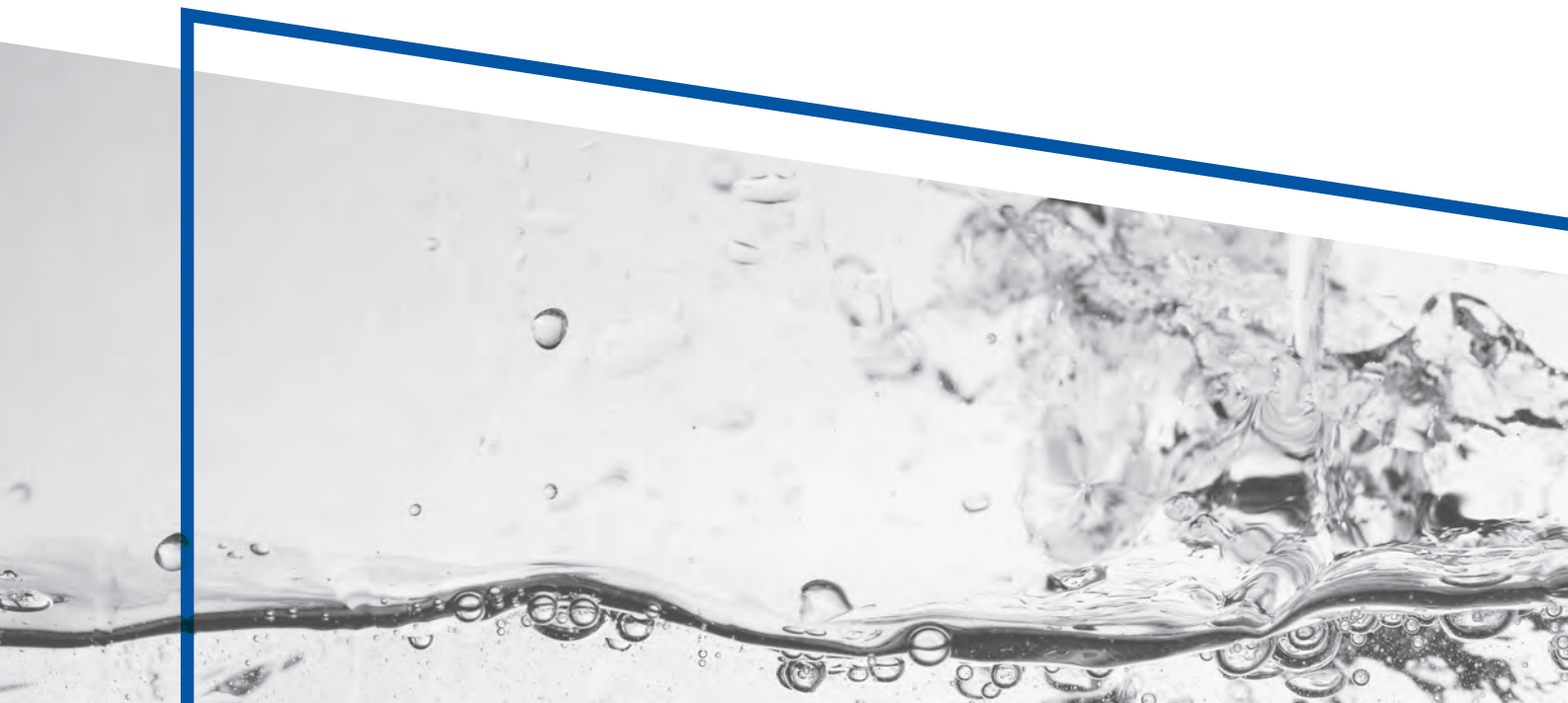
NATIONAL WASTEWATER DRