cannabis included from Report 6. Trends in estimated drug consumption are being established 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 this program.

For this eleventh report, wastewater samples were collected during a week in both April and June 2020. The April collection involved regional and capital city catchments, while June covered capital cities only. Twenty-four-hour composite influent wastewater samples were collected using time or flow-proportional autosamplers at each WWTP by plant operators. Samples were collected for up to seven consecutive days. 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 flow volumes and estimates of the catchment population size by evaluating census data vs. catchment maps, together with excretion and dose data obtained from the scientific literature.

A total of 20 WWTPs in capital cities and a further 35 regional sites participated in the program for the April 2020 period, covering a population of 13.1 million Australians. To maintain treatment plant confidentiality, each site was allocated a unique code and site names are not included in this report. Site codes stay assigned to each WWTP throughout the course of the program. Data from this report equates to coverage of approximately 56 per cent of Australia's population for April 2020 and 48 per cent for June 2020 (capital city sites only). A total of 5,423 individual daily samples have been collected and analysed since the beginning of the program, with new results from 509 additional samples added in this report. The collected samples provide comprehensive, Australia-wide baseline data against which subsequent results can be compared to ascertain both spatial and temporal trends.

The estimation of drug use across 55 sites provided a snapshot of the scale of use over a week in April 2020, which was compared with historical data included in previous reports. The April 2020 dataset was used for this purpose as it was more comprehensive, including both capital city and regional sites. After normalising the amount of drug measured in wastewater for population size and average dose consumed, alcohol and nicotine remained consistently the highest consumed drugs in all states and territories. Cannabis was not included in the comparison but will be once better estimates of a typical dose are available. The consumption of nicotine and alcohol was substantially higher in regional areas compared to capital cities. Sites in New South Wales, Queensland, Victoria, Tasmania and the Northern Territory had the highest levels of nicotine. Alcohol consumption was more consistent across regional parts of the country, apart from South Australia and Western Australia where use was substantially lower. The Northern Territory and Tasmania had the highest capital city consumption of alcohol. Levels of nicotine and alcohol have been relatively steady since the start of the program in 2016, averaging out short-term fluctuations. South Australia and Western Australia were some of the exceptions, with declining longer-term alcohol consumption rates.

On 20 March 2020, the Australian borders were closed to non-resident arrivals, which was the beginning of a multi-stage action to contain the spread of the SARS-CoV-2 virus which causes the coronavirus disease, COVID-19. By the beginning of April 2020, Stage 3 restrictions were in place, including several restrictions on population movement such as public gatherings, closures of businesses and inter-state borders, social-distancing restrictions, and employees working from home. Towards the end of April 2020, restrictions began to ease on a jurisdiction by jurisdiction basis. With the exception of Victoria and some areas in New South Wales, restrictions were gradually lifted across the country through May and June 2020. Victoria experienced a second wave of restrictions following outbreaks in late June, and on 30 June 2020 restrictions were re-imposed in several Melbourne postcodes in the city area. Government income support payments were also beginning to be distributed from June 2020. The results in this report need to be understood in this context.

The effect of the COVID-19 restrictions was particularly apparent for alcohol, with average consumption dropping in every capital city except Victoria in April. Rates of alcohol use rebounded in many instances in June, once restrictions were eased. Interestingly, regional average alcohol consumption was less impacted, with changes being consistent with fluctuations over the recent past.

When expressed as doses per day, methylamphetamine had the highest consumption of the illicit drugs included in the report, both in capital cities and regional sites. April 2020 data showed big differences between sites, even within the same state or territory. South Australia had the highest capital city levels while regional sites in this state, as well as New South Wales and Victoria, all had some of the highest use. Up to the previous reporting period (February 2020), the trend over the life of the program showed a rise in methylamphetamine use in almost every part of the country. Since the start of the pandemic, use of the drug declined sharply in every capital city. The drop in levels was delayed until June in some states, e.g. Queensland, South Australia and Western Australia. The impact was most dramatic in Western Australia where the capital city average almost halved. In contrast to the capital cities, the effects of COVID-19 restrictions were less apparent in regional Australia, with methylamphetamine use even increasing in some areas.

Amphetamine is a metabolite of methylamphetamine. Measured amphetamine concentrations across the sites were mostly consistent with the observed levels being related to methylamphetamine metabolism rather than a consequence of direct amphetamine consumption.

Compared to methylamphetamine, the estimated usage of other stimulants was generally much lower. Cocaine consumption in Australia in April 2020 was mostly centred in capital city New South Wales and to a lesser extent, the Australian Capital Territory, Queensland and Victoria. Unlike the other stimulants, average cocaine consumption was lower in regional centres. The overall trend over the life of the program showed increases in many states and territories up to the present reporting period. However, the pandemic resulted in a reduction in cocaine use in many states and territories, most notably New South Wales. After the initial lock-down in April 2020, levels recovered and reached historical highs in some parts of the country, e.g. the Australian Capital Territory, Victoria and Western Australia.

MDMA usage was relatively low and less variable than other stimulants across most parts of the country. Regional use was higher than in the capital cities. South Australia and Victoria generally had lower MDMA levels than other areas. COVID-19 restrictions appeared to arrest the increasing trend in MDMA use in many parts of Australia in the recent past, including regional averages in most states and territories. Overall MDA use was relatively low, with no consistent pattern evident. Sites in capital city Queensland and Tasmania recorded the highest levels, while regional averages were also higher than in the capital cities. After the pandemic broke out and restrictions came into effect, MDA use declined, except in the two territories and Western Australia.

Oxycodone and fentanyl are prescription pharmaceutical opioids with abuse potential. Oxycodone consumption was substantially higher in regional parts of the country in April 2020 compared to the capital cities, most evident in Victoria and Queensland. Tasmania had the highest rates of use of the capital cities. A decline in long-term use of the substance in Australia has been a feature, with the trend accelerating during the COVID-19 restrictions. Fentanyl use was also more prevalent in regional parts of the country, but not to the extent of oxycodone. Fentanyl consumption continued the decline observed in the preceding collections (October 2019 to February 2020) in most regions. However, compared to oxycodone, the pandemic appeared to result in a greater drop in consumption of fentanyl in capital cities. Regional areas were less impacted.

Heroin consumption remained mostly centred in Victoria and parts of New South Wales. Average use of the drug was lower in regional areas compared to the capital cities in the reporting period. Although no consistent long-term trends of heroin use have been apparent over the course of the program, heroin consumption has decreased since the onset of COVID-19 in many capital cities, except in Tasmania and Victoria. Similar to other illicit substances, regional areas were again less impacted.

The cannabis metabolite, 11-nor-9-carboxy-tetrahydrocannabinol (THC-COOH), a specific marker for cannabis consumption, is excreted in extremely small amounts. This may be a cause of variability in back-calculated results, so a cautious approach is needed when making comparisons. The results of the April 2020 collection were highly variable between and within jurisdictions. The regional average rate of consumption was high compared to capital cities. South Australia and parts of New South Wales, Queensland and Tasmania in particular had high consumption levels. Tasmania had the highest use of the capital cities. Use was relatively low in capital city New South Wales, Queensland and Victoria compared to other parts of the country. Cannabis consumption appears to have changed during the COVID-19 restrictions, with consumption increasing in most parts of the country compared to before the outbreak.

For the other drugs included in the NWDMP, methylone and mephedrone concentrations were generally at or below detection levels at most participating sites. The rise in detection frequency of mephedrone in Australian capital cities was mostly reversed in the current reporting period.

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 were commissioned to provide drug consumption data to the ACIC, for an initial three-year program from 2016 to 2019, including nine public reports. The two universities have been re-commissioned to provide data for a further four years, including 12 public reports. Wastewater treatment sites have been assessed, bimonthly in the case of capital city sites and every four 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 use across Australia to establish trends. This latest NWDMP report compares consumption data from previous reports with results obtained subsequently from all sites in April 2020 and capital cities in June 2020.

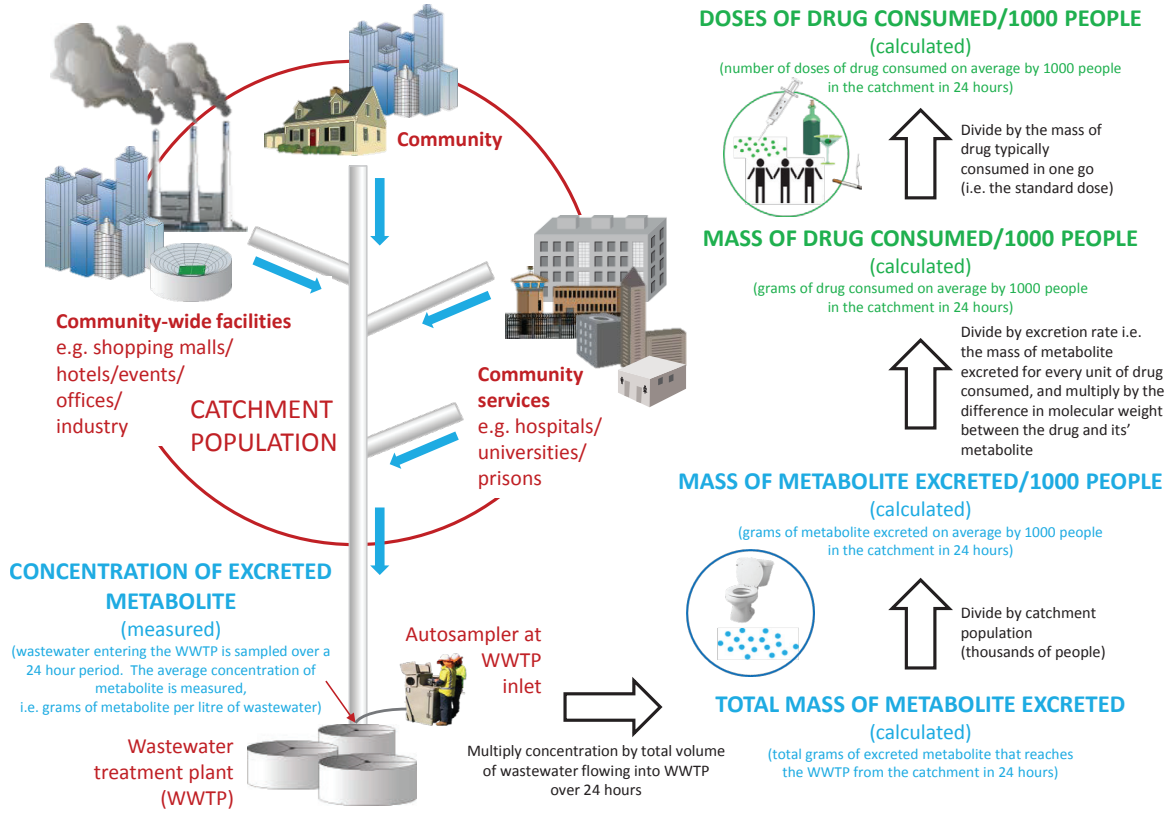
Compounds of concern include nicotine from nicotine intake (cigarettes, gum, patches, e-cigarettes, etc.), ethanol from alcohol intake, pharmaceutical opioids with abuse potential, illicit substances such as methylamphetamine, MDMA, cocaine and heroin, as well as two new psychoactive substances (NPS). Amphetamine and MDA were not included in the initial reports. Amphetamine is a by-product of methylamphetamine pyrolysis and is also one of its metabolites. Amphetamine can also be used as an illicit drug. However, we found the levels of amphetamine corresponded largely with the expected values from the excretion of methylamphetamine. Similarly, MDA is a metabolite of MDMA but can also be used as an illicit drug. However, since the proportion of MDA derived from MDMA is known, the difference between measured MDA and the MDMA metabolite has been included in the NWDMP since Report 3. The amount of MDA was calculated by subtracting 1.65 mg of MDA for every 100 mg of MDMA consumed (Pizarro et al. 2002; Khan & Nicell 2011) and is expressed in units of mg excreted per day per 1,000 people. Cannabis was measured by its urinary metabolite, THC-COOH. The report presents patterns of substance use across Australia, showing differences in levels between capital cities and regional centres, within and between states and territories, and nationally. Cannabis results are expressed only as mg consumed per day, per 1,000 people and will also be expressed as dose per day per 1,000 people when better estimates of a typical dose become available.

3: METHODS

The method underlying wastewater-based monitoring of drug use 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. The excreted compound or metabolite will eventually arrive in the sewer system. The drugs and their metabolites of interest were included in the first NWDMP report (available at www.acic.gov.au), as well as an in-depth description of the methodologies involved.[4] 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 1). The method is non-invasive and is done on a population-scale level, so individuals are not targeted, and privacy is respected.

4 Information in relation to heroin appears in Report 3.

Figure 1: 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 normalised population.



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. From the August 2018 collection period, operators collected a second daily influent sample with sodium metabisulphite (0.5% m/v) as preservative 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 our laboratories are based on filtration of the samples followed by an enrichment/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. Methods to extract and analyse the cannabis metabolite are outlined in Tscharke et al. (2016).

3.1 PARTICIPATING WASTEWATER TREATMENT PLANTS (WWTPs)

Fifty-five WWTPs across Australia participated in the NWDMP for the April 2020 collection period (Figure 2). Of these, 20 sites were located in capital cities and a further 35 were regional sites, covering a wide range of catchment population sizes. Sites were selected by the Australian Criminal Intelligence Commission. The number of participating sites for this report and a complete list of participating sites, number of samples and relative catchment sizes are listed in Table 1 and Appendix 2. To maintain the confidentiality of the participating sites, all sites were allocated a unique code to de-identify their results. Only site codes are presented in the results sections.

Figure 2: Participating WWTPs in April 2020 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.

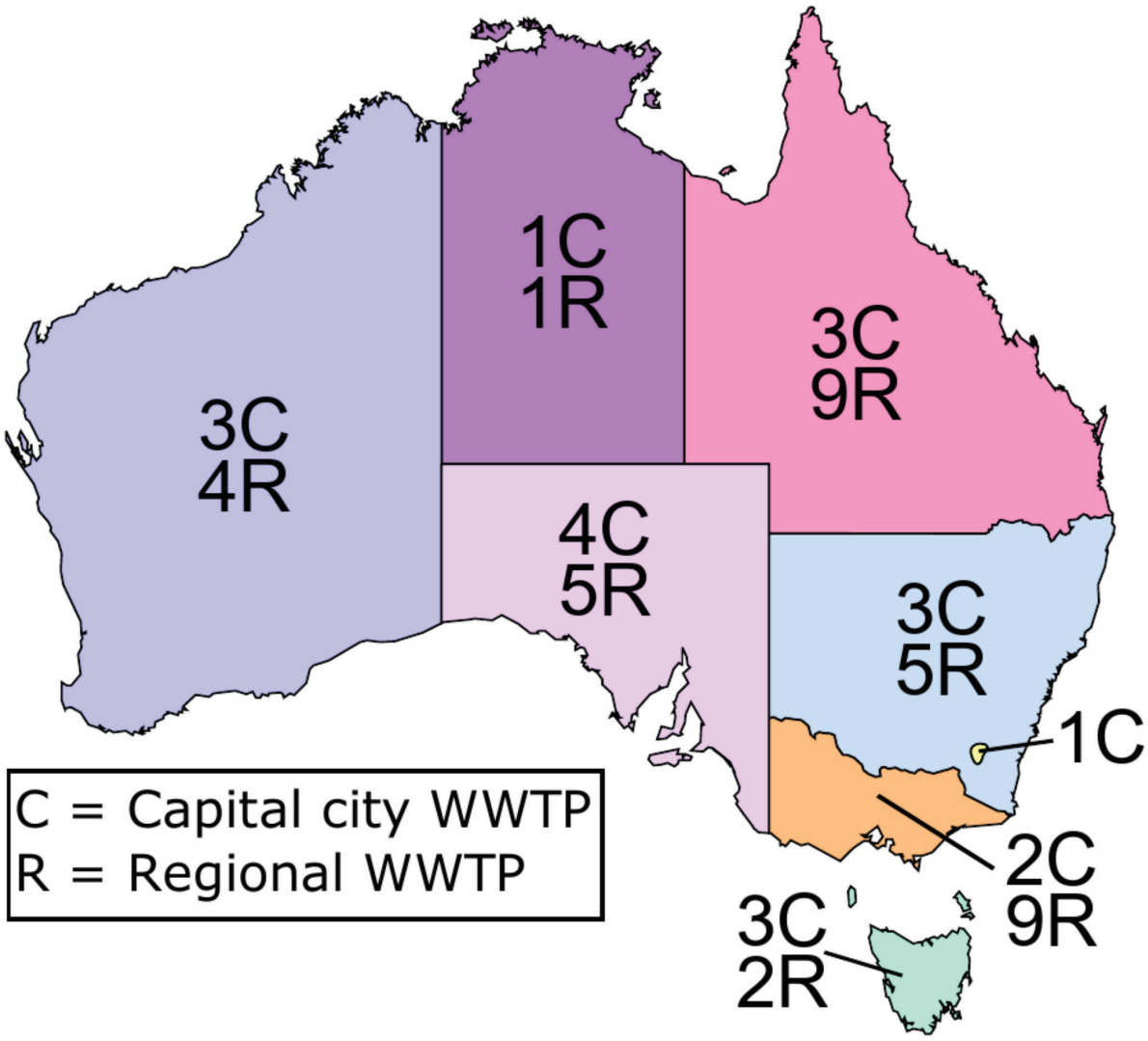


Table 1: Number of participating WWTPs for the periods covered in this report. One collection period aims to collect data from both regional (R) and capital city (C) sites, while the other collection period aims to collect data from capital city sites only.

State/territory	Apr 2020 Capital	Apr 2020 Regional	Jun 2020 Capital
ACT	1	0	1
NSW	3	5	3
NT	1	1	1
Qld	3	9	3
SA	4	5	4
Tas	3	2	3
Vic	2	9	2
WA	3	4	3
Sites	**20**	**35**	**20**
Population (millions) C & R	**11.2**	**1.9**	**11.2**
% of Australian Population	**47.9**	**7.9**	**47.9**
Total population (millions)		**13.1**	**11.2**
% of Australian population		**55.8**	**47.9**

Estimates have been rounded to the nearest 0.1 million. Census 2016 population used (23,401,892) for population percentage estimates.

3.2 SAMPLE COLLECTION AND PREPARATION

Daily composite samples were collected by treatment plant staff on seven consecutive days, or where seven days was not feasible, across as many consecutive days as possible. Regional sites in South Australia have only been providing weekend samples since April 2018, which should be considered when interpreting historical results where the number of sampling days was five—see Appendix 3, Report 6. In addition, 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, updated flow measurements supplied by wastewater treatment authorities. 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 methylamphetamine consumption, the methylamphetamine 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). For example, 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 the current report will be under-estimated compared to those determined for an adult-only population. For consistency, data from other studies included in this report 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 3. This includes information on interpreting the consumption data presented on the vertical axes in all graphs in this report. 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 case of MDA, the amount of MDA excreted following MDA consumption is not known, and therefore this drug 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. For cannabis, the approximate dosage is not well defined, and results are expressed as mg consumed per 1,000 people per day.

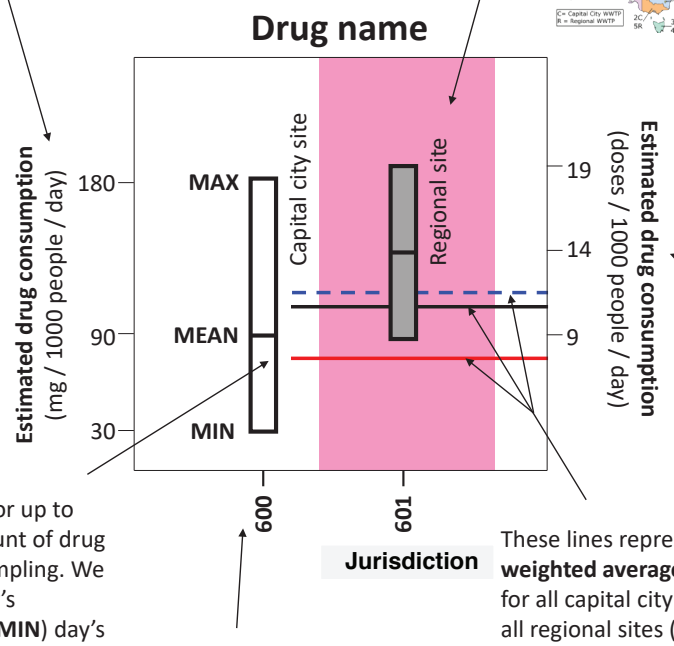
Figure 3: Explanation of the graphical representation of data for individual sites and bubble maps. General concepts relevant to all graphs in the report are also outlined (unique site codes, explanation of vertical axes, colour coding).

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. 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).



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).

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

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 grey 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 3 (continued): Explanation of the graphical representation of data for individual sites and bubble maps. General concepts relevant to all graphs in the report are also outlined (unique site codes, explanation of vertical axes, colour coding).

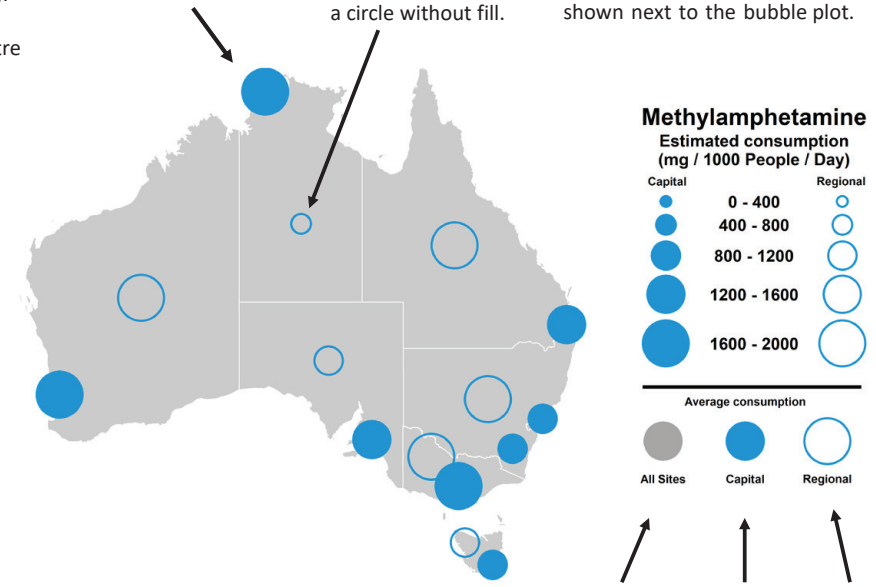
Bubbles:
Capital city site averages are drawn over the capital city of a jurisdiction and the regional site averages are drawn close to the middle of the State or Territory. Regional bubbles are drawn arbitrarily close to the centre of each jurisdiction and do not reflect location of sites.

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 next to the bubble plot.



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.

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)[5] 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.

Weekly pattern of drug use: The pattern of drug use over the sampling week for the sites in this report cannot be elucidated from the data included in the current report. This is because the starting day of the collection week did not always correspond for every plant. We present only maximum, minimum and average (for the individual sites) (e.g. Figure 3) and only population-weighted average values for all other graphs. Consistent patterns of drug use in Australia from previous wastewater-

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

based epidemiology studies indicate that some illicit drugs such as cocaine, MDMA, mephedrone and methylone 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).

4: RESULTS

Estimated drug consumption data are presented in several different ways in the following sections to allow comparisons of drug use at the individual site level for April 2020 (section 4.1), temporal trends for states and territories for the past two years (section 4.2) and within each state and territory (section 4.3). April 2020 data were used for this section 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 and the collection week did not correspond in all instances. A list of the detection frequency for each drug can be found in Appendix 3. This report retained the current population estimates introduced in Report 4 by integrating the specific wastewater catchment areas against the high-resolution population data released from the 2016 Census. 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 APRIL 2020

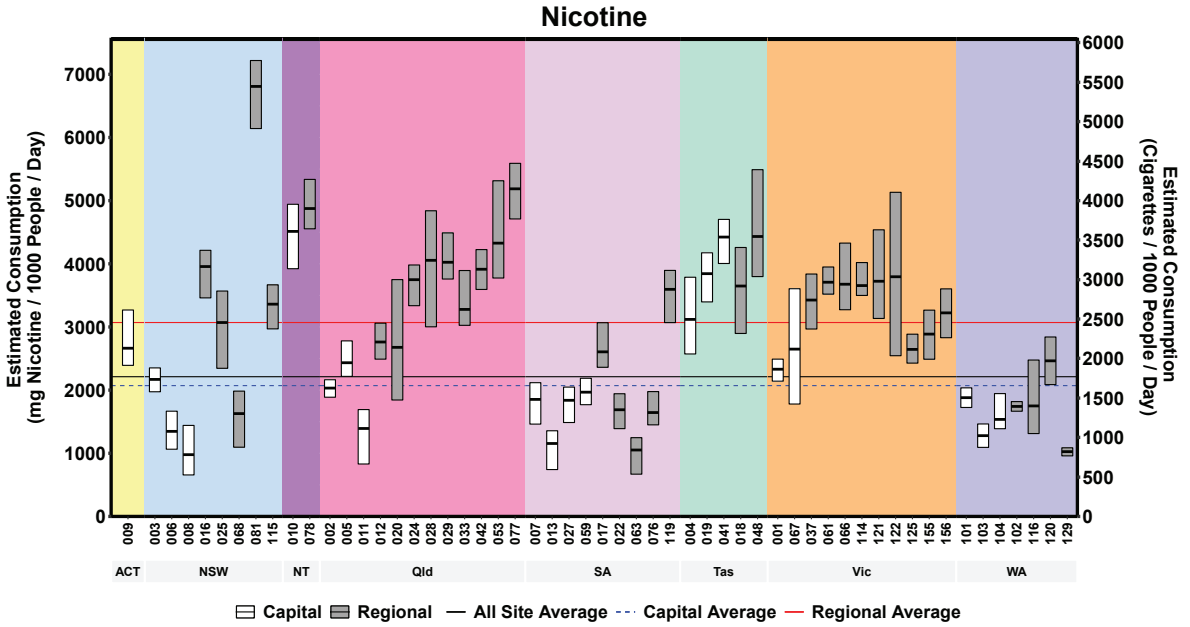
4.1.1 NICOTINE AND ALCOHOL

Two nicotine metabolites, cotinine and hydroxycotinine, were used to estimate the consumption of tobacco. 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. The results show that in April 2020 the consumption of nicotine was highly variable between sites across the country (Figure 4). The regional average was well above that of the capital cities (red horizontal and dotted blue lines, respectively). The Northern Territory and Tasmania had the highest overall capital city consumption. Regional South Australian and Western Australian sites generally had consumption rates below the national average.

Alcohol consumption can be measured using a specific metabolite of ethanol. The difference between the average consumption of alcohol in regional and capital city sites was substantial, with regional use much higher (Figure 5). However, findings varied across each region and some sites recorded relatively low consumption, regardless of the state or territory. The mean use in all South Australian sites fell below the national averages. This was also the case in capital city catchments in Western Australia. Some city sites in Tasmania and the Northern Territory recorded the highest levels in the country. Differences in use between days of the week was generally wide and in agreement with other wastewater studies, both in Australia and internationally, which have shown higher consumption of alcohol over weekend periods.

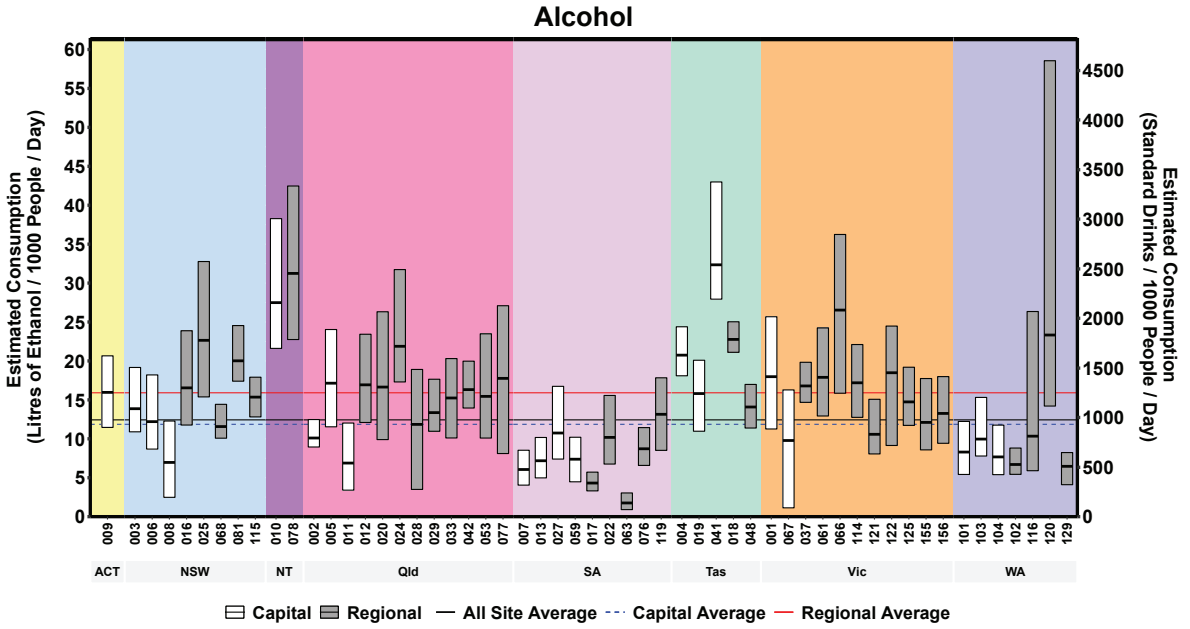
The relative consumption levels can be represented in a pictorial way by showing the relative scale of use of nicotine (Figure 6) and alcohol (Figure 7) as capital city or regional ‘bubbles’ for each state and territory.

Figure 4: Estimated nicotine consumption for April 2020 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 5-7.



- High regional average
- Variable across Australia

Figure 5: Estimated alcohol consumption for April 2020 in volume consumed per day (left axis) and standard drinks per day (right axis) per thousand people. The number of collection days varied from 5-7.



- Regional average higher
- Relatively large weekly spread

Figure 6: Estimated average nicotine consumption per jurisdiction for April 2020 in number of cigarettes per day per thousand people. The number of collection days varied from 5-7.

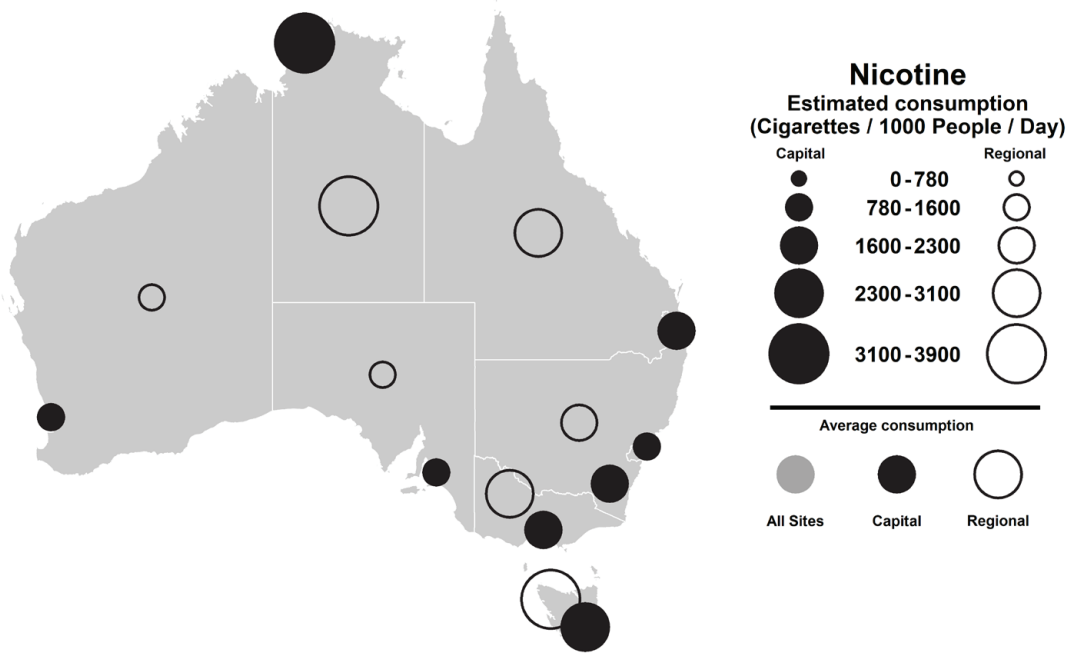
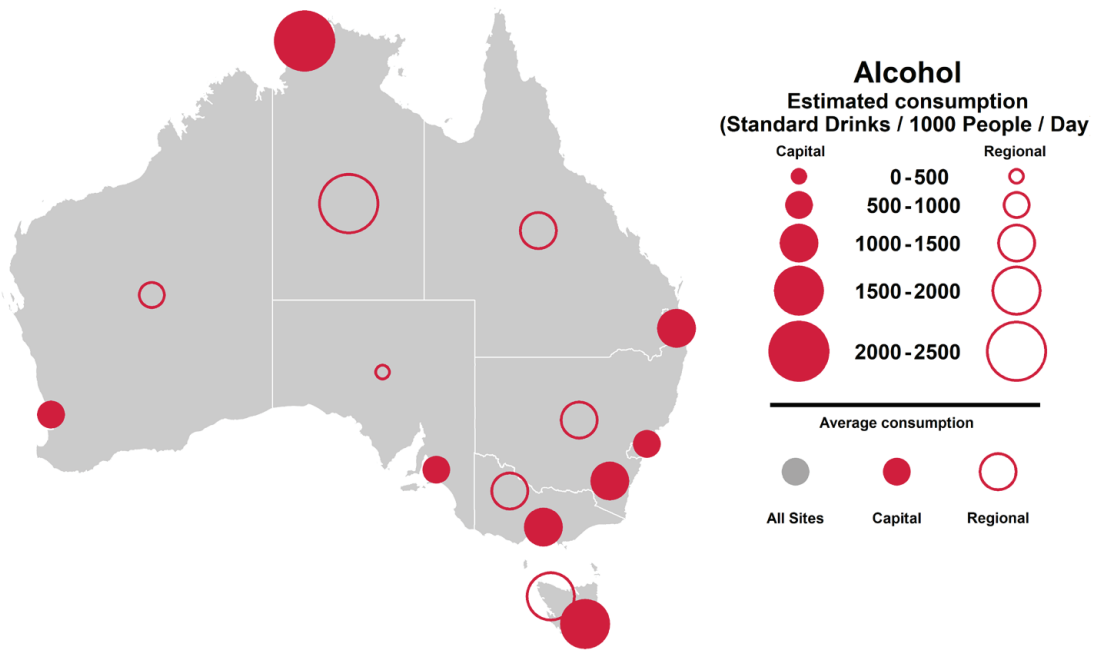


Figure 7: Estimated average alcohol consumption per jurisdiction for April 2020 in number of standard drinks per day per thousand people. The number of collection days varied from 5-7.



4.1.2 STIMULANTS

The relative estimated consumption levels across the participating sites for four stimulants—methylamphetamine, cocaine, MDMA and MDA—are described in more detail below.

4.1.2.1 METHYLAMPHETAMINE

The average regional use of methylamphetamine in April 2020 was above that of capital city sites at almost 2,000 mg per thousand people per day (Figure 8). Use of the drug was highly variable, with

some sites in regional New South Wales, South Australia and Victoria having very high levels, while other sites within the same states had relatively low levels. The difference between regional and city use was less apparent in Tasmania, Victoria (apart from one site) and Western Australia. The mean consumption estimate for capital cities in the Australian Capital Territory, New South Wales, Queensland and Tasmania was generally below the national average. Capital city consumption in South Australia was the highest of the capital cities.

4.1.2.2 AMPHETAMINE

The measured concentration of amphetamine in the April 2020 samples mostly fell within a range which is consistent with the reported excretion rates following methylamphetamine consumption (Gracia-Lor et al. 2016). The results were in agreement with our previous findings (see Appendix 4 of Report 1). Therefore, we assumed that the levels of amphetamine in wastewater samples were predominantly due to the metabolism of methylamphetamine. It is possible that some of the measured amphetamine could be the result of ingestion of the drug, but the high levels of methylamphetamine 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. In contrast to methylamphetamine, capital city areas on average had higher cocaine use than regional centres, with the highest figures generally being in New South Wales (Figure 9). Site 12 in regional Queensland had relatively high use as well. Cocaine consumption was generally low in most other parts of Australia, particularly the Northern Territory, Tasmania and Western Australia. Tasmanian regional sites were not able to provide weekend samples. As a larger proportion of cocaine may be consumed on weekends, these results may be under-representing consumption in that state.

4.1.2.4 MDMA (3,4-METHYLENEDIOXYMETHYLAMPHETAMINE)

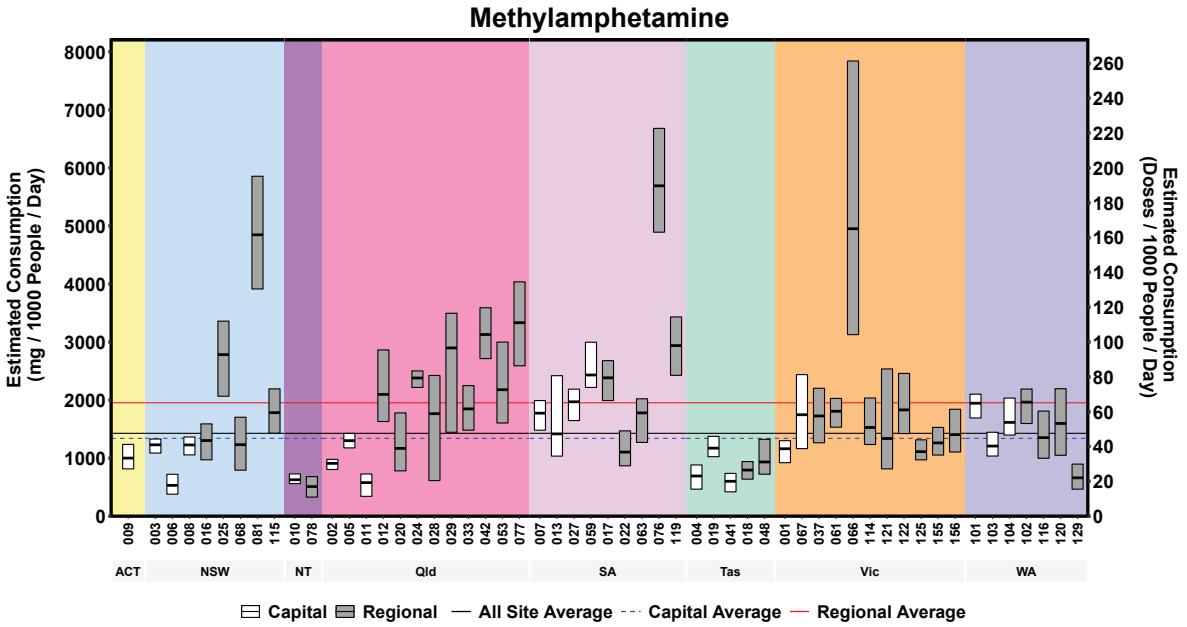
The average consumption of MDMA was typically lower in capital city than regional catchments (Figure 10). The Northern Territory and Tasmania were exceptions where capital city use was clearly higher than in regional centres. The large spread in values over the sampling week was consistent with the weekend use of the drug. A direct comparison of regional and capital city sites in some regions (e.g. Tasmania) may be inappropriate as a few regional sites did not sample on weekends when MDMA consumption is typically higher. See Appendix 2 for a list of the number of samples collected per site. In contrast to methylamphetamine and cocaine, the use of MDMA across Australia was far less variable and also at a relatively low level.

4.1.2.5 MDA (3,4-METHYLENEDIOXYAMPHETAMINE)

MDA is both a drug in its own right and a metabolite of MDMA. Since the proportion of MDA eliminated after MDMA consumption is known, this proportion of MDA attributable to MDMA metabolism was subtracted from the total measured amount of MDA for each site. Results for MDA were expressed as mg excreted per 1,000 people per day (daily mass load) and not as consumption due to the lack of metabolic information of MDA elimination following MDA consumption. The daily mass loads for regional sites were on average higher than capital cities (Figure 11). Rates of use were somewhat more variable than MDMA across the nation.

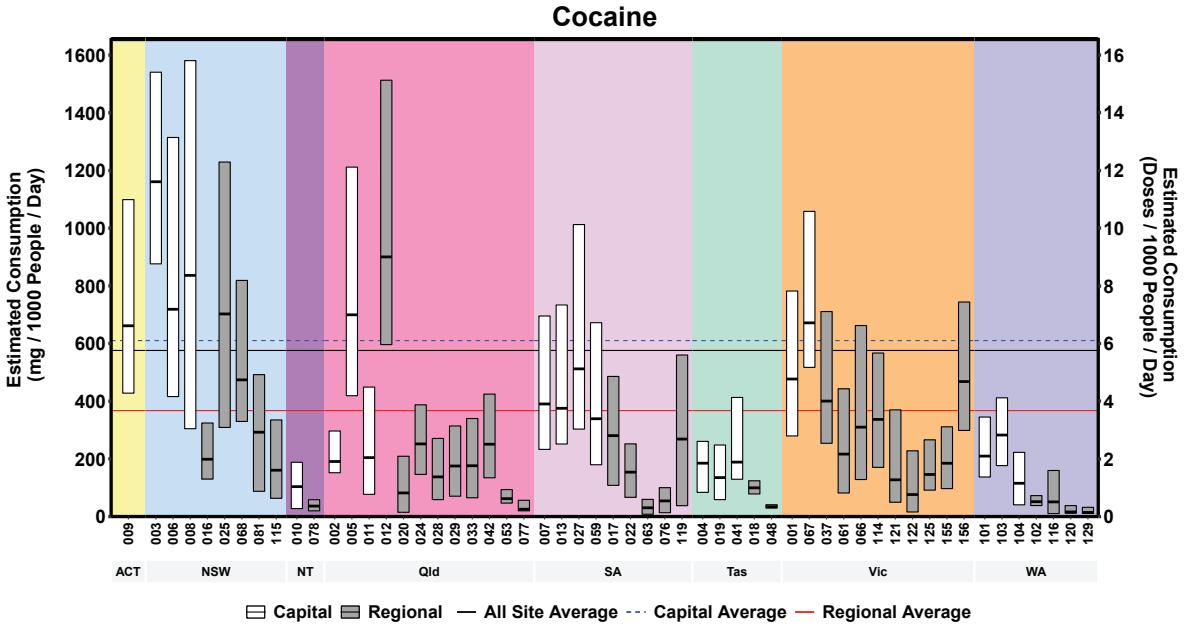
The scale of use of each stimulant is expressed as a bubble graph to compare regional and capital city use of methamphetamine (Figure 12), cocaine (Figure 13), MDMA (Figure 14) and MDA (Figure 15) across the country. The popularity of cocaine on the south-eastern seaboard remains apparent.

Figure 8: Estimated methylamphetamine consumption for April 2020 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5-7.



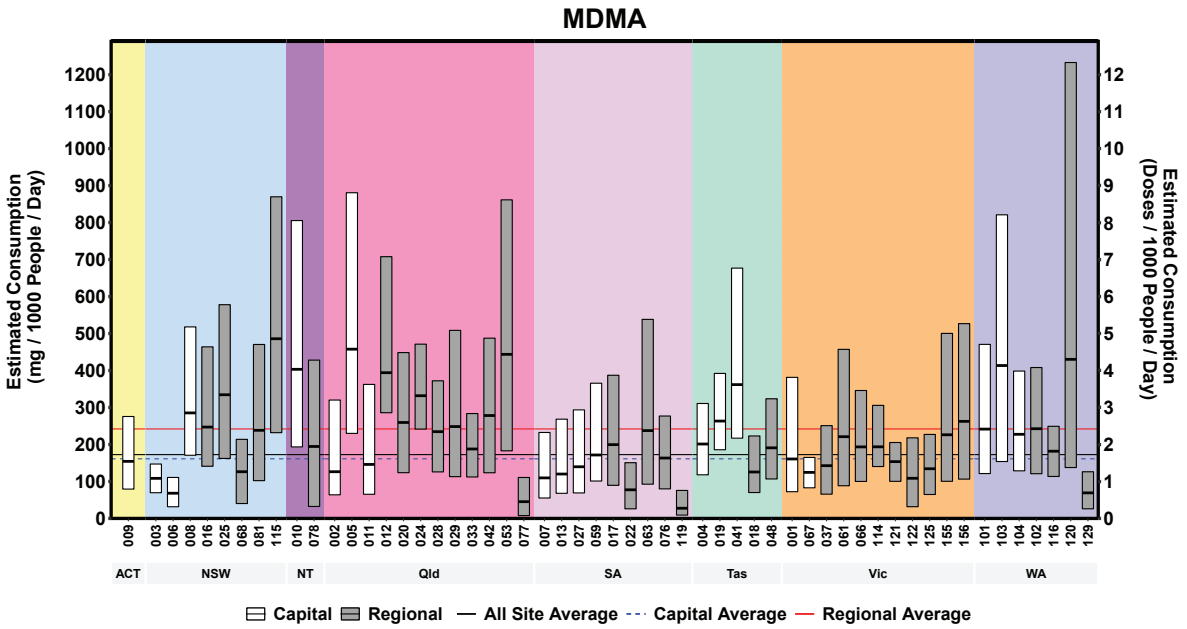
- Higher regional consumption
- Variable across Australia

Figure 9: Estimated cocaine consumption for April 2020 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5-7.



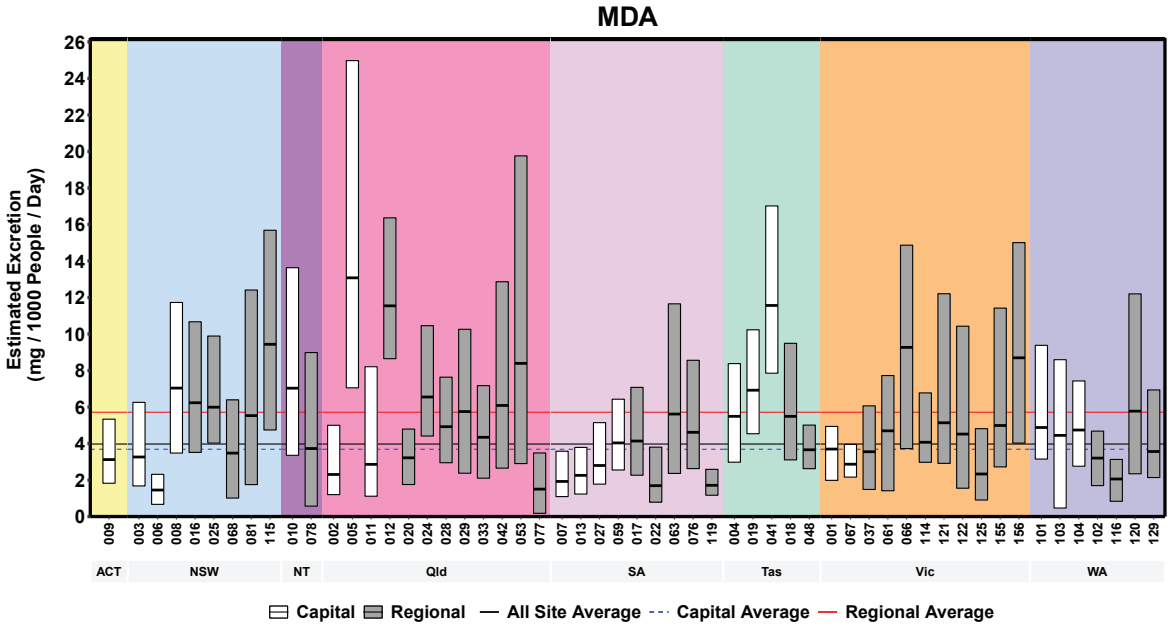
- Higher capital city consumption
- High overall consumption in NSW

Figure 10: Estimated MDMA consumption for April 2020 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5-7.



- Overall, low consumption rates nationally
- Wide weekly spread indicates higher weekend consumption

Figure 11: Estimated MDA excretion for April 2020 in mass excreted per day per thousand people. The number of collection days varied from 5-7.



- Regional averages higher, similar to MDMA use
- Relatively low levels in general

Figure 12: Estimated average methylamphetamine consumption per jurisdiction for April 2020 in mg consumed per day per thousand people. The number of collection days varied from 5-7.

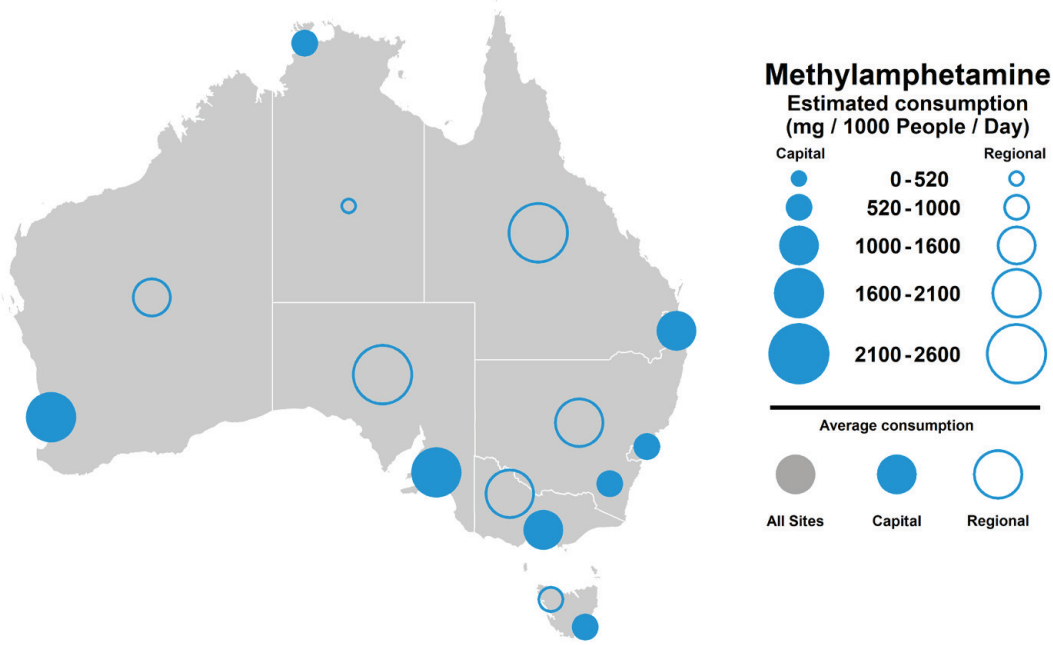


Figure 13: Estimated average cocaine consumption per jurisdiction for April 2020 in mg consumed per day per thousand people. The number of collection days varied from 5-7.

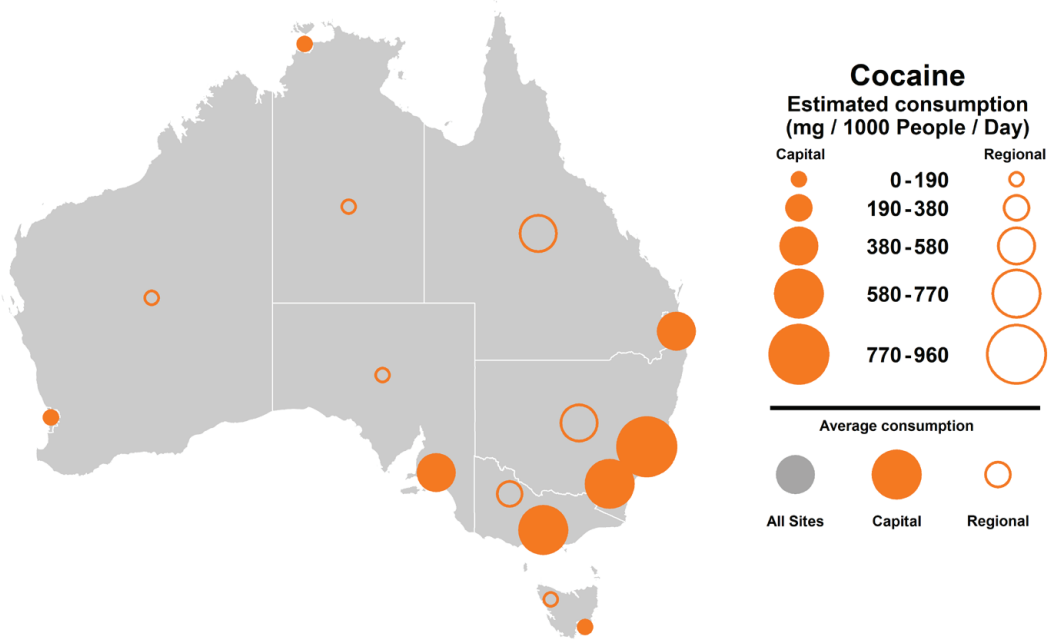


Figure 14: Estimated average MDMA consumption per jurisdiction for April 2020 in mg consumed per day per thousand people. The number of collection days varied from 5-7.

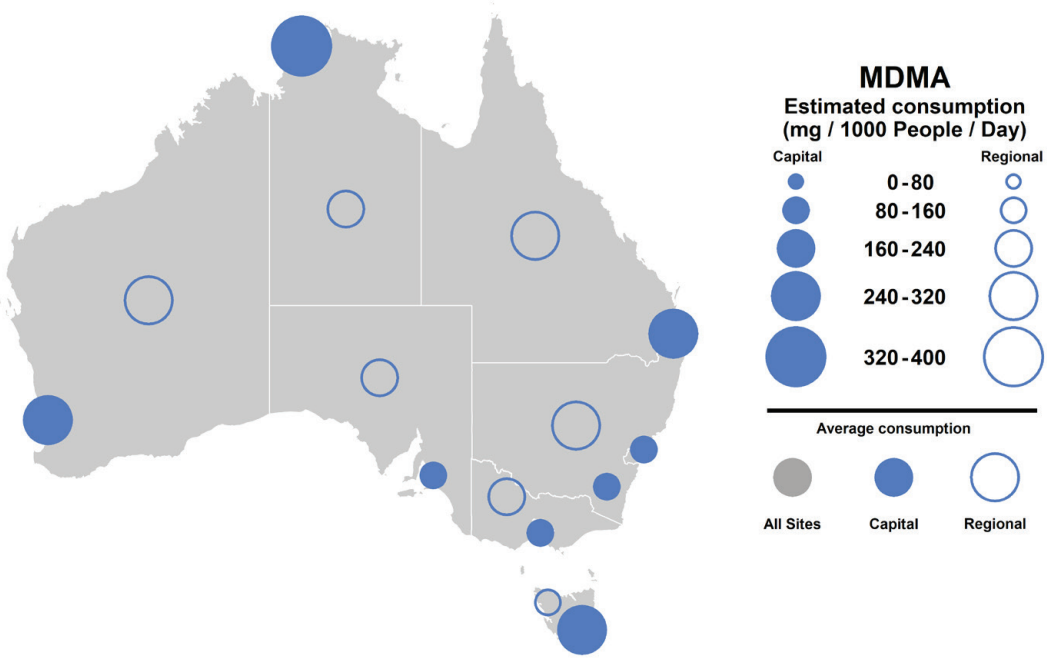
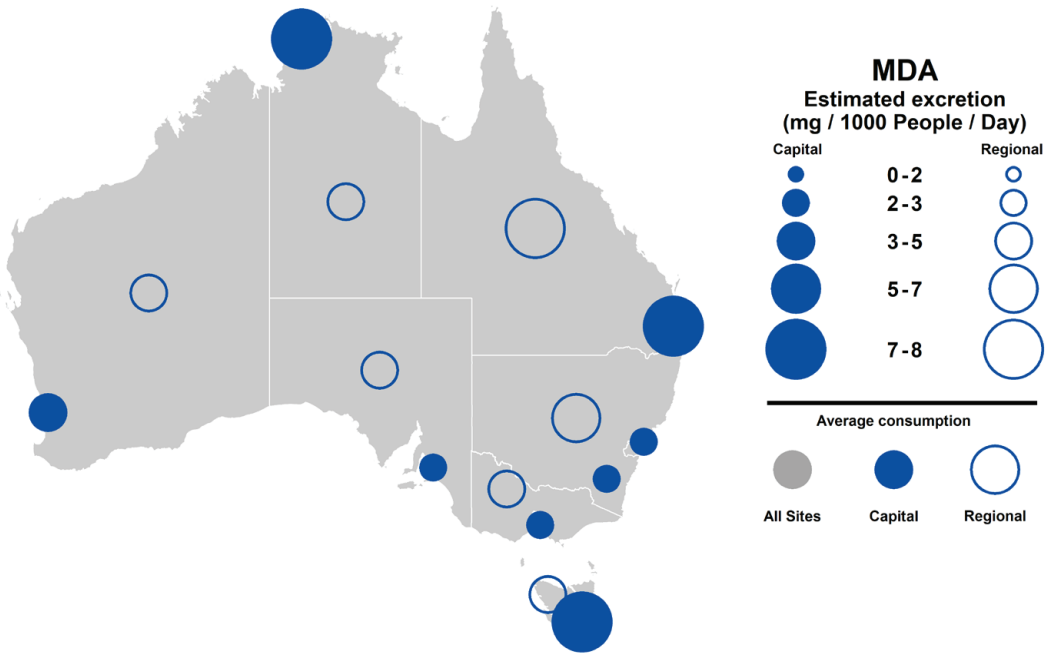


Figure 15: Estimated average MDA excretion per jurisdiction for April 2020 in mg excreted per day per thousand people. The number of collection days varied from 5-7.



4.1.3 OPIOIDS

Two prescription opioids were measured, as well as heroin, an illicit drug. Oxycodone and fentanyl are legally prescribed pharmaceuticals with abuse potential. Although wastewater analysis cannot be used to differentiate between prescribed use for therapeutic purposes and use for non-medical purposes, the relative scale of use of these substances remains of interest as they have the potential for addiction.

4.1.3.1 PHARMACEUTICAL OPIOIDS

The metabolism and excretion profiles of oxycodone and fentanyl are well characterised. The main metabolite of each compound was measured to estimate drug consumption.

The graph of oxycodone consumption across Australia in April 2020 shows a very large difference between the overall regional average and the capital city average (Figure 16). In general, regional Victoria had the highest consumption, while Tasmania had the highest rates of use of the capital cities. Western Australia had relatively low overall consumption levels compared to the national averages.

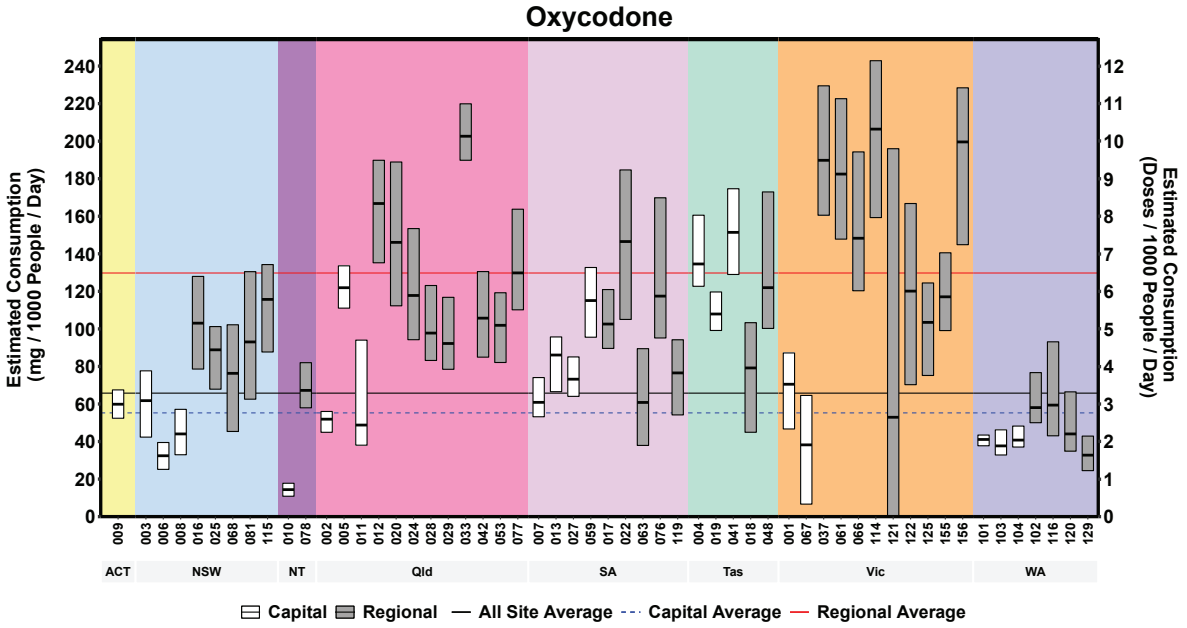
Fentanyl use was variable across Australia, but once again regional use of this pharmaceutical opioid exceeded that in the capital cities (Figure 17). Factors such as average population age and density of medical services may account for some site-specific differences. Site 81 in New South Wales had the highest consumption. Some regional catchments in Queensland, South Australia and Victoria also had relatively high levels of use. Specific days at some sites had levels below the quantification limits of the method.

The relative scale of oxycodone and fentanyl use was apparent when results were aggregated by jurisdiction and capital or regional area and presented in bubble graph form. Generally higher oxycodone consumption rates in regional areas and in capital city Tasmania were apparent (Figure 18). Fentanyl consumption was relatively consistent between most capital cities, apart from South Australia, Tasmania and Queensland (Figure 19).

4.1.3.2 HEROIN

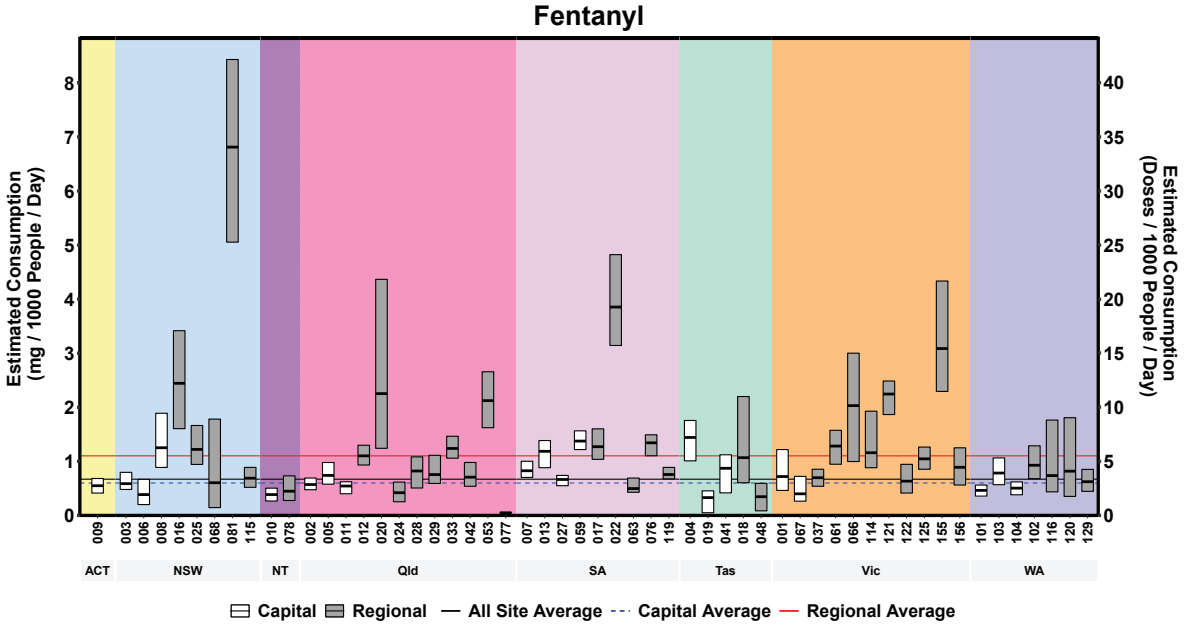
Heroin is metabolised in the body and excreted in low amounts as the unique metabolite, 6-monoacetylmorphine (6-MAM). Since the metabolite is characteristic of heroin use, it can be used to distinguish heroin from other opioids such as morphine and codeine. Unlike the two pharmaceutical opioids, heroin consumption in regional areas was generally much less than in the capital cities (Figure 20). Victoria Site 67 had very high consumption rates across the sampling week, well above any other catchment. A few capital city catchments in New South Wales and Western Australia also had relatively high levels. Many regional sites had levels at or below the limits of quantification. The elevated heroin consumption in capital city Victoria is clearly evident from the bubble graph (Figure 21).

Figure 16: Estimated oxycodone consumption for April 2020 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5-7.



- Higher regional average, particularly regional Victoria
- Tasmania highest of the capital cities

Figure 17: Estimated fentanyl consumption for April 2020 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5-7.



- Higher and variable regional average
- New South Wales highest consumption

Figure 18: Estimated average oxycodone consumption per jurisdiction for April 2020 in mg consumed per day per thousand people. The number of collection days varied from 5-7.

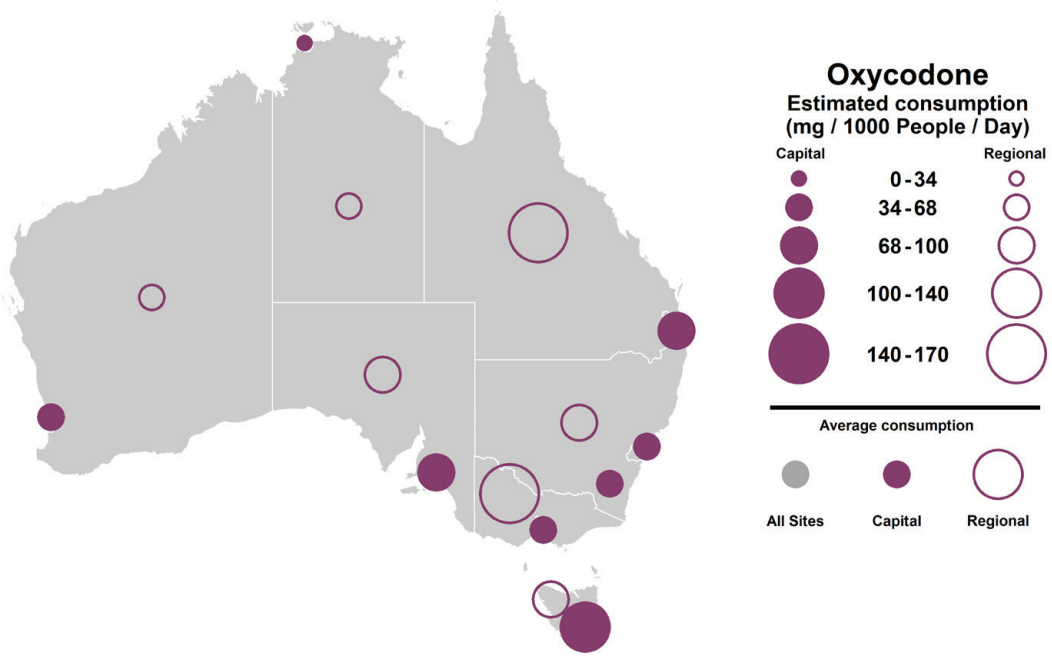


Figure 19: Estimated average fentanyl consumption per jurisdiction for April 2020 in mg consumed per day per thousand people. The number of collection days varied from 5-7.

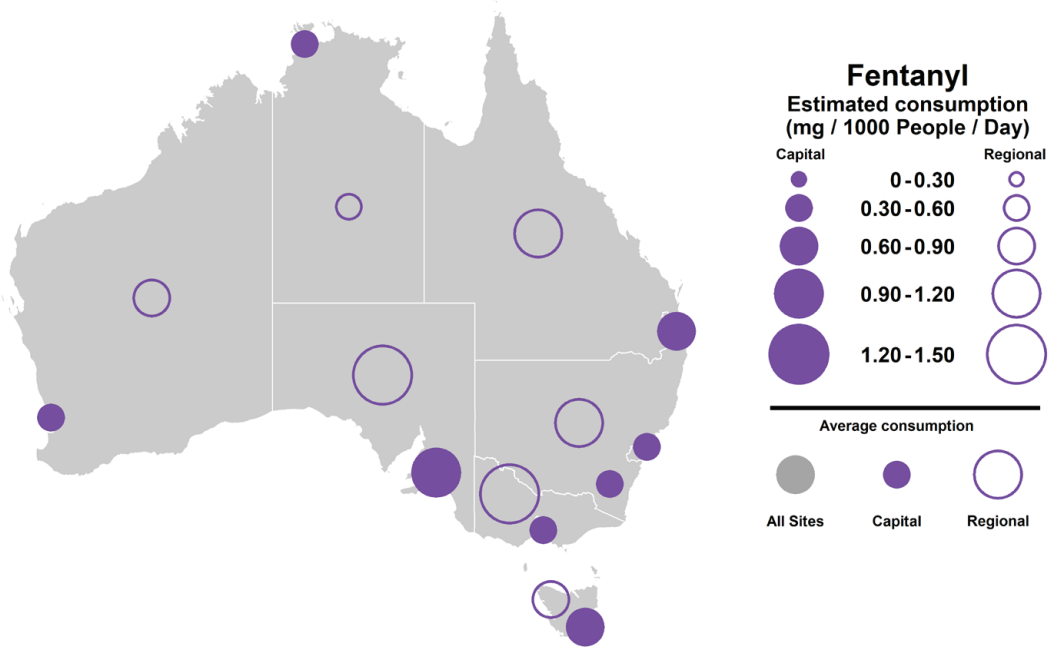
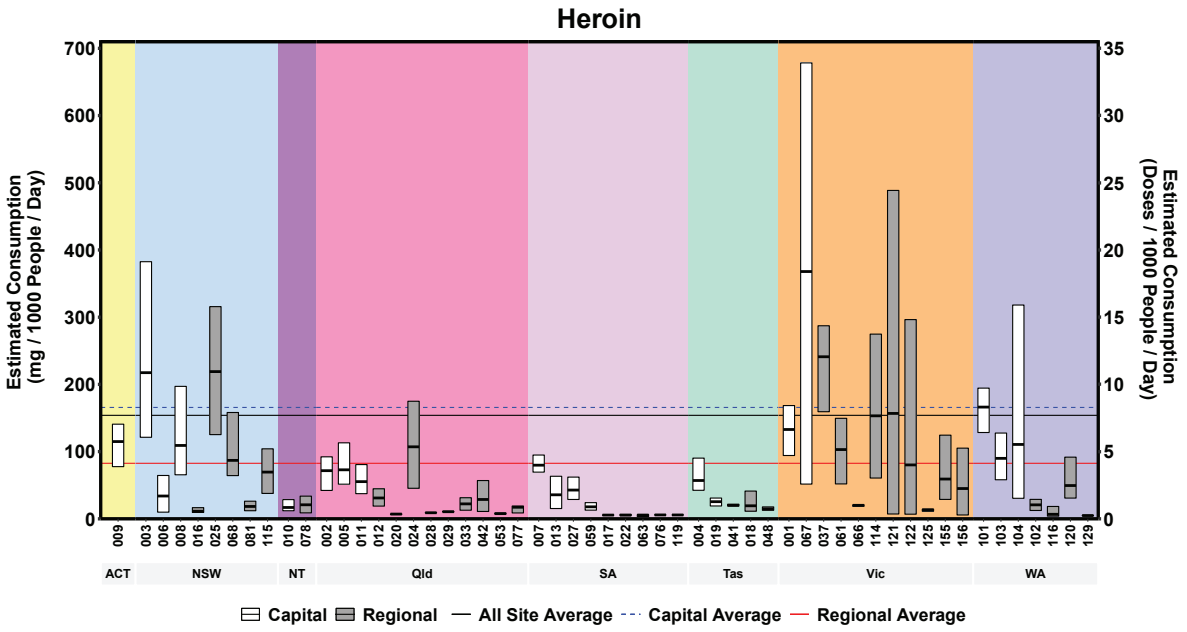
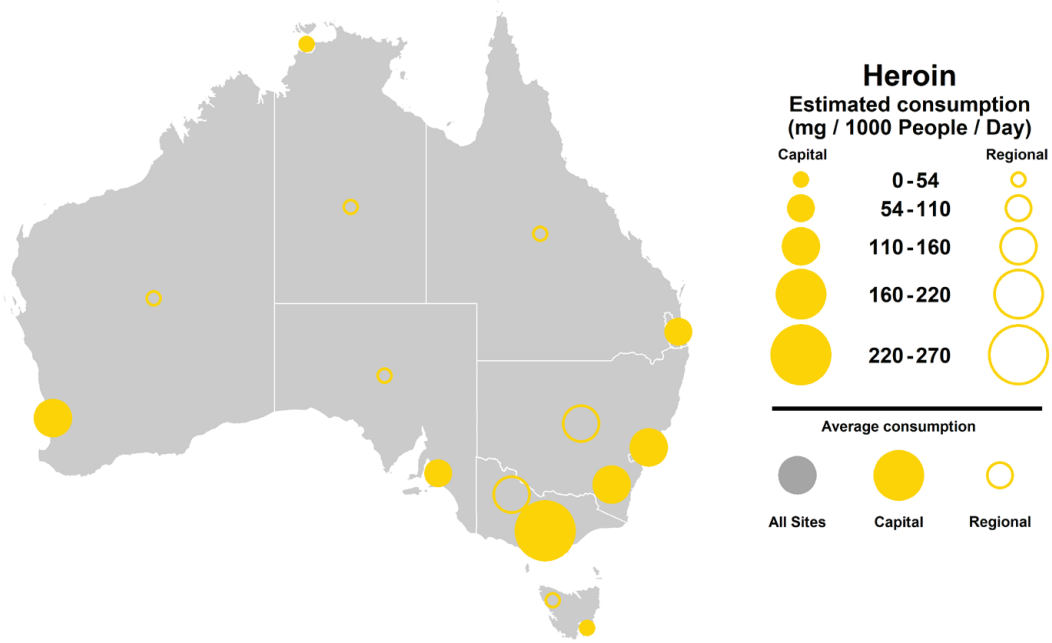


Figure 20: Estimated heroin consumption for April 2020 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5-7.



- Lower regional consumption, often not detected
- Highest consumption in Victoria

Figure 21: Estimated average heroin consumption per jurisdiction for April 2020 in mg consumed per day per thousand people. The number of collection days varied from 5-7.



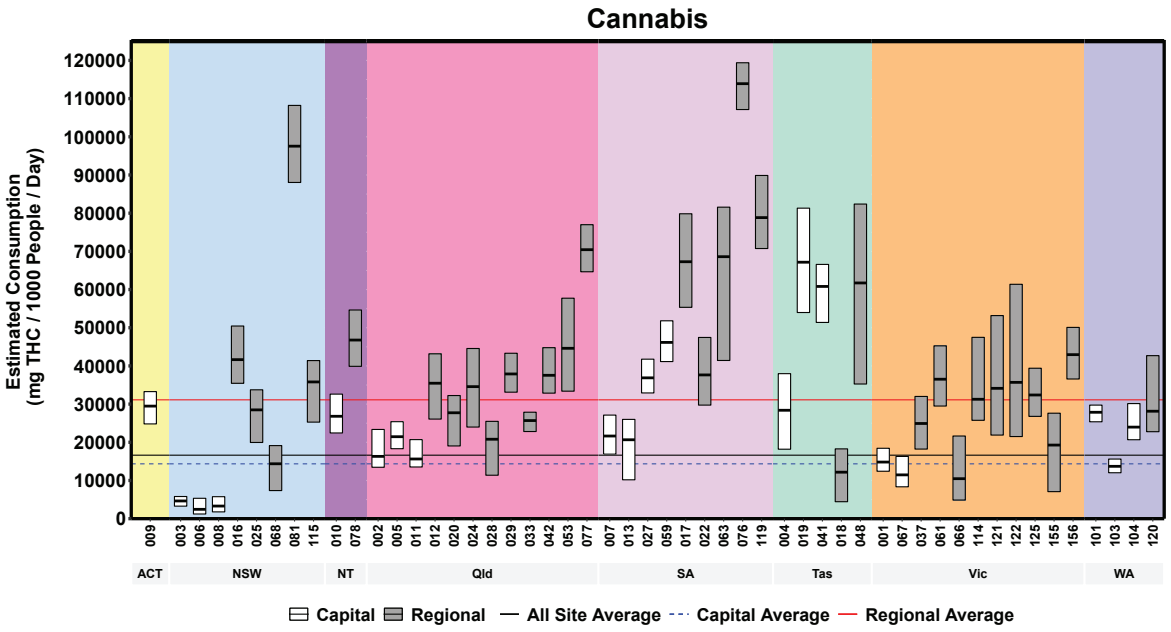
4.1.4 CANNABIS

Tetrahydrocannabinol (THC) is the main psychoactive compound found in cannabis. The compound is metabolised and largely cleared through the gut. A small proportion (0.06 per cent) 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. 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. Upon collection, samples have to be preserved 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.

Cannabis consumption was expressed as the daily mass load (mg) of consumed active ingredient (THC) consumed per 1,000 people. An average dose was not defined as for other drugs in the report. The dose of cannabis depends on several factors, such as the part of the plant, the strain, or whether an extract was used. This will be included in graphical representations of the data when an appropriate dose becomes available.

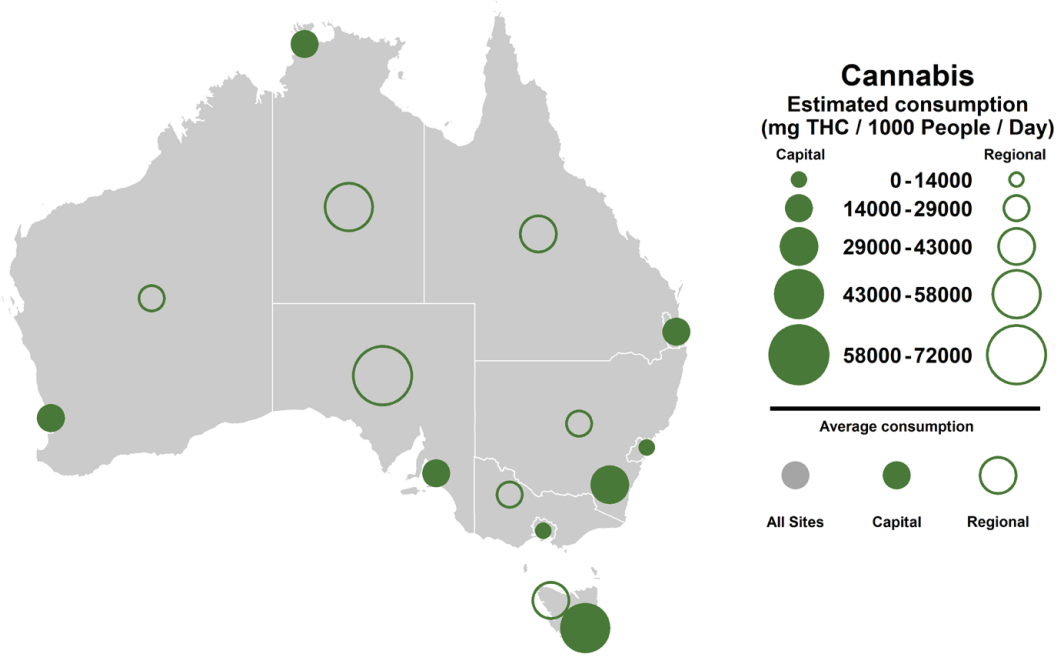
Clear spatial differences were evident across Australia (Figure 22). The average use across regional Australia in April 2020 exceeded capital city consumption. Sites 76 and 81 in regional South Australia and New South Wales, respectively, recorded some very high daily values. However, a number of other regional catchments also had high consumption rates. Two Tasmanian capital city sites had the highest capital city consumption, followed by South Australia. In contrast, capital city New South Wales had very low levels of cannabis use. The bubble plot and jurisdictional differences of cannabis use across Australia show the generally higher consumption in regional areas, particularly South Australia, and Tasmanian capital city sites (Figure 23).

Figure 22: Estimated cannabis consumption for April 2020 in mass consumed per day (left axis). The number of collection days varied from 5-7.



- High regional consumption
- Variable use across the country

Figure 23: Estimated average cannabis consumption per jurisdiction for April 2020 in mg consumed per day per thousand people. The number of collection days varied from 5-7.



4.1.5 NEW PSYCHOACTIVE SUBSTANCES

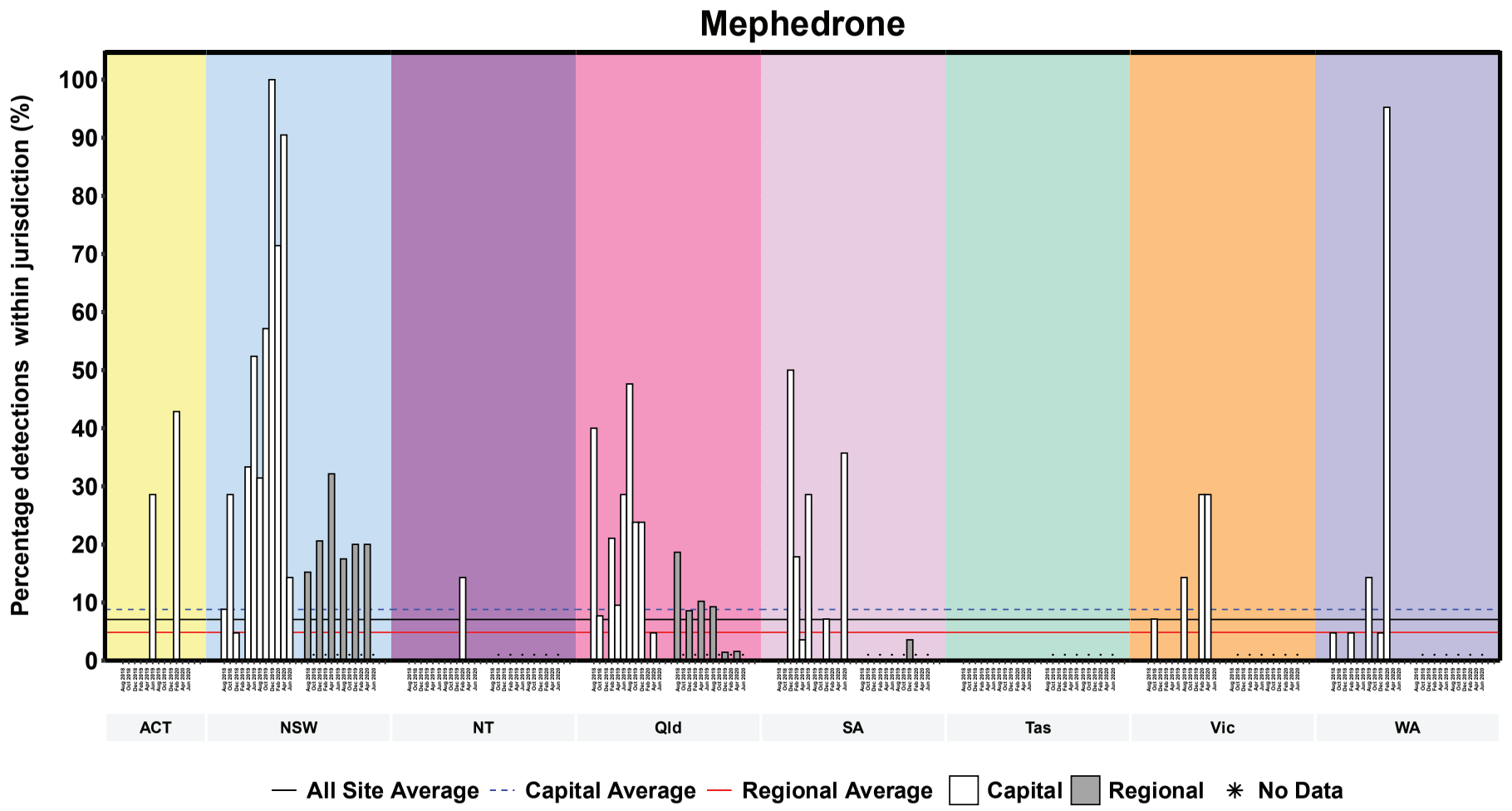
Two compounds are included under the NPS class in the NWDMP: methylone and mephedrone. Limited information is available on the human metabolism and excretion of these drugs. Therefore, the parent compound was measured. Due to the low rates of detection for these drugs, results are reported as the number of detections made (Table 2). Sites that showed the presence of the two compounds are qualitatively listed in Table 2 for April 2020. Mephedrone detections were mainly in capital city catchments and were most frequent in New South Wales, followed by Victoria and Queensland. No detections were recorded elsewhere in Australia. For methylone, the majority of detections were observed in Western Australia, followed by Queensland and South Australia. A small number of cases of methylone were found in other parts of the country, including the Northern Territory and New South Wales.

The temporal changes in detections per state and territory (proportion of samples above LOD) are shown as relative detection frequencies for mephedrone and methylone up to June 2020 in capital cities and April 2020 in regional centres (Figure 24a and 24b, respectively) and as bubble plots in Figure 24c. Mephedrone detections have remained relatively low, although the detection frequency has been on the increase in New South Wales. The number of detections of methylone has been variable, but the general trend over time is a decrease in most parts of the country. Detections of the two NPS were less frequent in regional areas.

Table 2: The number and code of sites per state and territory where mephedrone and methylone were detected. The total number of daily samples that were assessed was 375.

	Number of detections April 2020		Sites detected April 2020	
State /territory	**Mephedrone**	**Methylone**	**Mephedrone**	**Methylone**
ACT	0	0	–	–
NSW	26	2	003, 006, 008, 068	008
NT	0	3	–	010, 078
Qld	2	7	005, 012	011, 012, 053
SA	0	6	–	007
Tas	0	0	–	–
Vic	4	0	001	–
WA	0	12	–	101, 103, 104, 120
Total	**32**	**30**	**7 sites**	**11 sites**

Figure 24a: Estimated percentage of positive detections per jurisdiction for mephedrone, August 2018 to June 2020. This is the number of detections as a percentage of the total number of samples analysed per jurisdiction. The number of collection days varied from 5–7.



- New South Wales had most detections
- Some regions recorded no detections

Figure 24b: Estimated percentage of positive detections per jurisdiction for methylone, August 2018 to June 2020. This is the number of detections as a percentage of the total number of samples analysed per jurisdiction. The number of collection days varied from 5–7.

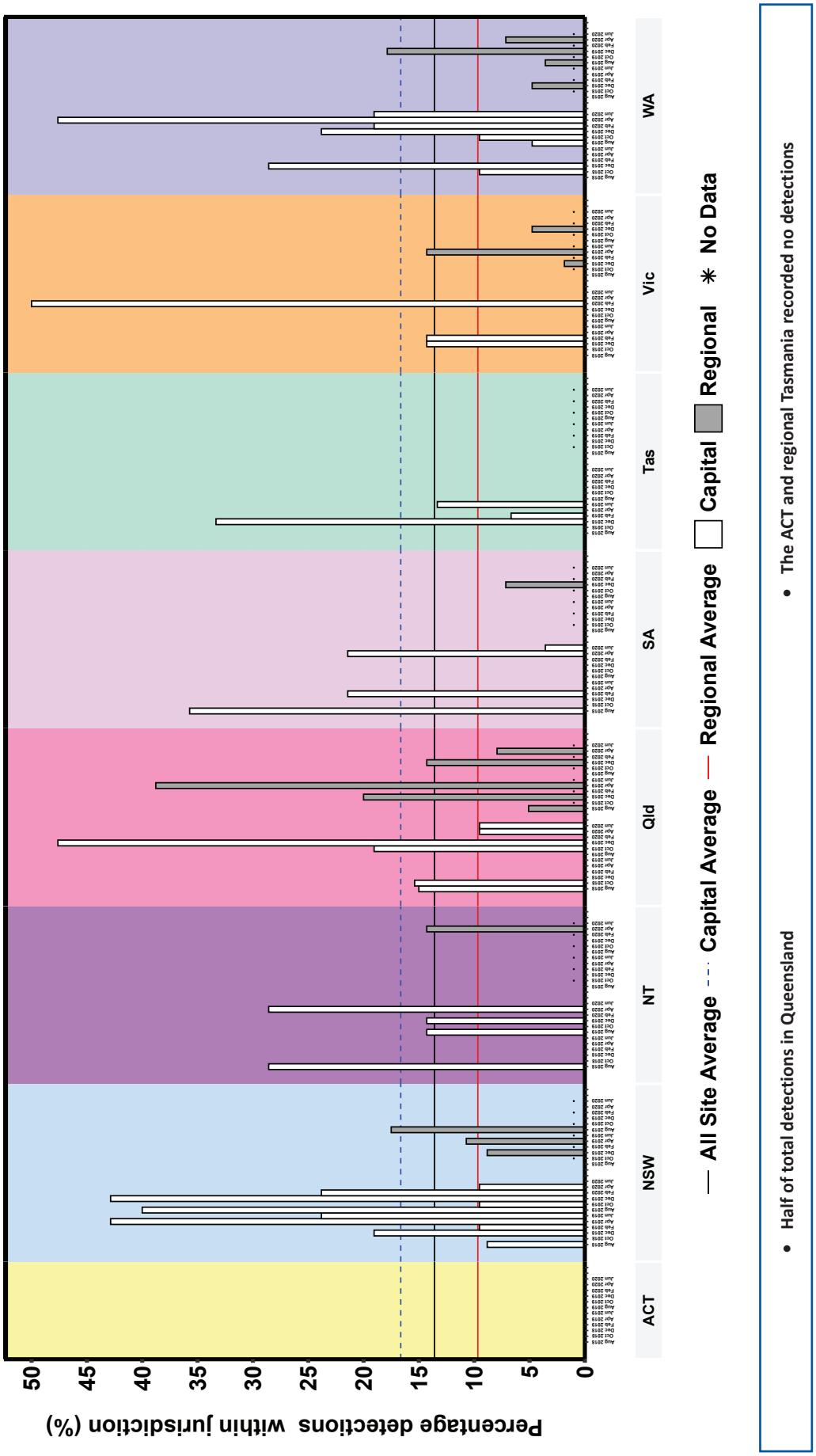
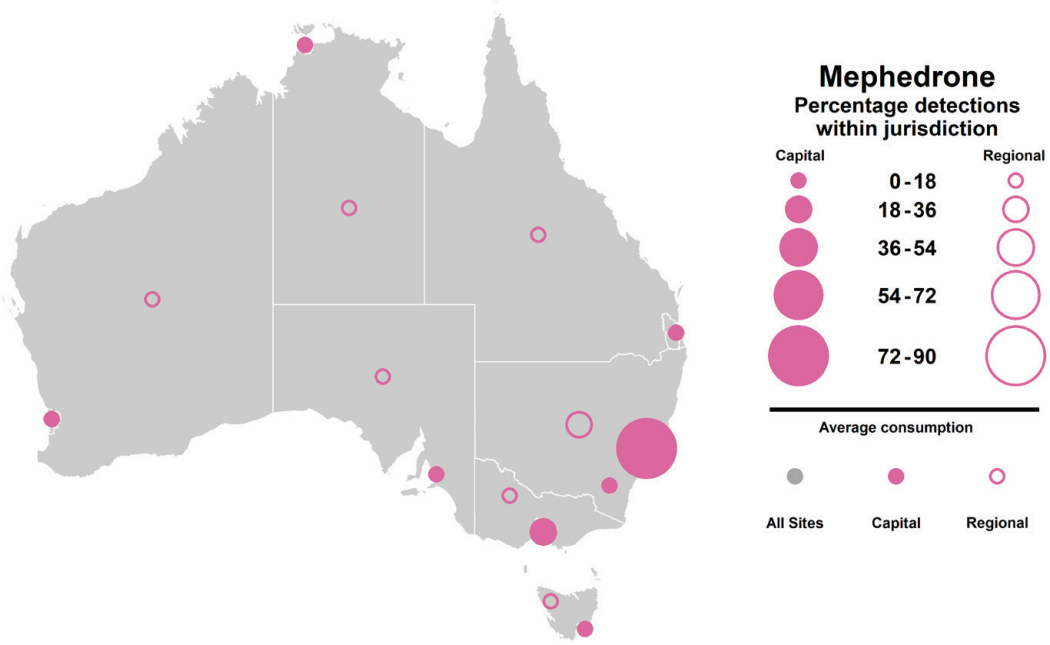
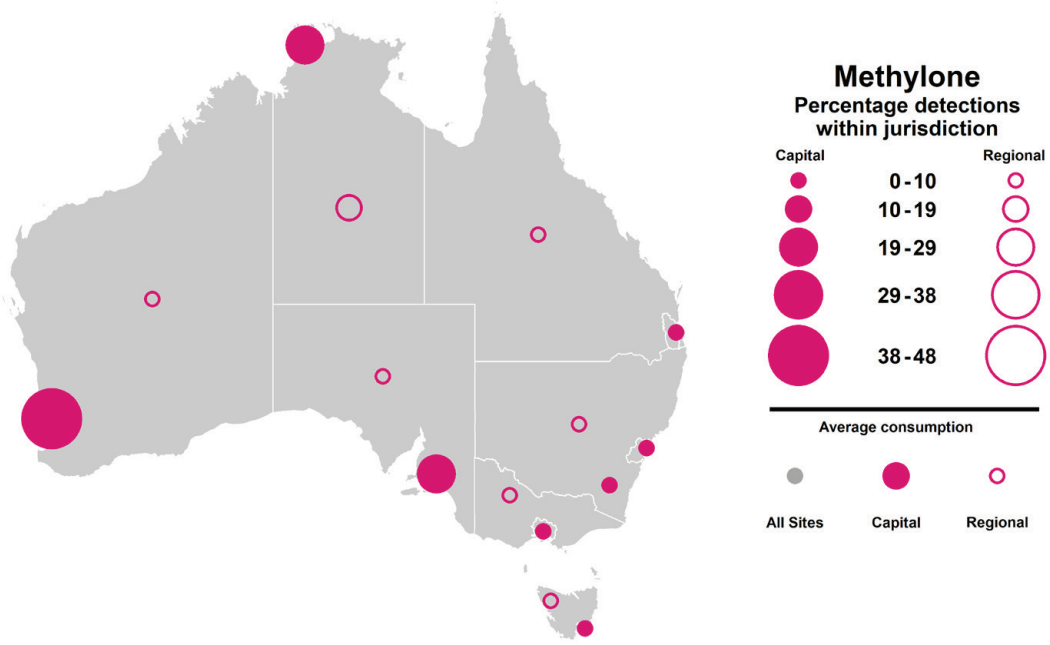


Figure 24c: Estimated percentage of positive detections per jurisdiction for mephedrone and methylone for April 2020. This is the number of detections as a percentage of the total number of samples analysed per jurisdiction. The number of collection days varied from 5–7.





4.2 TEMPORAL CHANGES IN DRUG CONSUMPTION ESTIMATES BY JURISDICTION

The total level of each drug outlined in the preceding reports per state or territory was compared with subsequent collection periods included in the current report. The data relating to capital cities in this section have been updated to include both the April and June 2020 collections, while regional areas were updated for April 2020. This needs to be considered when comparing results between sections 4.1 and 4.2. Although every effort was 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 (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 reporting period is reported with up to two years of previous data. Prior data for each substance of interest will be made 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.

4.2.1 NICOTINE AND ALCOHOL

Nicotine consumption in the capital cities of the Australian Capital Territory, New South Wales and the Northern Territory has increased since the previous reporting period (October, December 2019 and February 2020). In the two territories, this appears to be part of a longer-term trend since the start of the program in 2016 (Figure 25). Elsewhere in Australia, changes in nicotine consumption were relatively minor and no clear patterns were evident. The cumulative regional average nicotine consumption (red line) remains well above capital city levels (blue dashed line).

Alcohol consumption showed an interesting pattern. In the capital cities of almost every state and territory, alcohol consumption declined in the month of April when COVID-19 restrictions came into effect (penultimate white bars, Figure 26). Victoria was the exception. A similar finding was observed in regional parts of some states and territories (final grey bar), but not to the same extent as the capital cities. In all but Tasmania, alcohol consumption returned to slightly above February 2020 levels in the month of June for the capital cities. The difference in the cumulative average consumption of alcohol in regional areas compared to the cities were less pronounced than nicotine, but consumption was also higher outside the capital cities. A declining trend in alcohol use has been a feature in South Australia and Western Australia over the duration of the program, though the levels have stabilised in regional catchments over the past year. The Northern Territory has tended to have the highest overall use of alcohol since the start of the program, followed by Tasmania.

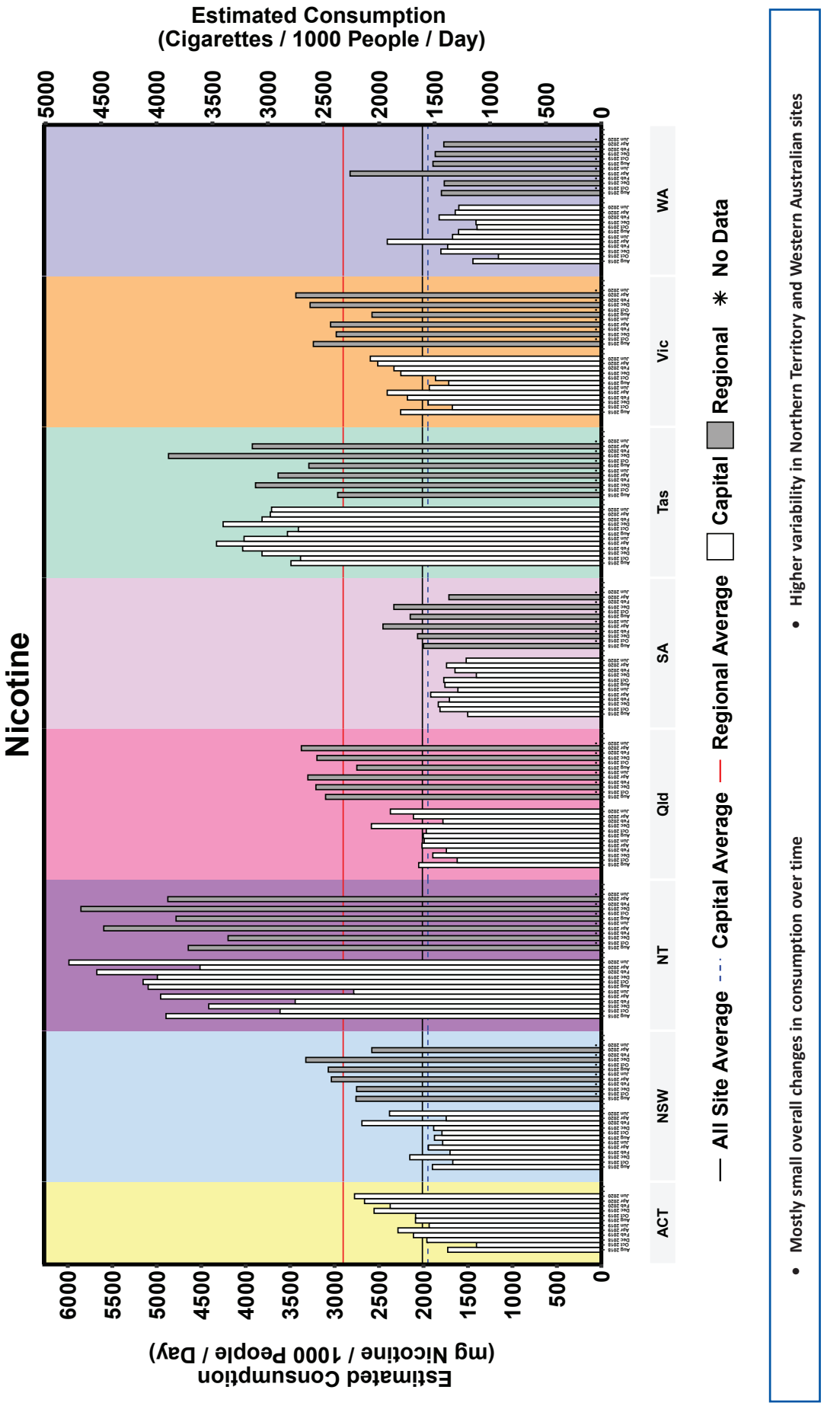


Figure 25: Estimated average consumption of nicotine by state/territory, August 2018 to June 2020, where 1 cigarette provides 1.25 mg of nicotine.[6]

6 Nicotine consumption data have been adjusted to refine the factor used to convert consumed mass load to dose. Overall trends in nicotine consumption remain unchanged.

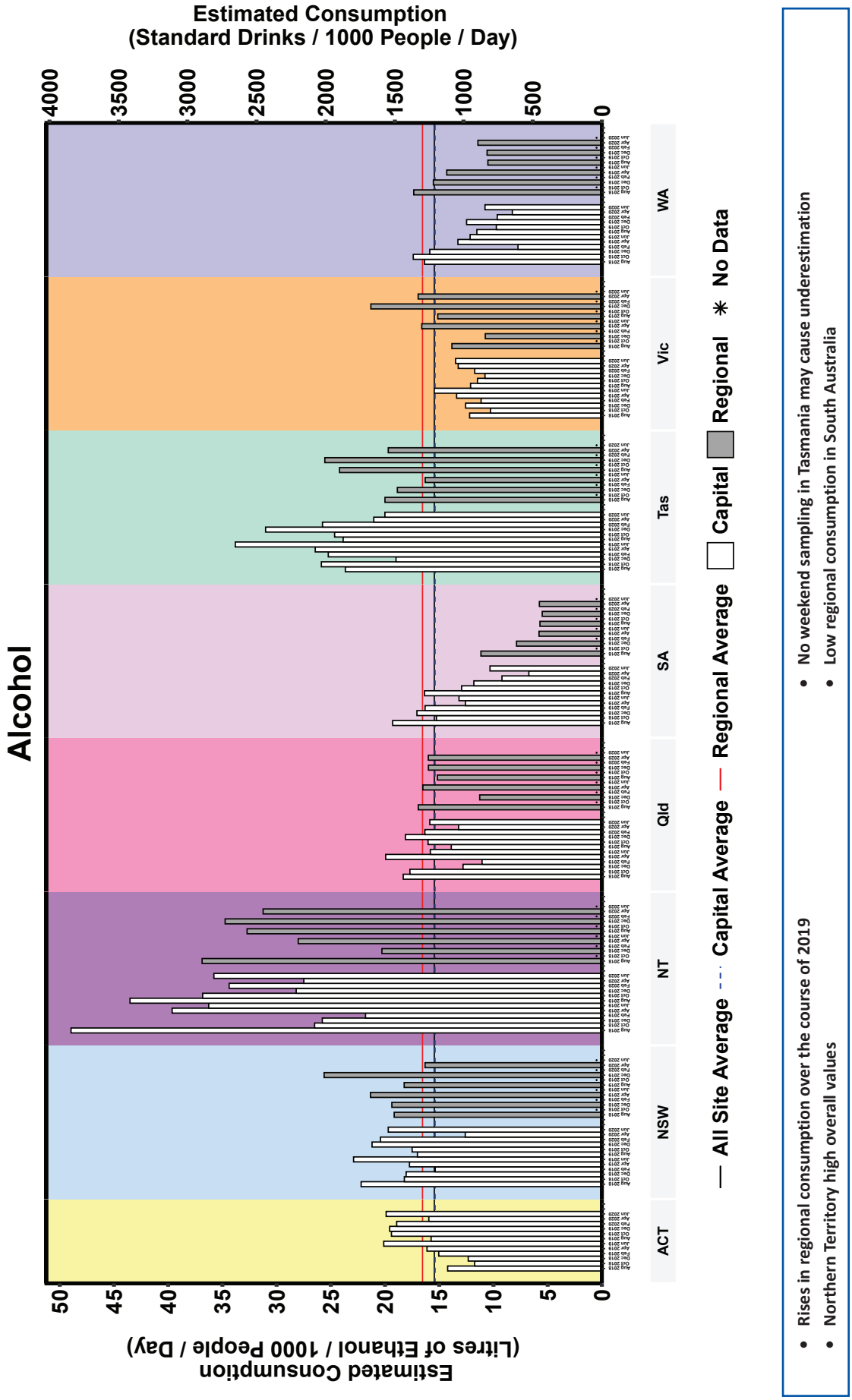


Figure 26: Estimated average consumption of alcohol by state/territory, August 2018 to June 2020. A standard drink is 10.0 g, or 12.6 mL.

4.2.2 STIMULANTS

Methylamphetamine use declined dramatically in the current reporting period in every capital city. Interestingly, most regional areas defied the trend in April 2020. In some capital cities, e.g. New South Wales, the Northern Territory and Tasmania, the effect was immediate upon the introduction of COVID-19 restrictions in April. In the other states, the reduction in use only occurred in June 2020 (Figure 27). Regional South Australia showed a dramatic increase in methylamphetamine use in April 2020; exceeding capital city use for the first time in that state. Consumption in regional New South Wales, Queensland and Victoria all increased in the reporting period as part of a long-term pattern.

Long-term changes in use of methylamphetamine are also apparent in Queensland, South Australia and Western Australia, where data are available back to before the start of the NWDMP (Figure 28). South Australia showed a fourfold increase in methylamphetamine use between 2009 and 2016. The decline in South Australia in mid-2018 was followed by a long continuous period during which the drug's use was maintained at a lower but increasing level. The reduction in use in June 2020 is a clear indication of a disruption in the pattern. The historical increase in South Australia was also apparent between 2009 and 2016 in sites in regional Queensland, with up to fivefold increases in the methylamphetamine consumption rate being observed. In Victoria and Western Australia, the longer-term trends have been more variable and any increases of a relatively low magnitude. In Western Australia, the recent drop in use was most evident, being almost half of the preceding reporting period.

Cocaine use also showed declines in the reporting period in some parts of Australia. However, the pattern was not consistent across the country, with many locations already showing a decline in February 2020 (Figure 29). In the longer term, cocaine consumption in capital cities continues to rise in the Australian Capital Territory, Victoria and Western Australia. In regional parts of the country, changes appear to be short-term and variable with no clear patterns emerging. Tasmania and Western Australia continue to be relatively low consumers of cocaine in the Australian context. The average regional use across the country is well below the capital cities.

MDMA use across Australia declined almost everywhere in April 2020, increasing again in June 2020 in capital cities (Figure 30). Levels of the drug have been increasing in almost all jurisdictions since early to mid-2018. This remained most evident in regional areas of most states and territories. The per capita drug use in capital city Northern Territory continues to be high compared to most other parts of the country. In other capital cities the use of MDMA is highly variable between collection periods.

MDA use, corrected for the proportion derived from MDMA (Khan & Nicell 2011), had relatively similar use between capital cities across the country (Figure 31). Tasmania's historically high use declined in the past year and is now no longer a feature of that state. Use in almost every jurisdiction declined in the recent past, especially during the current reporting period. The Northern Territory was the only prominent exception, where levels increased sharply. Overall, regional use of MDA was well above that of the capital cities.

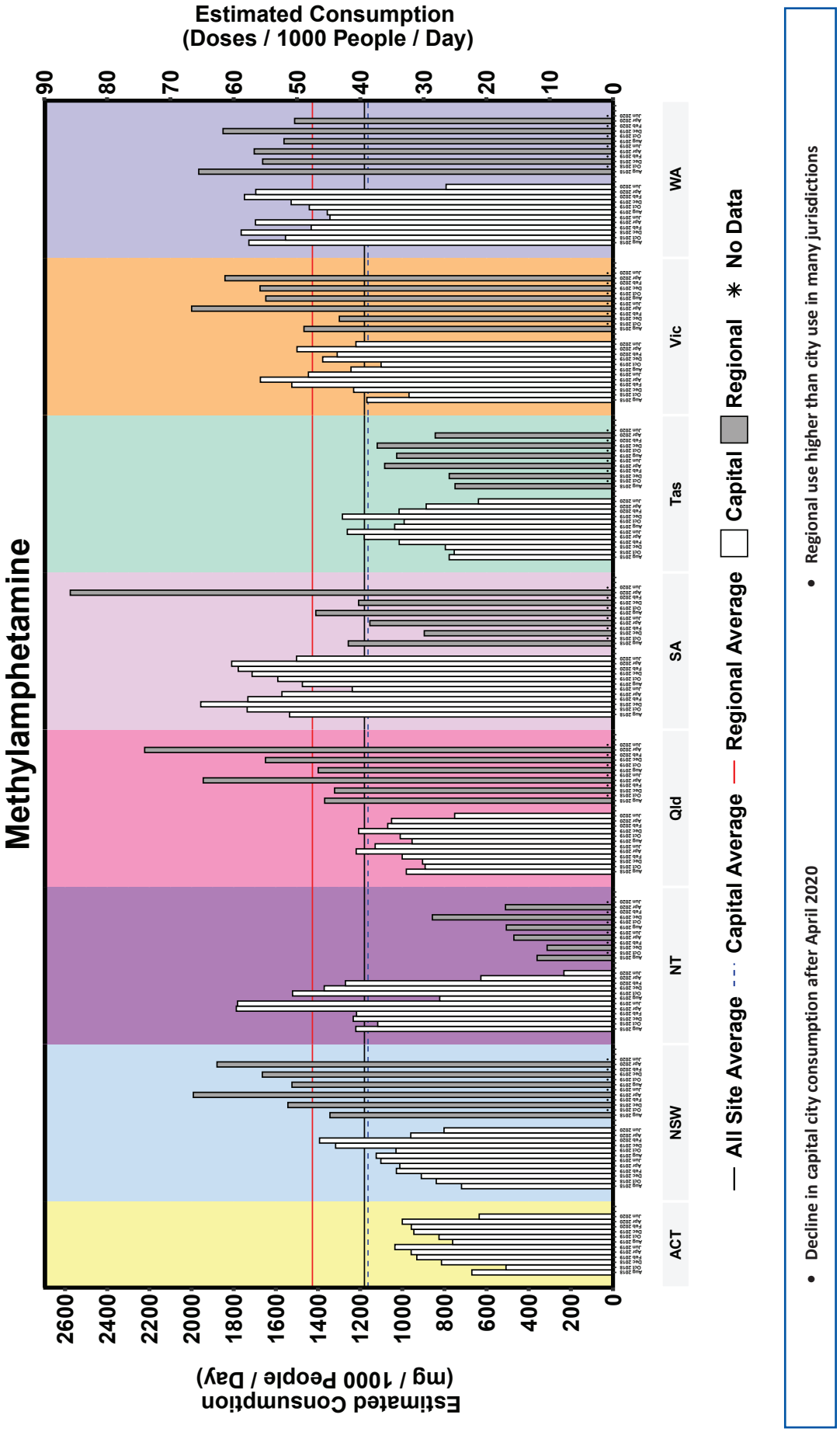


Figure 27: Estimated average consumption of methylamphetamine by state/territory, August 2018 to June 2020.

Figure 28: Change in methylamphetamine consumption for sites with historical data.

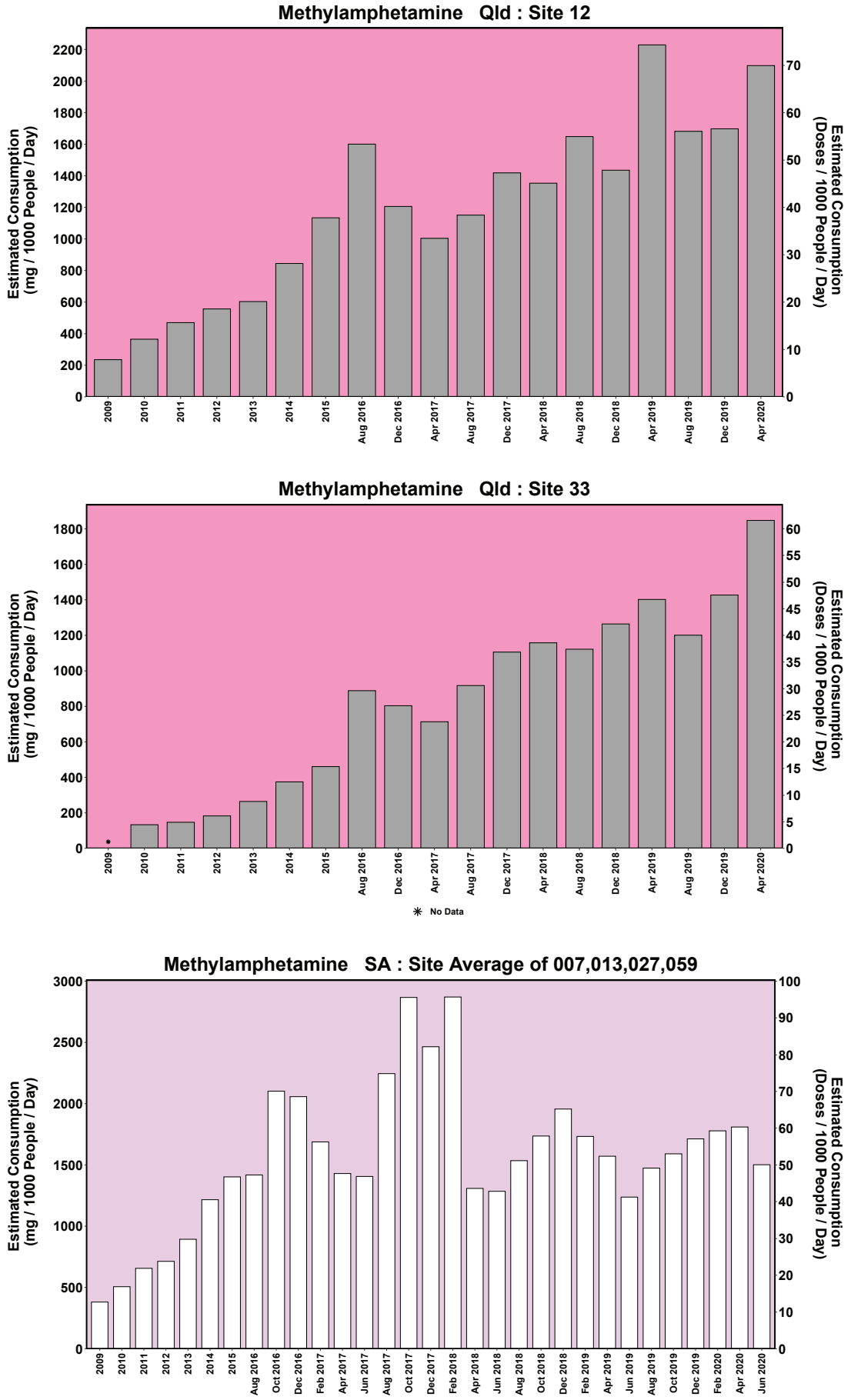
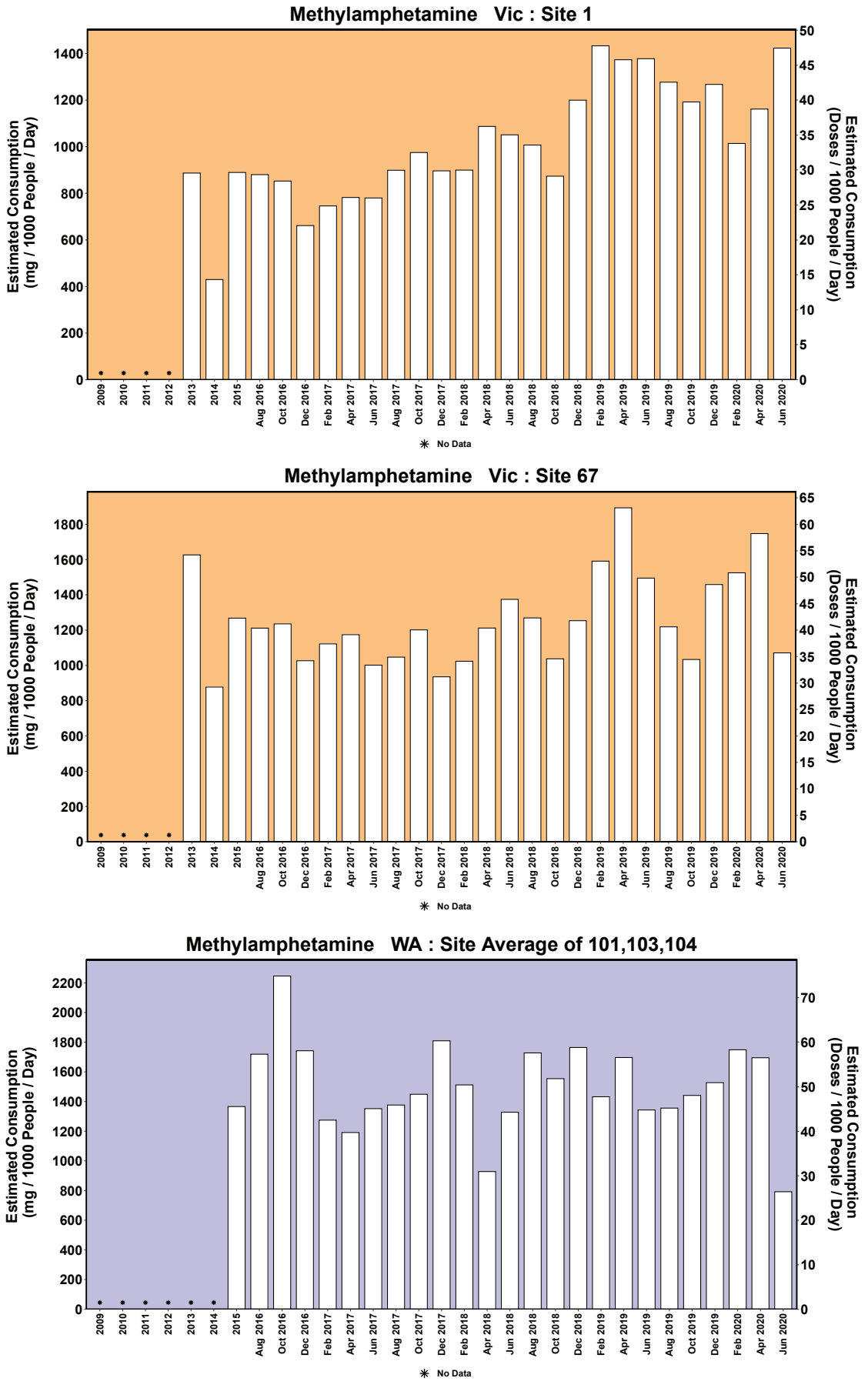


Figure 28 (continued): Change in methylamphetamine consumption for sites with historical data. Both Victorian sites were the average of one week per year in 2013, 2014 and 2015.



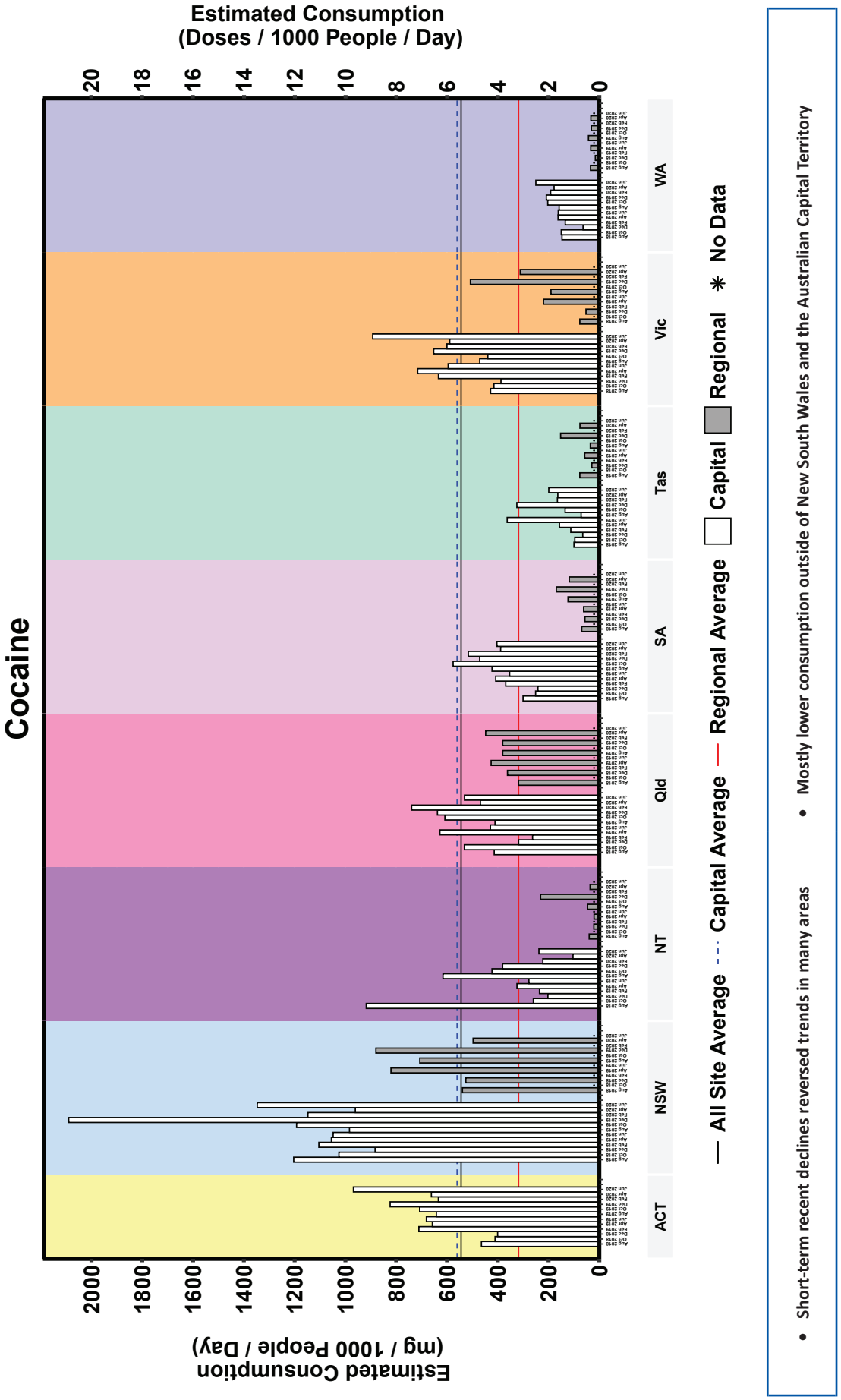


Figure 29: Estimated average consumption of cocaine by state/territory, August 2018 to June 2020.

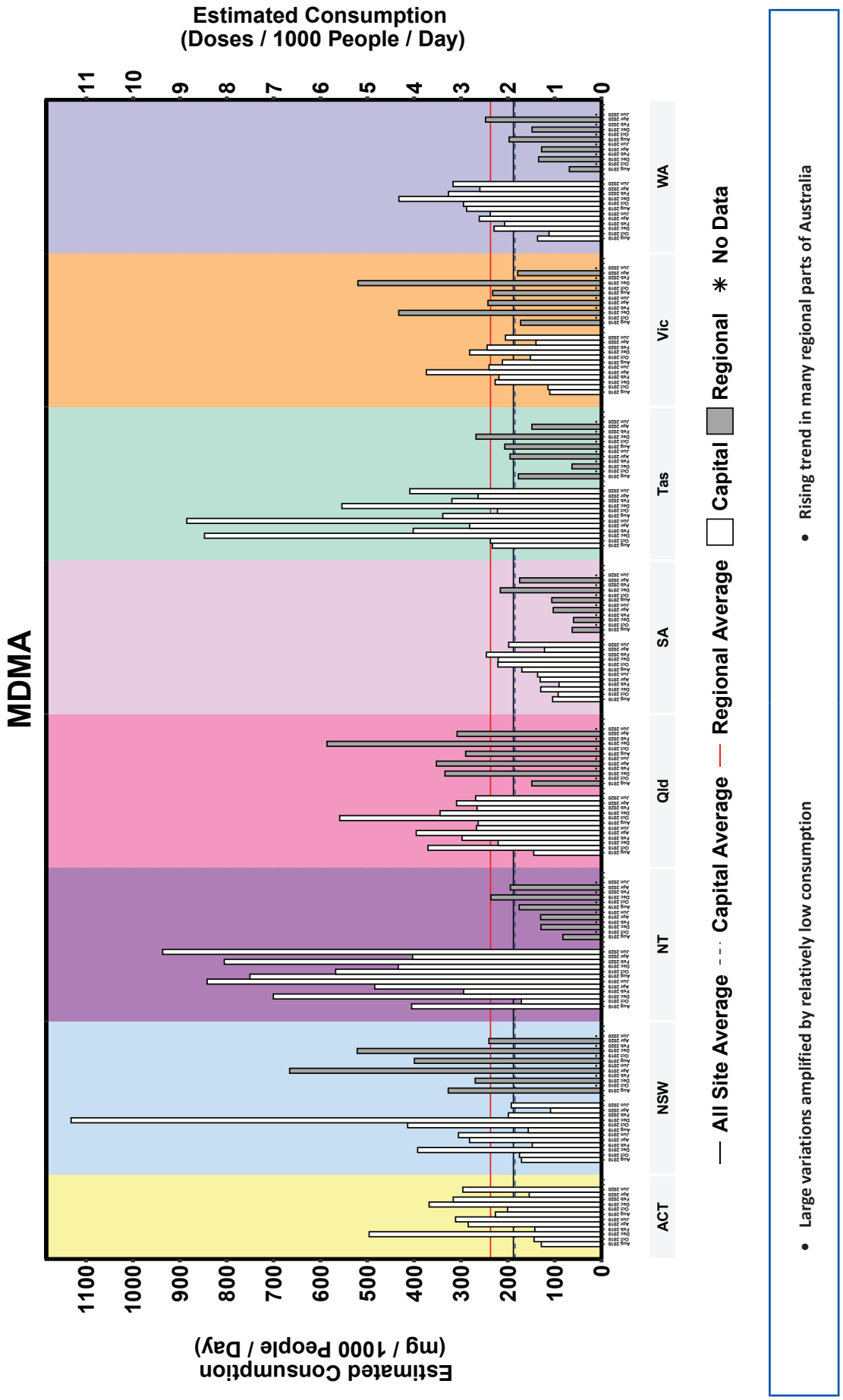
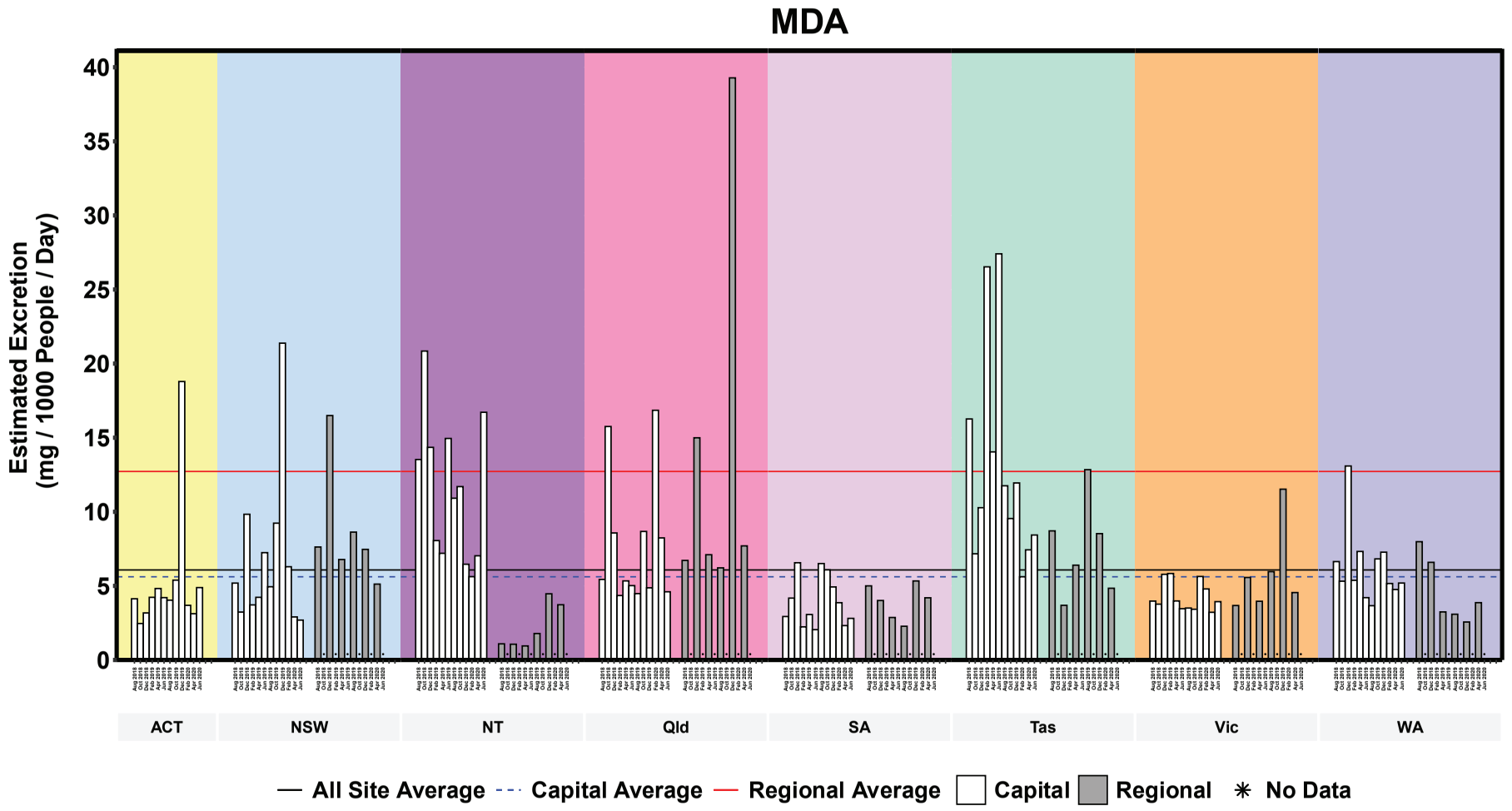


Figure 30: Estimated average consumption of MDMA by state/territory, August 2018 to June 2020.

Figure 31: Estimated average excretion of MDA by state/territory, August 2018 to June 2020.



- Low overall use, with sporadic outbreaks in regional Queensland
- No consistent trends between jurisdictions

4.2.3 OPIOIDS

The use of oxycodone has been steadily declining over the past few years in every part of Australia monitored by the program (Figure 32). Results from the current period continued the trend, both in the capital cities and regional centres. Consumption rates in the regional catchments are very high compared to the capital cities. Tasmania and regional Victoria tend to be the highest consumers of oxycodone on a population basis.

Trends in fentanyl use have similarly headed downwards in the past two years (Figure 33). The level of fentanyl consumption in regional Australia relative to the capital cities is even greater than in the case of oxycodone. Results for the current collections are lower than the previous period for all sampling areas. Whereas fentanyl was historically high in capital city Tasmania, levels have declined to be largely similar to many of the other capital cities.

In contrast to the pharmaceutical opioids, heroin use in Australia occurs largely in the capital cities, especially Victoria (Figure 34). Consumption of heroin in Victoria appeared to be largely unaffected by the start of the pandemic, with levels rising slightly after February 2020. In contrast, use declined in the current reporting period in most of the other capital cities. Tasmania, the Northern Territory and regional parts of South Australia were amongst the lowest users. Heroin consumption has been measured in capital city South Australia since 2013 (Figure 35). The declining levels of heroin consumption in South Australia were reversed after February 2019, with a gradual increase in consumption being evident up to the last reporting period. However, in the current collection, heroin use declined in the capital city's catchments.

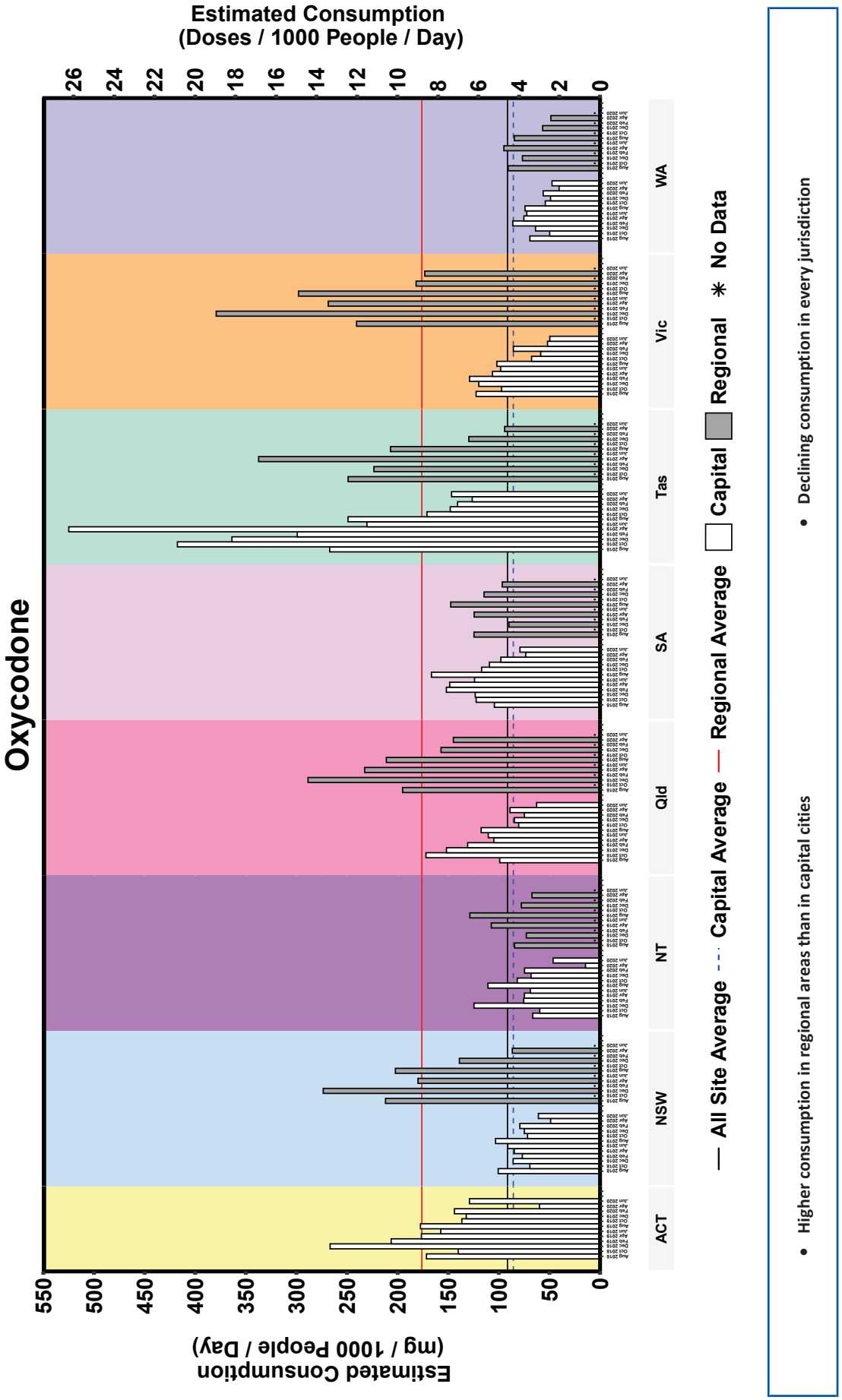


Figure 32: Estimated average consumption of oxycodone by state/territory, August 2018 to June 2020.

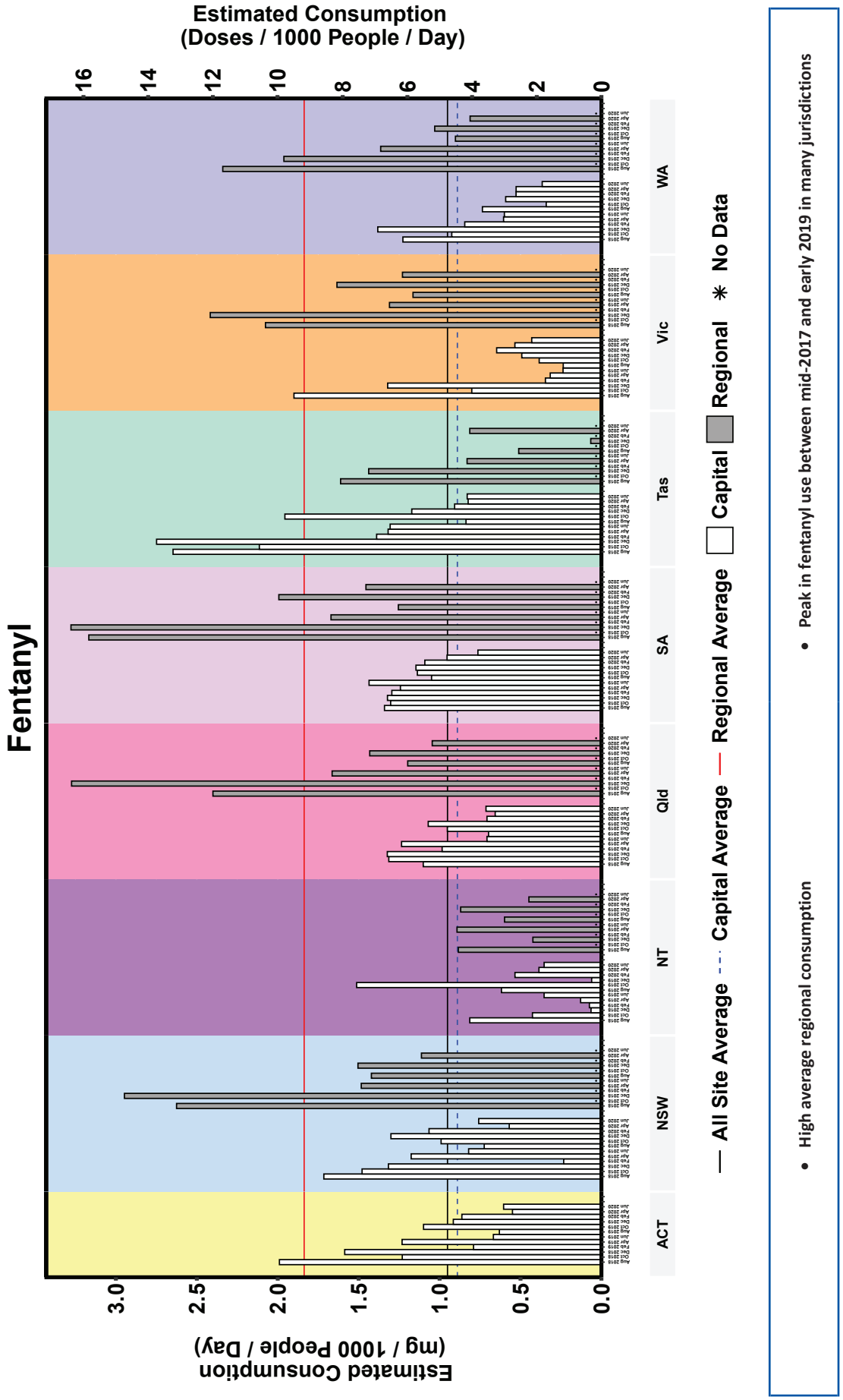


Figure 33: Estimated average consumption of fentanyl by state/territory, August 2018 to June 2020.

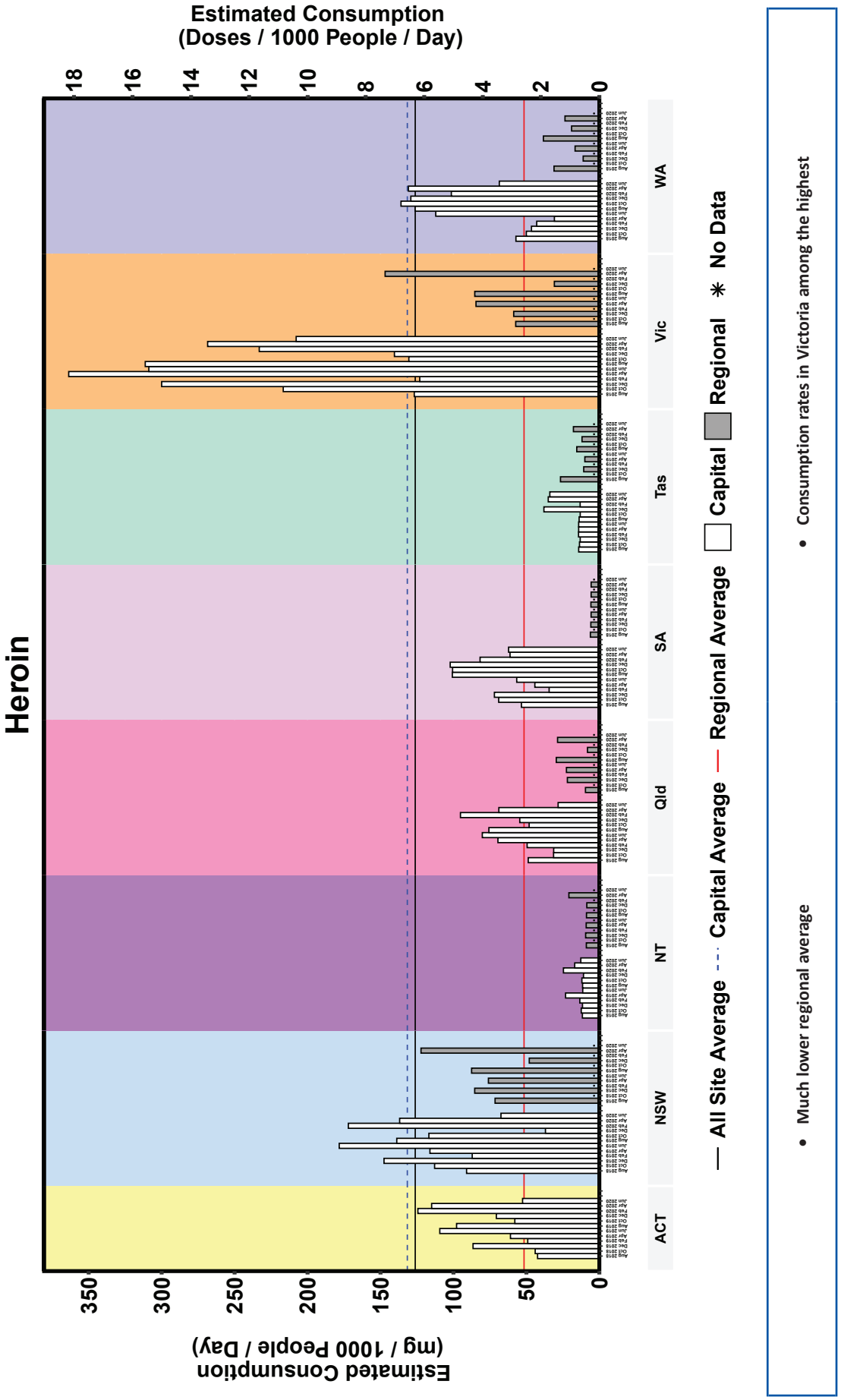
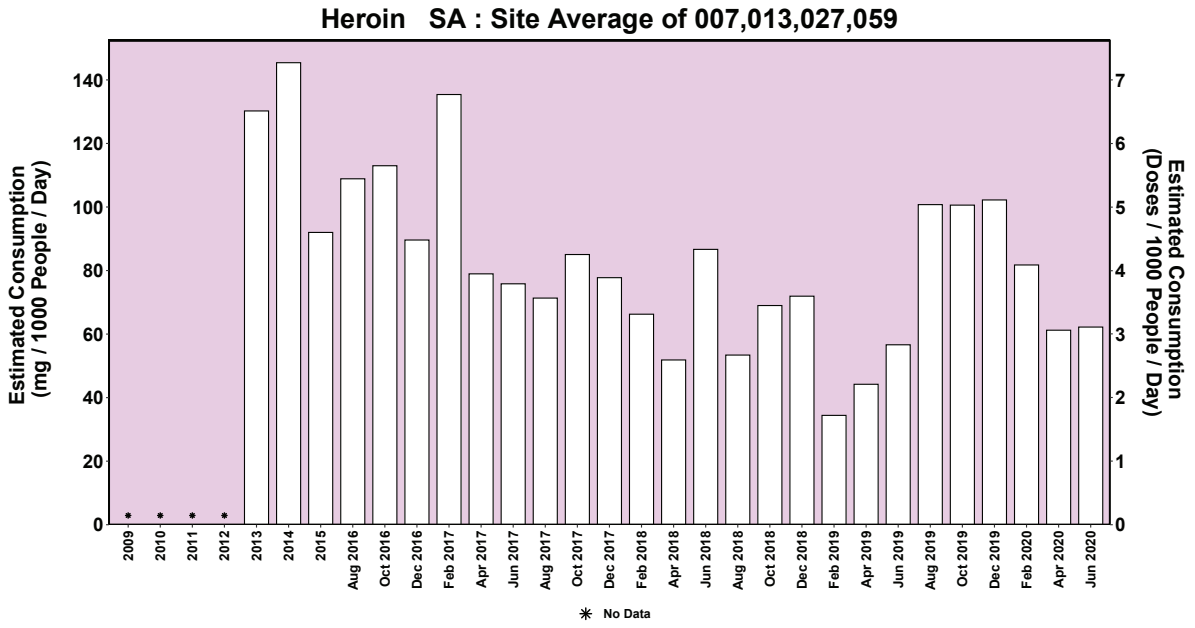


Figure 34: Estimated average consumption of heroin by state/territory, August 2018 to June 2020.

Figure 35: Change in heroin consumption for South Australia.

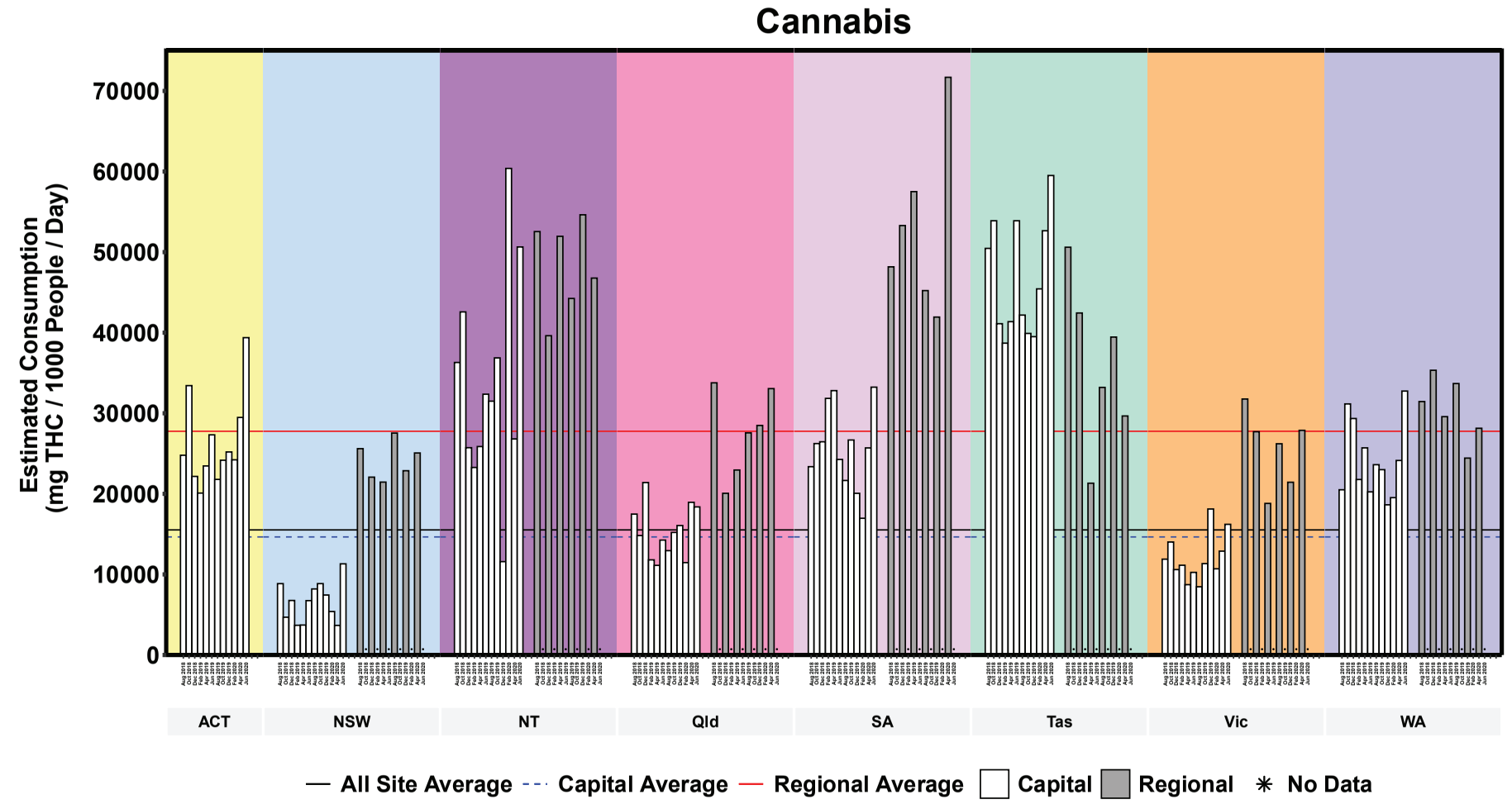


4.2.4 CANNABIS

Cannabis was first included in the program in August 2018. Since that time, trends appear erratic and no common pattern is evident. Since COVID-19 related restrictions came into effect in April 2020, cannabis consumption in most capital cities appeared to increase compared to February 2020 (Figure 36). In some instances, an initial decline in April was followed by a spike in June. Regional centres appeared to be less affected by recent events. Longer term trends may become apparent with an extended time series, as has become evident with other substances recorded in the program. Regional consumption has been substantially higher than capital city levels, with the highest consumption spread over several states and territories, in particular the Northern Territory, Tasmania and regional South Australia. Use in sites covering the larger population centres of New South Wales, Victoria and Queensland was much lower. Consumption in these capital cities was less than half that in the regional areas within the respective jurisdictions.

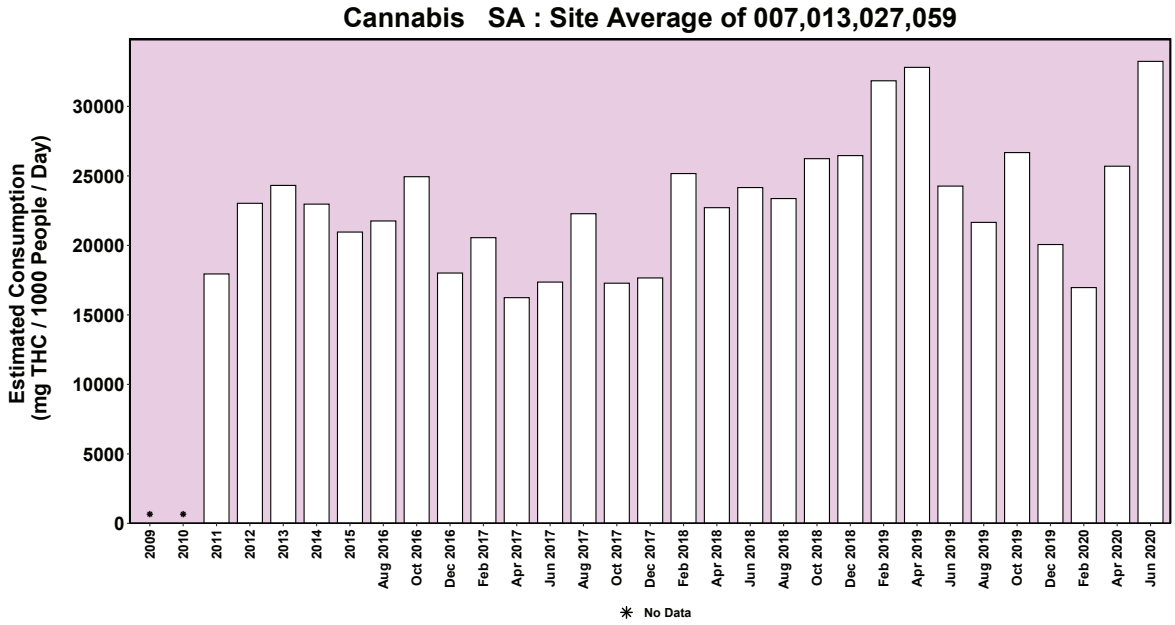
Consumption of cannabis has previously been measured in capital city South Australia since 2011. Use of the substance has seen small but steady increases have occurred over the course of the program, particularly from April 2017 to the previous highest consumption rate in April 2019 (Figure 38). The increase in consumption since COVID-19 can clearly be seen, with highest consumption levels being detected in June 2020.

Figure 36: Estimated average consumption of cannabis by state/territory, August 2018 to June 2020.



- Regional average high compared to capital cities
- Lower consumption in larger capital cities
- Variable between states

Figure 37: Change in cannabis consumption in capital city South Australia. Cannabis is detected via the THC metabolite, THC-COOH.



4.2.5 NEW PSYCHOACTIVE SUBSTANCES (NPS)

Methylone and mephedrone were only detected sporadically and at very low levels compared to other substances included in the report (April 2020 mephedrone and methylone results are shown in Table 2).

4.2.6 NATIONAL CAPITAL CITY AND REGIONAL AVERAGES

In order to show the national trends in the use of individual substances, all capital city and regional sites were combined and displayed as separate graphs for the total sampling period (Figure 38). Fewer sites were sampled in October 2016. Therefore, the contributing population was smaller between these dates and some approximations were necessary to account for the absence of densely populated regions (e.g. October 2016 for capital city New South Wales and Queensland).

Methylamphetamine consumption rates declined from October 2016 to June 2017, followed by increases from mid to late 2017, particularly in regional areas. Since then the trend has fluctuated, with small rises and troughs apparent in both capital city and regional areas. Since the COVID-19 outbreak, there has been a clear divergence between methylamphetamine use in capital cities and regional centres: use has declined substantially in the cities, while regional levels have increased to continue the long-term trend.

MDMA consumption rates declined overall over the first year of the program, followed by a gradual increase. The initial rate of decline was more pronounced in regional areas (August 2016 to April 2017). From mid-2018 to the present, use of MDMA has increased in regional parts of Australia, reaching its highest levels of the program at the end of 2019. Since then, levels of MDMA have declined substantially overall across the country.

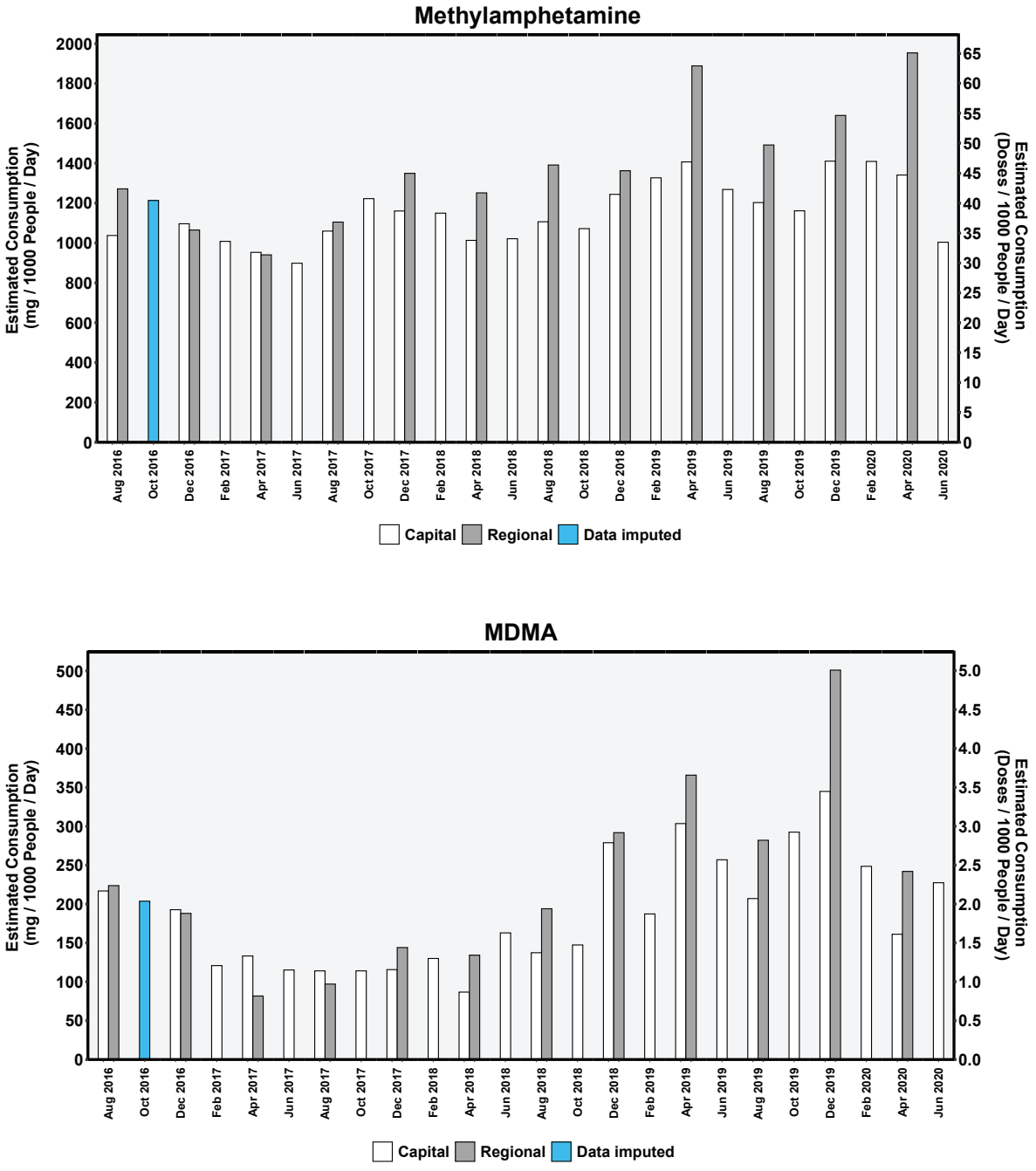
Cocaine and heroin consumption showed some short-term variations, both in terms of capital city and regional levels. However, the long-term trends over the entire program show that cocaine consumption is increasing, with national rates at their highest points since the beginning of the program for capital cities. The gap between city and regional use appeared to be closing towards the end of 2019, but with the outbreak of COVID-19 the gap has increased again.

Heroin consumption in the capital cities is more variable. The overall trend appears to be essentially flat, considering the low number of doses per capita. Heroin consumption in regional areas remains low. Consumption of heroin appeared to be less affected by the pandemic than some other substances monitored by the program.

In terms of legal substances with abuse potential, alcohol and nicotine consumption remained largely unchanged from the start of the program, with only small fluctuations evident (Figure 39). Results from this reporting period show a continuation of the slight rise in use since the middle of 2019 in capital city areas. Nicotine consumption remained substantially higher in regional areas compared to the capital city average. In the case of alcohol, the April 2020 ban on social events and general restrictions caused a decline in averages in both regional and capital city areas. A distinct difference between capital cities and regional Australia was observed for the two pharmaceutical opioids monitored in the program. Capital city populations consumed both drugs at substantially lower levels compared to regional areas. Oxycodone consumption increased steadily after early 2017 and reached a peak in December 2018, declining since then. This has been more apparent in the case of regional centres. Fentanyl use showed a peak in consumption from late 2017 to early 2019, stabilising for a period at relatively low rates, before declining again in this reporting period. Currently fentanyl use is at the lowest levels since the program commenced in 2016.

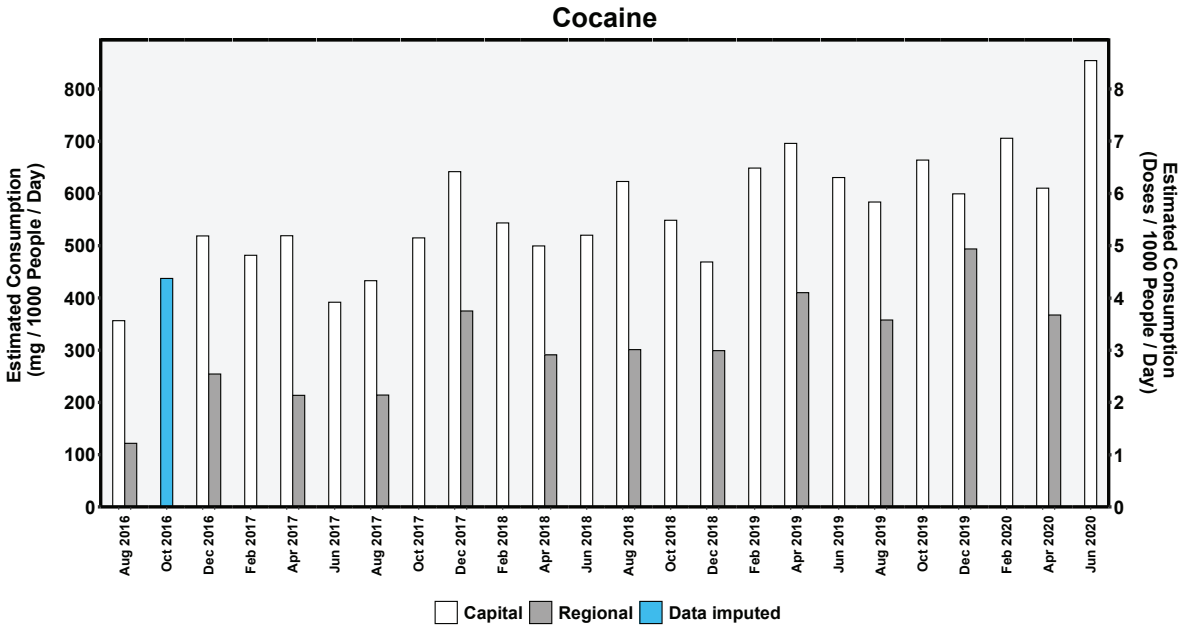
The remaining substances, cannabis, MDA, mephedrone and methylone had mixed findings in the national context. Cannabis showed relatively steady consumption rates across capital cities and somewhat more variable rates in regional areas (Figure 40). Although an increase since the start of the COVID-19 pandemic has occurred, the same increase was observed towards the end of 2019. MDA also appeared stable across city sites. The regional overall rates of use were variable, which was partially driven by sites in Queensland (for example, high consumption rates in August 2017 and December 2019 were mainly influenced by Site 012). The mephedrone and methylone detection rates varied across the course of the program for samples collected in capital city and regional areas. Methylone detections have been on the decline and have remained low since 2017. The detection frequency of mephedrone in capital cities has increased from a low base to the highest levels observed in the program in February 2020, but the frequency dropped after the COVID-19 restrictions in April of this year. Mephedrone detections in regional centres have declined since this time last year.

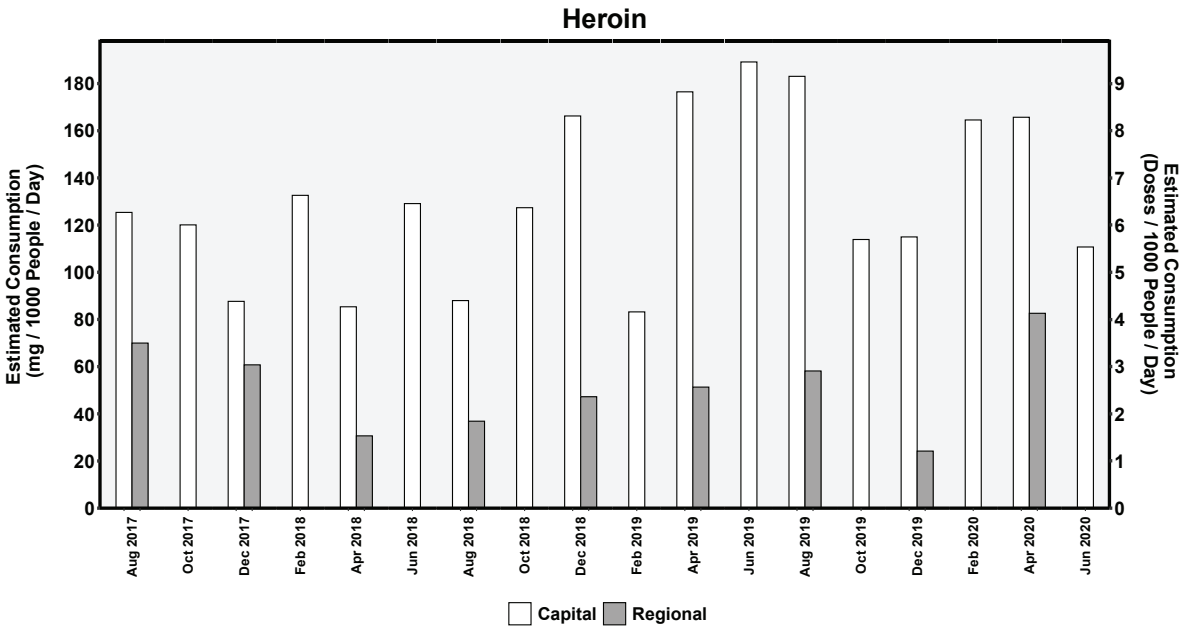
Figure 38: The population-weighted average of all sites for methylamphetamine, MDMA, cocaine and heroin.



Regional areas are only sampled every second collection period. 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.

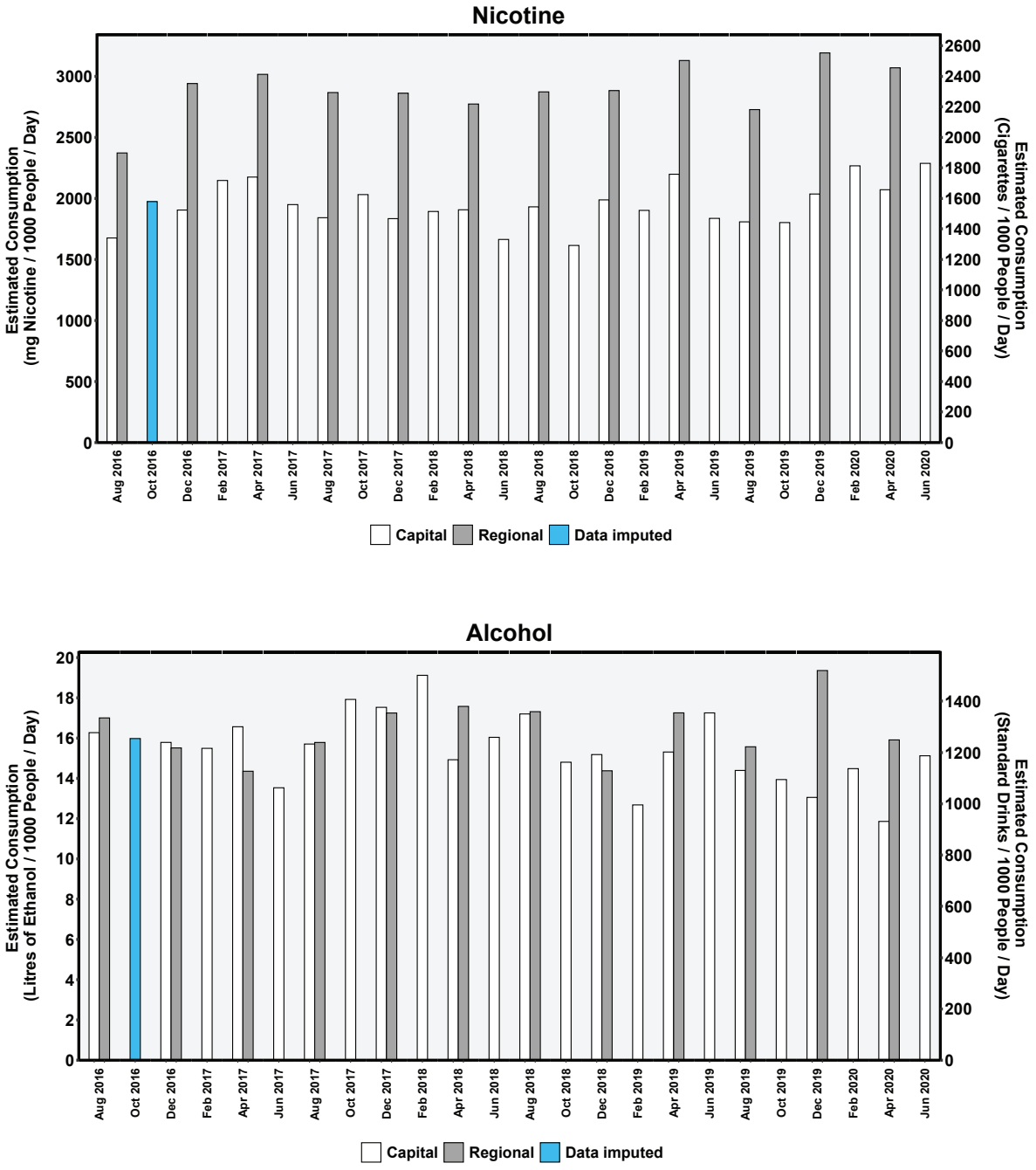
Figure 38 (continued): The population-weighted average of all sites for methylamphetamine, MDMA, cocaine and heroin.





Regional areas are only sampled every second collection period. 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.

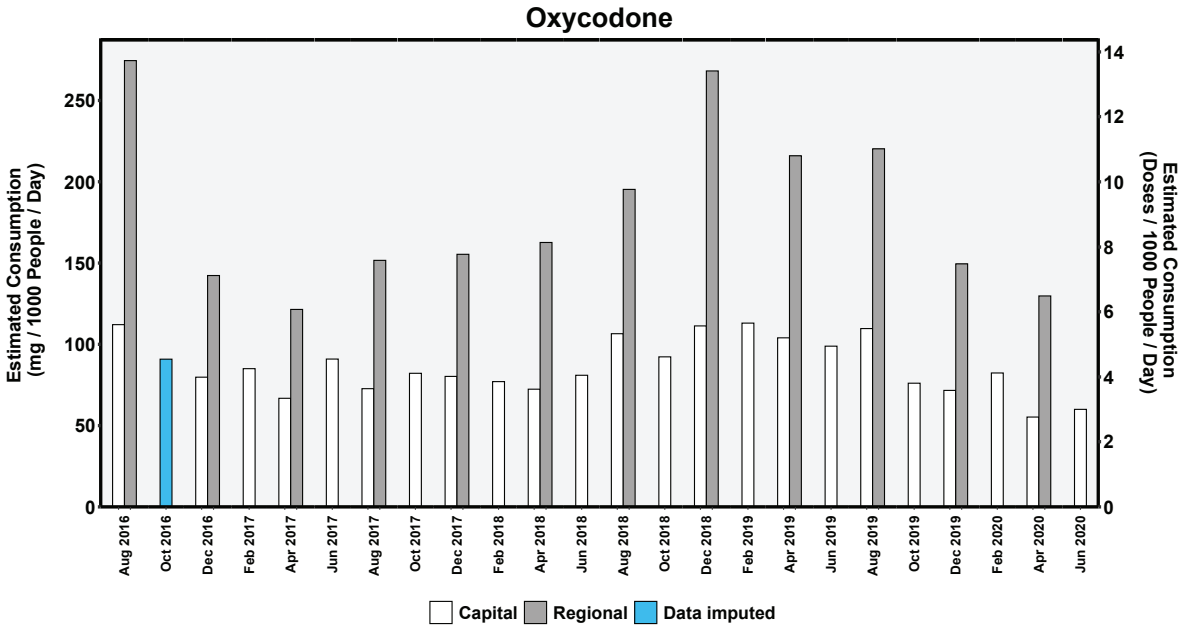
Figure 39: The population-weighted average of all sites for nicotine[7], alcohol, oxycodone and fentanyl.

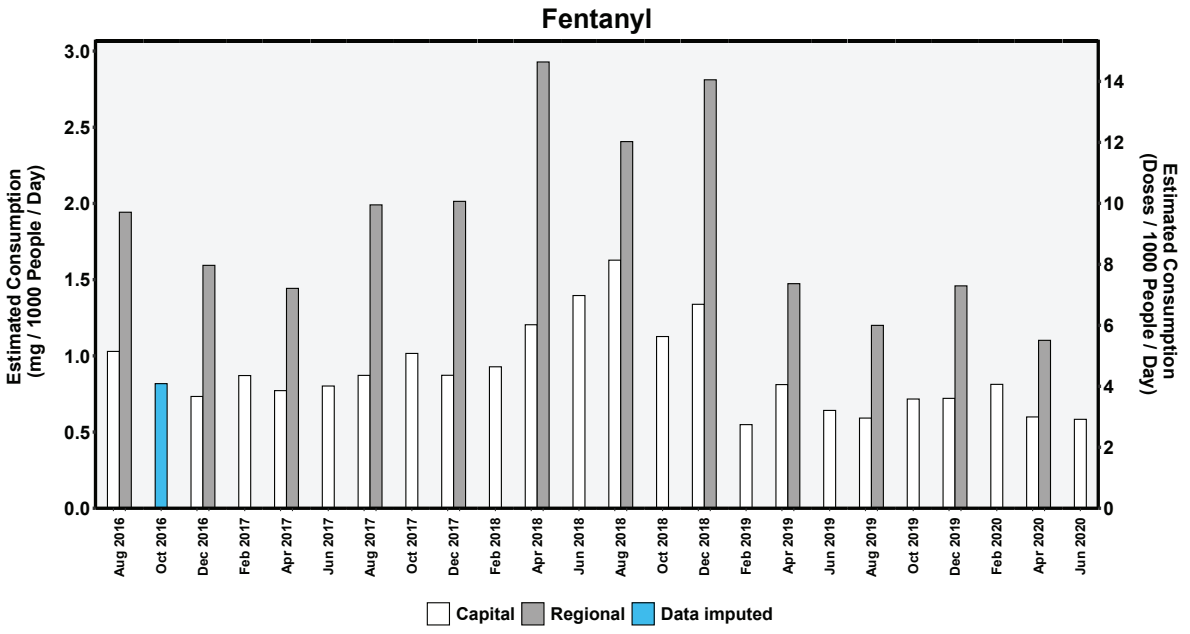


Regional areas are only sampled every second collection period. As Queensland and New South Wales capital city sites were not sampled in October 2016, their average consumption in August and December 2016 was used to provide the overall October estimate.

7 Nicotine consumption data have been adjusted to refine the factor used to convert consumed mass load to dose. Overall trends in nicotine consumption remain unchanged.

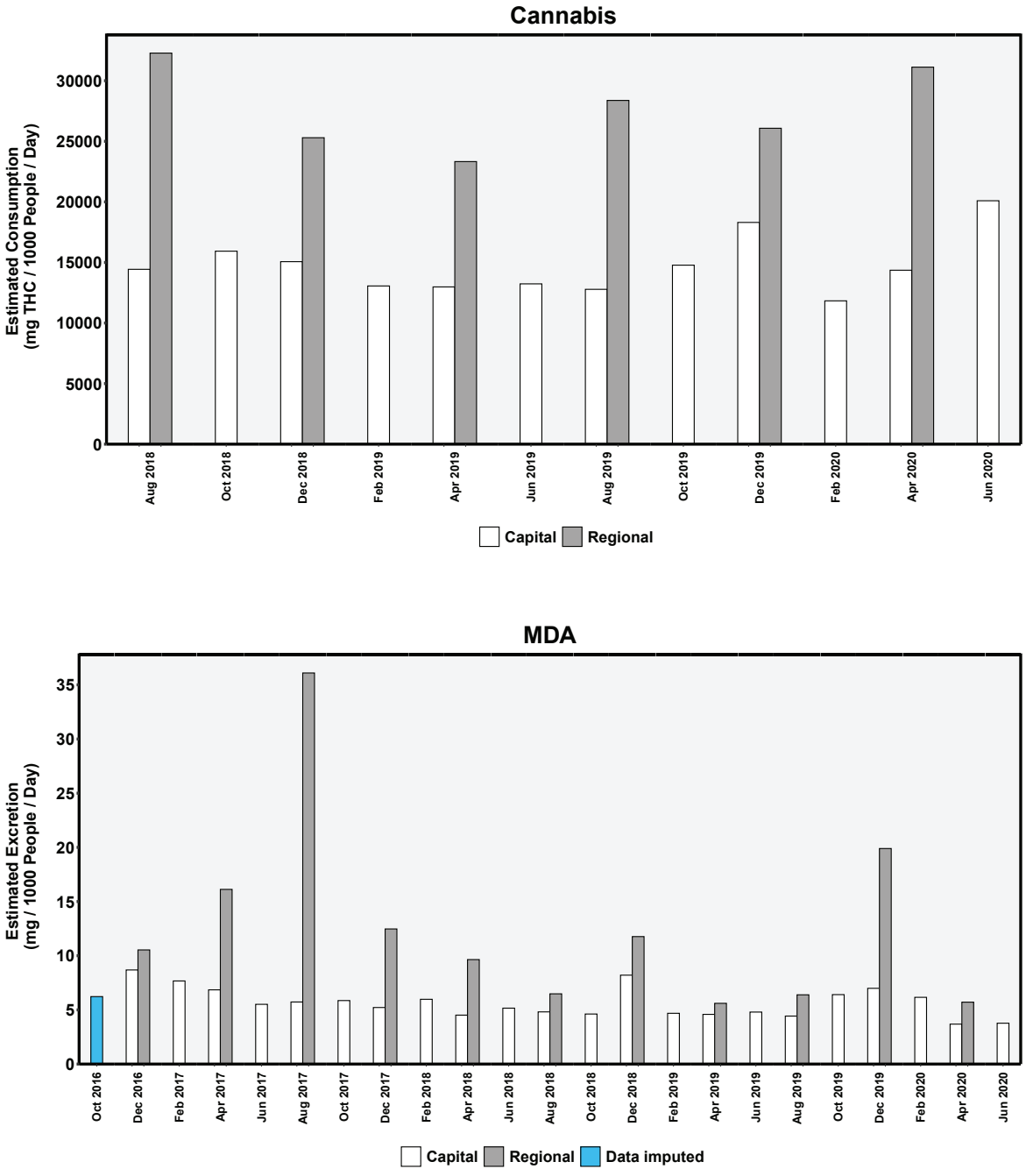
Figure 39 (continued): The population-weighted average of all sites for nicotine, alcohol, oxycodone and fentanyl.





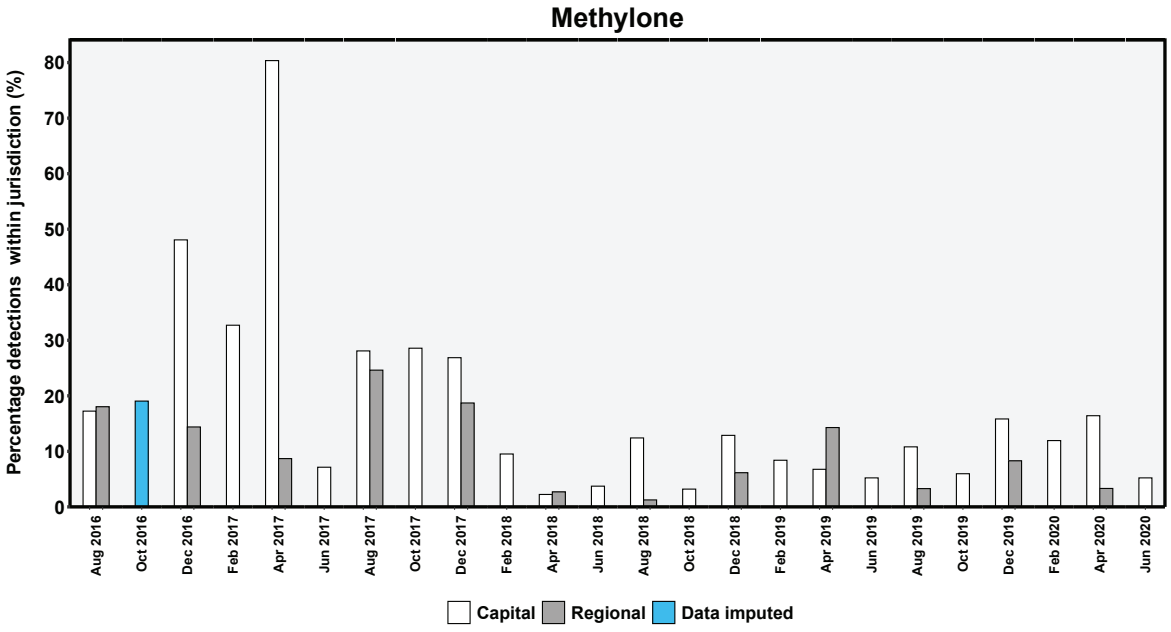
Regional areas are only sampled every second collection period. As Queensland and New South Wales capital city sites were not sampled in October 2016, their average consumption in August and December 2016 was used to provide the overall October estimate.

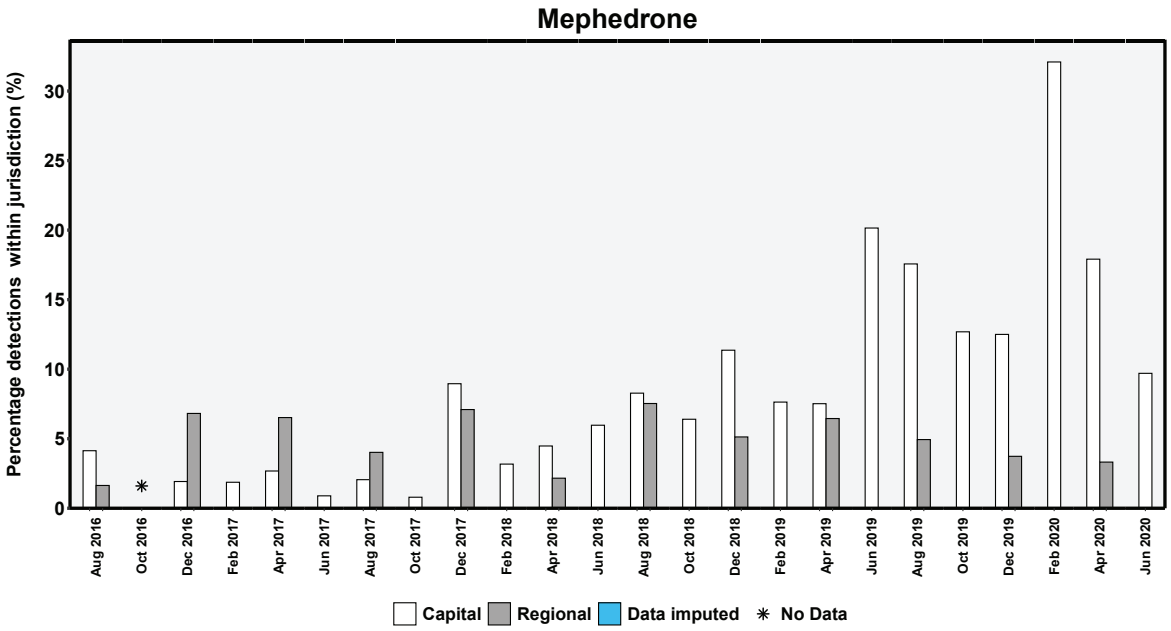
Figure 40: The population-weighted average of all sites for cannabis, MDA, methylone and mephedrone.



Regional areas are only sampled every second collection period. 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 40 (continued): The population-weighted average of all sites for cannabis, MDA, methylone and mephedrone.





Regional areas are only sampled every second collection period. 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.

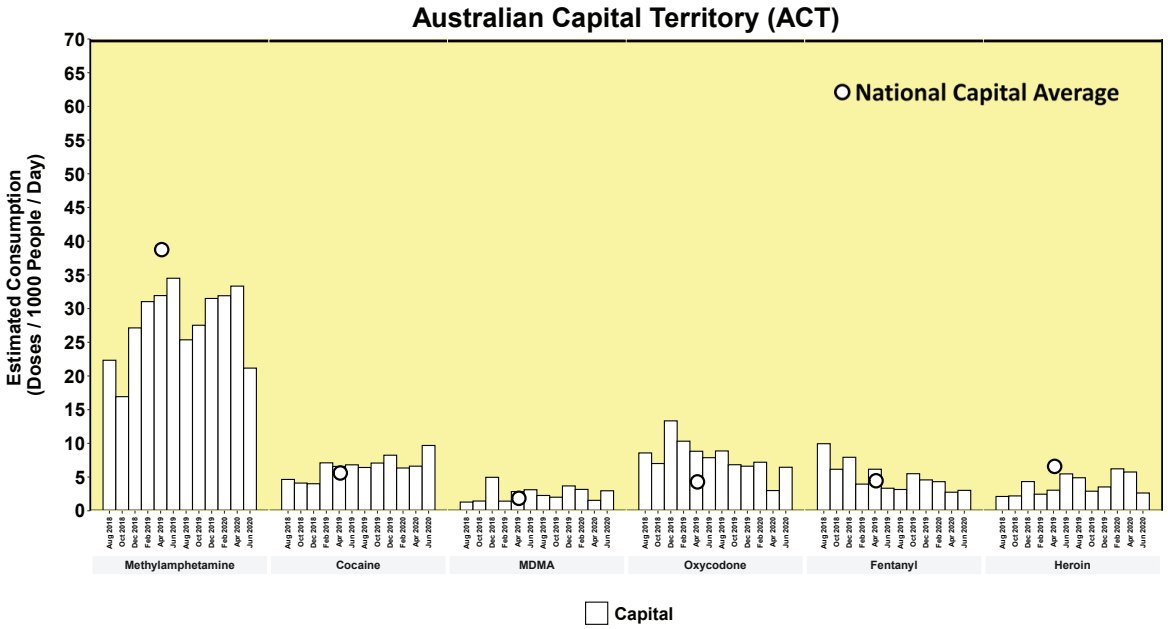
4.3 DRUG PROFILE FOR EACH STATE AND TERRITORY

For the purpose of comparing the scale of use of different types of drugs within the same region (for example, within a state or territory), drug consumption was reported as the number of doses consumed. Cannabis has been omitted from this section in this and previous reports since the definition of a typical dose of cannabis is not well defined. This will be included in comparisons when an appropriate dose for cannabis becomes available. In the absence of pharmacokinetic excretion data for MDA, methylone and mephedrone, these compounds were also excluded from the section.

When the amount of drug measured in wastewater was normalised for population size and average dose consumed (conversion factors listed in Report 1, and in Appendix 1), alcohol and nicotine remained consistently the highest consumed drugs in all states and territories. For example, the national average consumption of nicotine and alcohol per 1,000 people per day was approximately 1,800 cigarettes (Figure 4) and 1,000 standard drinks (Figure 5), whereas for methylamphetamine, the national average consumption was closer to 50 doses per 1,000 people per day (Figure 8).

Aside from nicotine and alcohol, of the illicit stimulants with dose information available, methylamphetamine use remained highest of the drugs included in the report (Figure 41). This was the case across all regions of Australia, with the scale of use of methylamphetamine consistently high for both capital cities and regional sites. It is apparent that the scale of methylamphetamine use dropped in all capital cities since the start of the COVID-19 pandemic, while in regional areas the levels of the drug were less affected. In terms of the profiles of other drugs monitored by the NWDMP (cocaine, MDMA, oxycodone and fentanyl), the patterns were less consistent, but in many states and territories, levels of some of the compounds declined in April or June 2020. Prior to this current reporting period, trends tended to be more state-specific.

Figure 41: Profile of average drug consumption by state or territory, August 2018 to June 2020 for capital sites and to April 2020 for regional sites. 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 respective drugs.



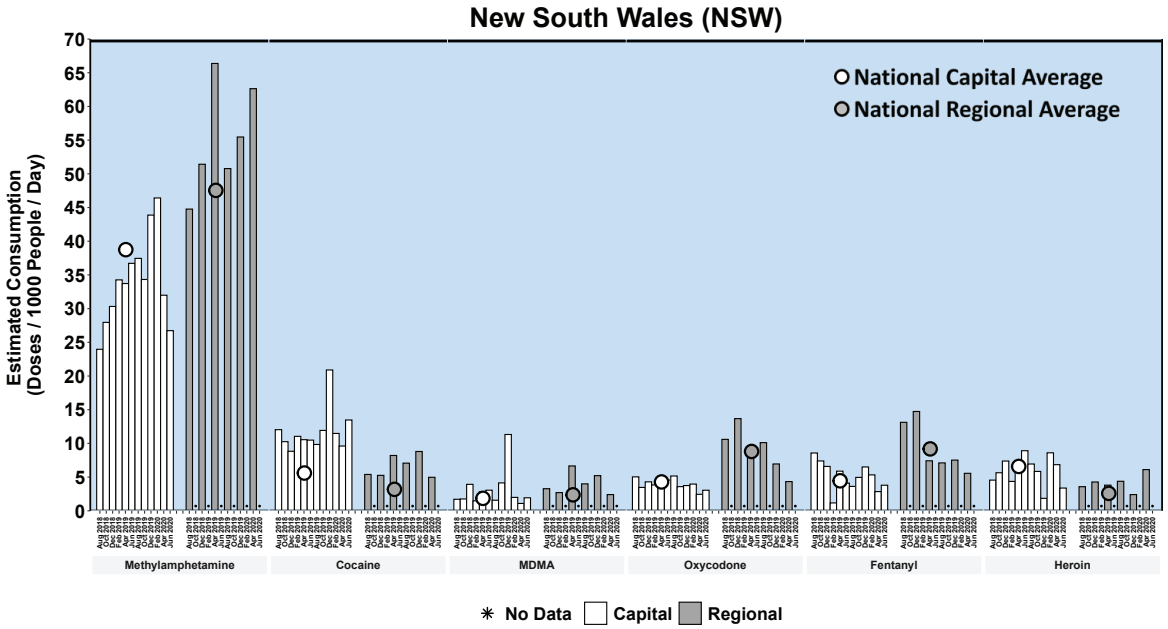
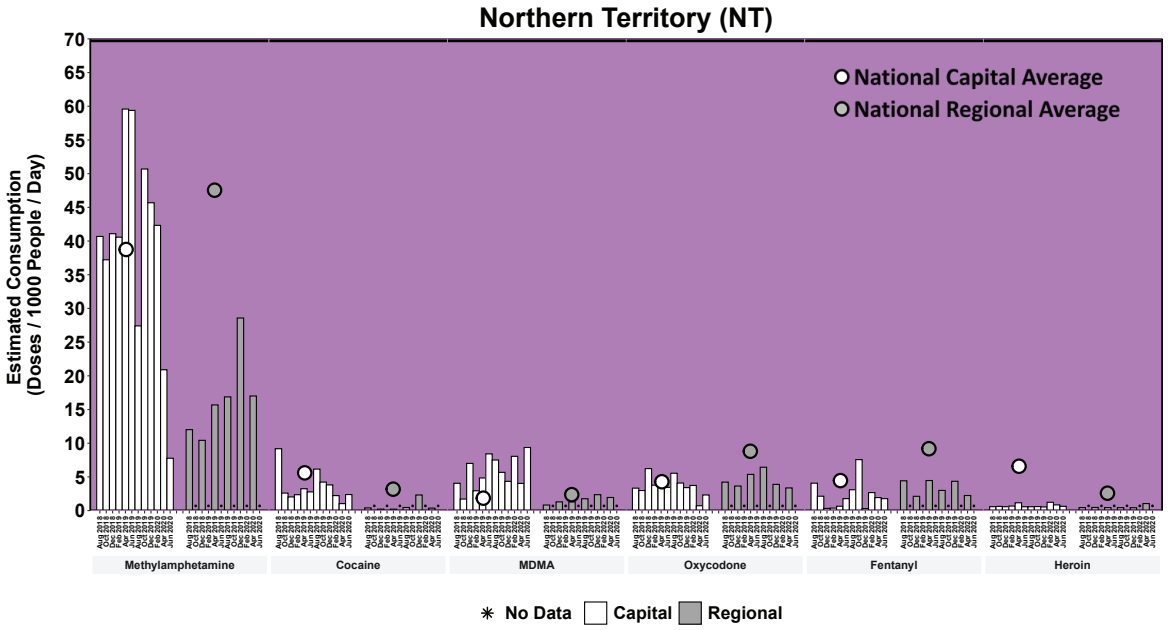


Figure 41 (continued): Profile of average drug consumption by state or territory, August 2018 to June 2020 for capital sites and to April 2020 for regional sites.



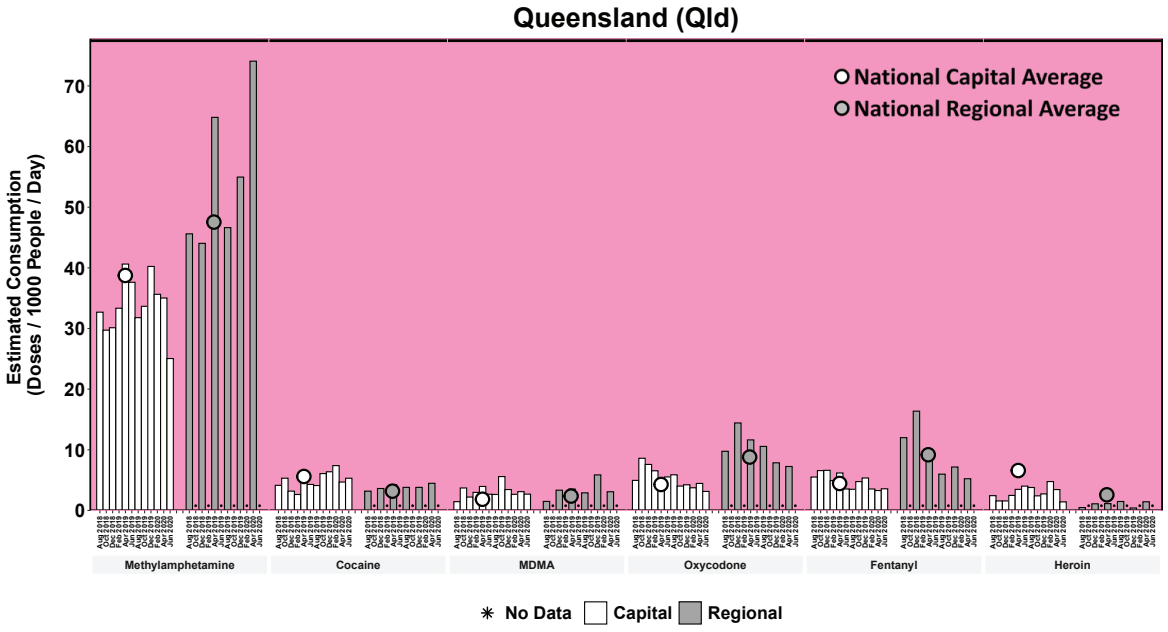
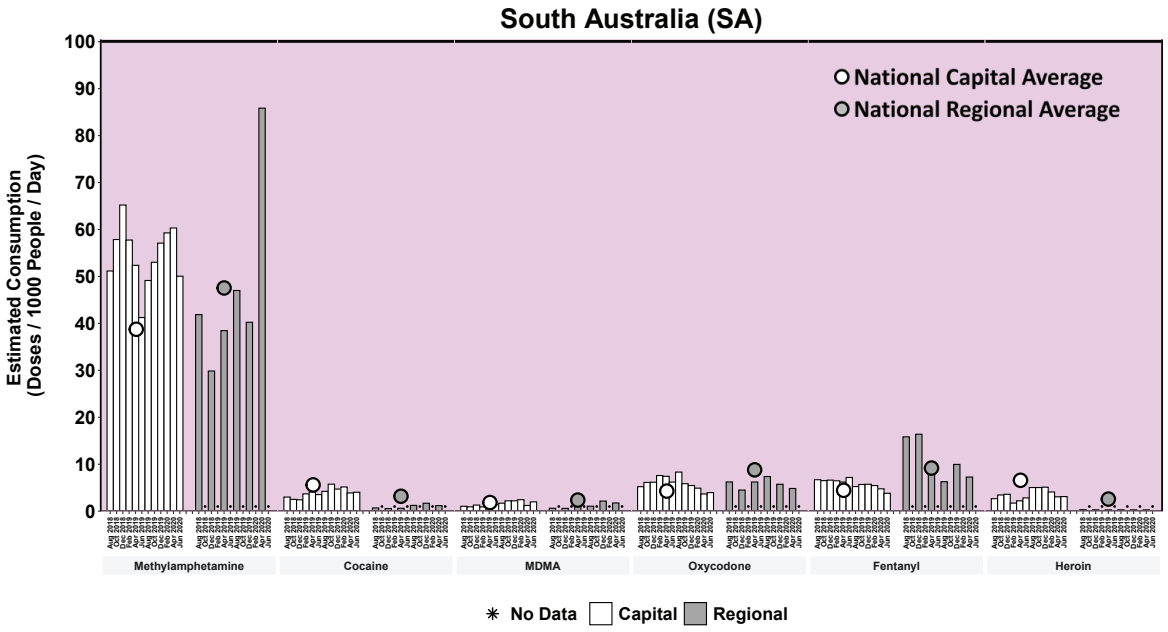


Figure 41 (continued): Profile of average drug consumption by state or territory, August 2018 to June 2020 for capital sites and to April 2020 for regional sites. Note: the y axis for South Australia is higher than the other jurisdictions.



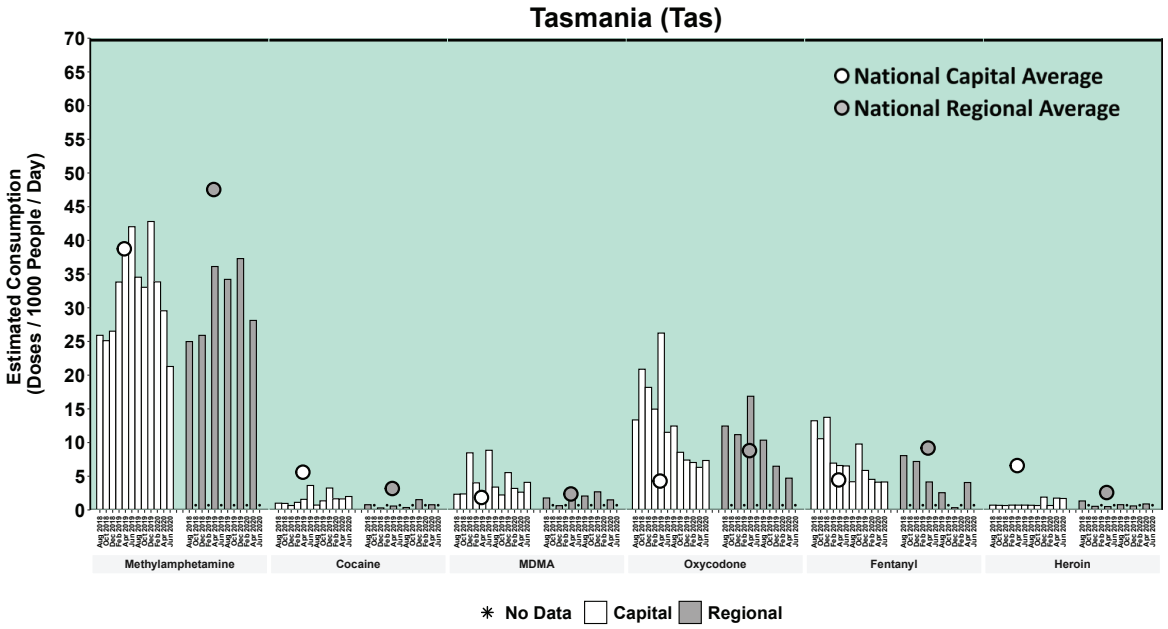
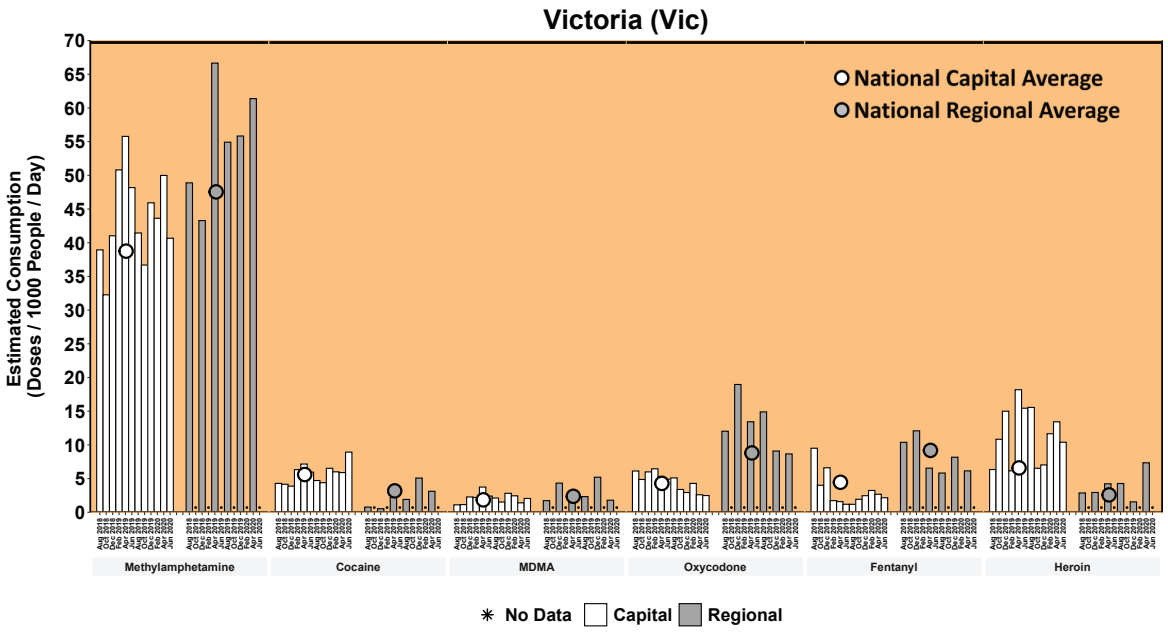
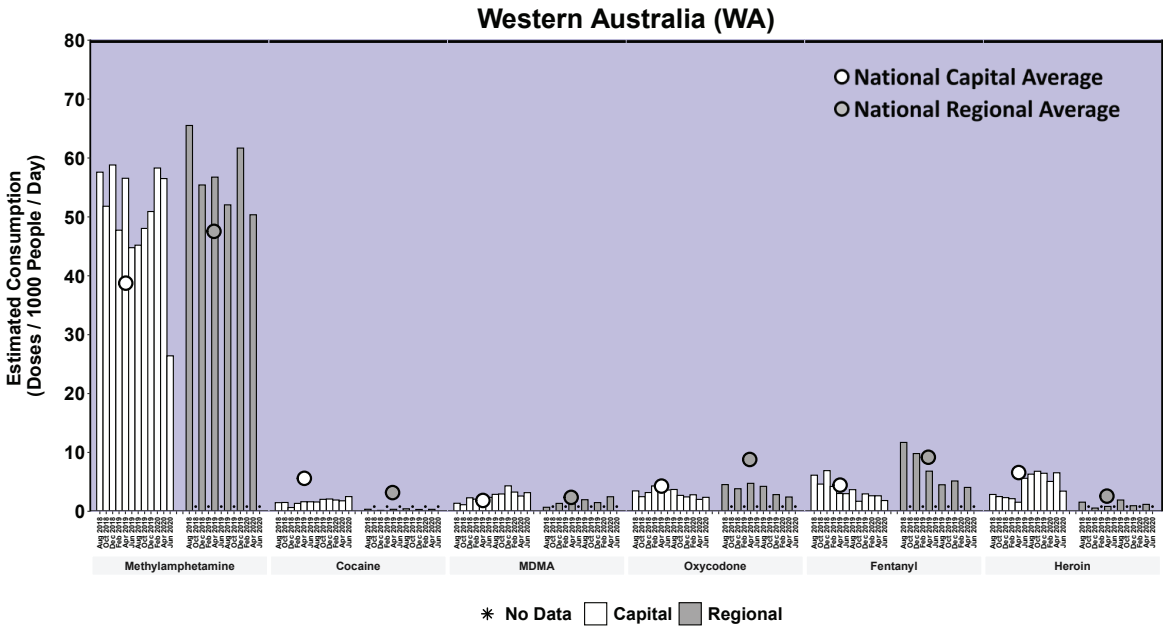


Figure 41 (continued): Profile of average drug consumption by state or territory, August 2018 to June 2020 for capital sites and to April 2020 for regional sites. Note: the y axis for Western Australia is higher than the other jurisdictions.





5: ACKNOWLEDGMENTS

The project team sincerely thanks the numerous WWTP operators involved in sample collection, and WWTP management agencies for providing flow volumes and site information. The cooperation of the plants and management agencies is critical to the ongoing success of this project.

The University of South Australia would like to thank our funding partners, the Drug and Alcohol Services South Australia (DASSA), for their permission to use historical and current data from South Australia, as well as the Western Australia Police Force for permission to use data and for members assisting the University of South Australia with logistics. The University of Queensland thanks Geoff Eaglesham for his contributions to the analytical work for this study and Rachel Mackie and PhD students at QAEHS for their assistance in sample collection and processing.

We also thank the members of the Emerging Environmental Health Risks research group at QAEHS (incorporating the former Entox) for assistance with preparing and shipping sampling bottles to the various plants, and those members, past and present, who helped establish this field at the university.

We also would like to acknowledge the wider wastewater-based epidemiology field which includes addiction specialists, analytical chemists, environmental engineers, forensic scientists, pharmacologists, policy advisors and sewer engineers for their ongoing contributions to knowledge, willingness to share both methodology and data, critical review and for advancing wastewater analysis research.

The symbols/images used in Figure 1 in the report were provided courtesy of the Integration and Application Network, University of Maryland, Center for Environmental Science (ian.umces.edu/symbols/).

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7: APPENDICES

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

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

Analyte/metabolite	Drug	Limit of detection (LOD) [ng/L]	Limit of quantification (LOQ) [ng/L]	Excretion factor	Standard dose pure drug (mg)
Amphetamine	Amphetamine	12	16	0.394[a]	30[b]
Cocaine	Cocaine	17	50	0.075[b]	100[b]
Cotinine	Nicotine	33	100	0.3[c]	1.25[c]
Norfentanyl	Fentanyl	0.1	0.1	0.3[d]	0.2[d]
MDA *	MDA	1	4	n.a.	n.a.[#]
MDMA	MDMA	1.5	2	0.225[b]	100[b]
Mephedrone	Mephedrone	0.4	0.8	n.a.	n.a.
Methylamphetamine	Methylamphetamine	33	100	0.39[g]	30[b]
Methylone	Methylone	0.01	0.1	n.a.	n.a.
Hydroxycotinine	Nicotine	17	50	0.44[c]	1.25[c]
Noroxycodone	Oxycodone	0.1	1	0.22[f]	20[d]
Ethyl Sulphate	Alcohol (ethanol)	167	500	0.00012[e]	10g[e]
Benzoylecgonine	Cocaine	33	100	0.35[g]	100[b]
6-Monoacetylmorphine	Heroin	0.5	1.0	0.013[h]	20[i]
THC-COOH	THC (Cannabis)	30	180	0.006[b]	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 after 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.

APPENDIX 2: SAMPLING DETAILS OF EACH SITE FOR APRIL AND JUNE 2020[8]

Sites	Capital or Regional	Apr 2020	Jun 2020	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	–	–	30,000 to 150,000
NSW: 071	Capital	–	–	> 150,000
NSW: 016	Regional	7	–	30,000 to 150,000
NSW: 025	Regional	7	–	30,000 to 150,000
NSW: 040	Regional	–	–	< 30,000
NSW: 051	Regional	–	–	< 30,000
NSW: 068	Regional	7	–	> 150,000
NSW: 081	Regional	7	–	< 30,000
NSW: 115	Regional	7	–	30,000 to 150,000
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: 020	Regional	7	–	< 30,000
Qld: 024	Regional	7	–	30,000 to 150,000
Qld: 028	Regional	7	–	30,000 to 150,000
Qld: 029	Regional	7	–	30,000 to 150,000
Qld: 033	Regional	7	–	30,000 to 150,000
Qld: 039	Regional	–	–	< 30,000
Qld: 042	Regional	7	–	30,000 to 150,000
Qld: 053	Regional	7	–	< 30,000
Qld: 077	Regional	7	–	< 30,000
Qld: 092	Regional	–	–	< 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

8 Sampling details of each wastewater treatment plant for the previous collection periods are available in Report 7, Appendix 2 and Report 6, Appendix 3.

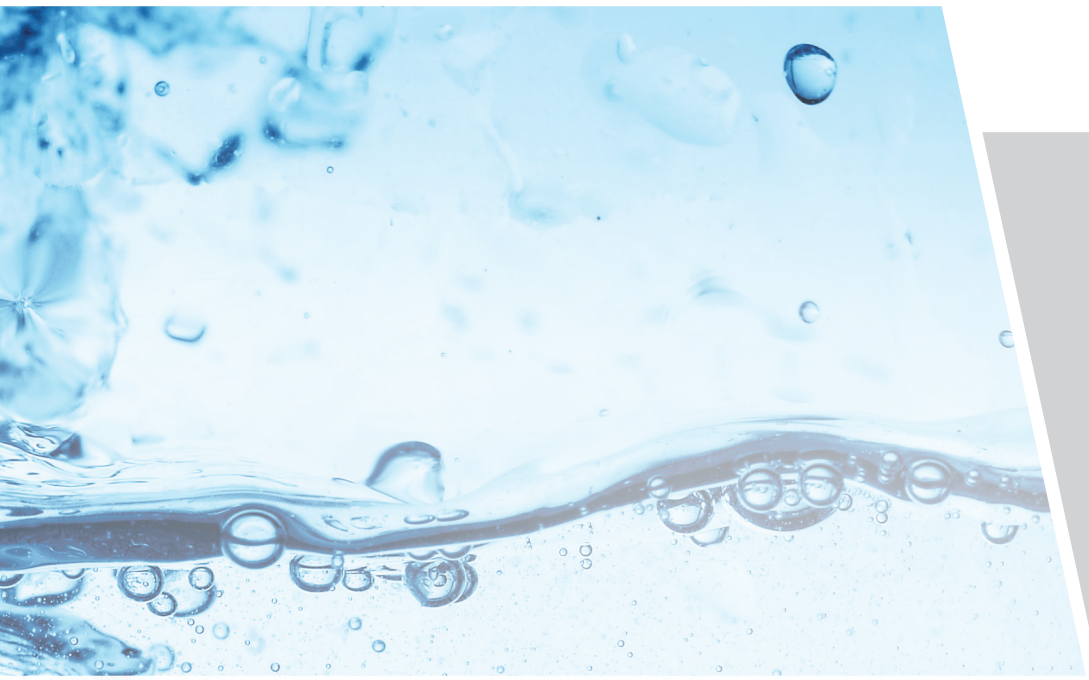
APPENDIX 2 (CONTINUED)

Sites	Capital or Regional	Apr 2020	Jun 2020	Population
Tas: 004	Capital	5	5	< 30,000
Tas: 019	Capital	5	5	< 30,000
Tas: 041	Capital	5	5	< 30,000
Tas: 018	Regional	5	5	< 30,000
Tas: 038	Regional	–	–	< 30,000
Tas: 048	Regional	5	5	< 30,000
Tas: 058	Regional	–	–	< 30,000
Vic: 001	Capital	7	7	> 150,000
Vic: 067	Capital	7	7	> 150,000
Vic: 037	Regional	7	–	> 150,000
Vic: 046	Regional	–	–	30,000 to 150,000
Vic: 061	Regional	7	–	30,000 to 150,000
Vic: 062	Regional	–	–	< 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: 123	Regional	–	–	< 30,000
Vic: 124	Regional	–	–	< 30,000
Vic: 125	Regional	7	–	30,000 to 150,000
Vic: 155	Regional	7	–	30,000 to 150,000
Vic: 156	Regional	7	–	< 30,000
WA: 101	Capital	7	7	> 150,000
WA: 103	Capital	7	7	> 150,000
WA: 104	Capital	7	7	> 150,000
WA: 102	Regional	7	–	30,000 to 150,000
WA: 116	Regional	7	–	< 30,000
WA: 118	Regional	0	–	< 30,000
WA: 120	Regional	7	–	30,000 to 150,000
WA: 129	Regional	7	–	< 30,000
Regional Sites		35	–	
Capital Sites		20	20	
Total Sites		55	20	
Regional Samples		241	–	
Capital Samples		134	134	
Total Samples		375	134	
Cumulative Samples		5,289	5,423	

APPENDIX 3: PROPORTION OF SAMPLES ABOVE LOD (%) FOR EACH DRUG AND PERIOD ASSESSED[9]

Drug	Capital or Regional	Apr 2020	Jun 2020
Alcohol	Capital	100	100
Alcohol	Regional	100	–
Cannabis	Capital	100	100
Cannabis	Regional	100	–
Cocaine	Capital	99	100
Cocaine	Regional	84	–
Fentanyl	Capital	99	100
Fentanyl	Regional	97	–
Heroin	Capital	90	87
Heroin	Regional	50	–
MDA	Capital	100	100
MDA	Regional	100	–
MDMA	Capital	100	100
MDMA	Regional	100	–
Mephedrone	Capital	7	1
Mephedrone	Regional	2	–
Methylamphetamine	Capital	100	100
Methylamphetamine	Regional	100	–
Methylone	Capital	16	5
Methylone	Regional	3	–
Nicotine	Capital	100	100
Nicotine	Regional	100	–
Oxycodone	Capital	100	100
Oxycodone	Regional	98	–

9 Percentage detection for previous collection periods are available in Report 7, 8, 9, Appendix 3 and Report 6, Appendix 4.



CONCLUSIONS

CONCLUSIONS

For the eleventh report of the National Wastewater Drug Monitoring Program, wastewater analysis was conducted in April and June 2020. The program has identified variations in patterns of drug consumption, both over time and within and between jurisdictions. Consistent with previous reports, findings show that of the substances monitored with known doses, nicotine and alcohol are the most consumed drugs in Australia, while methylamphetamine remains the most consumed illicit drug.[10]

METHYLAMPHETAMINE

When comparing data for December 2019 and April 2020, the population-weighted average consumption of methylamphetamine decreased in capital city sites and increased in regional sites, with average regional consumption in April 2020 the highest level recorded by the program. Regional average methylamphetamine consumption continues to exceed capital city average consumption. South Australia had the highest estimated average methylamphetamine consumption in both capital city and regional sites in April 2020.

COCAINE

When comparing data for December 2019 and April 2020, the population-weighted average consumption of cocaine increased in capital city sites and decreased in regional sites. Average capital city cocaine consumption further increased from April 2020 to June 2020 to the highest level recorded by the program. Capital city average cocaine consumption continues to exceed regional average consumption. New South Wales had the highest estimated average cocaine consumption in both capital city and regional sites in April 2020.

3,4-METHYLENEDIOXYMETHYLAMPHETAMINE (MDMA)

When comparing data for December 2019 and April 2020, the population-weighted average consumption of MDMA decreased in both capital city and regional sites. Regional average MDMA consumption continues to exceed capital city average consumption. The Northern Territory[11] had the highest estimated average capital city consumption of MDMA in April 2020, while Queensland had the highest estimated average regional consumption.

3,4-METHYLENEDIOXYAMPHETAMINE (MDA)

MDA is a metabolite of MDMA. When comparing data for December 2019 and April 2020, MDA excretion in both capital city and regional sites decreased. Regional average MDA excretion continues to exceed capital city average excretion. Queensland had the highest estimated average MDA excretion in both capital city and regional sites in April 2020.

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

11 As the Northern Territory only had two participating sites, results may not be representative of the Territory as a whole.

HEROIN

When comparing data for December 2019 and April 2020, the population-weighted average consumption of heroin increased in both capital city and regional sites, with regional consumption in April 2020 the highest level recorded by the program. Capital city average heroin consumption continues to exceed regional average consumption. Victoria had the highest estimated average heroin consumption in both capital city and regional sites in April 2020.

CANNABIS

When comparing data for December 2019 and April 2020, the population-weighted average consumption of cannabis decreased in capital city sites and increased in regional sites. Average capital city cannabis consumption increased from April 2020 to June 2020 to the highest level recorded by the program. Regional average cannabis consumption continues to exceed capital city average consumption. Tasmania had the highest estimated average capital city consumption of cannabis in April 2020, while South Australia had the highest estimated average regional consumption.

OXYCODONE

When comparing data for December 2019 and April 2020, the population-weighted average consumption of oxycodone decreased in both capital city and regional sites, with average capital city consumption in April 2020 the lowest level recorded by the program. Regional average oxycodone consumption continues to exceed capital city average consumption. Tasmania had the highest estimated average capital city consumption of oxycodone in April 2020, while Victoria had the highest estimated average regional consumption.

FENTANYL

When comparing data for December 2019 and April 2020, the population-weighted average consumption of fentanyl decreased in both capital city and regional sites, with average regional consumption in April 2020 the lowest level recorded by the program. Regional average fentanyl consumption continues to exceed capital city average consumption. South Australia had the highest estimated average fentanyl consumption in both capital city and regional sites in April 2020.

NICOTINE

When comparing data for December 2019 and April 2020, the population-weighted average consumption of nicotine increased in capital city sites and decreased in regional sites. Average capital city consumption increased from April 2020 to June 2020 to the highest level recorded by the program. Regional average nicotine consumption continues to exceed capital city average consumption. The Northern Territory[12] had the highest estimated average nicotine consumption in both capital city and regional sites in April 2020.

12 As the Northern Territory only had two participating sites, results may not be representative of the Territory as a whole.

ALCOHOL

When comparing data for December 2019 and April 2020, the population-weighted average consumption of alcohol decreased in both capital city and regional sites, with average capital city consumption in April 2020 the lowest level recorded by the program. Regional average alcohol consumption exceeded capital city average consumption. The Northern Territory[13] had the highest estimated average alcohol consumption in both capital city and regional sites in April 2020.

MEPHEDRONE

Consistent with previous reporting periods, mephedrone was mostly detected below the level at which it could be reliably quantified. The number of national detections of mephedrone increased, from 24 in December 2019 to 32 in April 2020, with the number of detections in capital city sites exceeding the number of detections in regional sites. The number of sites where mephedrone was detected decreased, from 8 in December 2019 to 7 in April 2020. Mephedrone was detected in New South Wales, Queensland, and Victoria, with New South Wales reporting the highest number of detections in April 2020.

METHYLONE

Consistent with previous reporting periods, methylone was mostly detected below the level at which it could be reliably quantified. The number of national detections of methylone decreased, from 39 in December 2019 to 30 in April 2020, with the number of detections in capital city sites exceeding the number of detections in regional sites. The number of sites where methylone was detected decreased, from 16 in December 2019 to 11 in April 2020. Methylone was detected in all states and territories with the exception of the Australian Capital Territory, Tasmania and Victoria. Western Australia reported the highest number of methylone detections in April 2020.

NEXT REPORT

The twelfth report of the National Wastewater Drug Monitoring Program is scheduled for public release in February 2021.

13 Ibid.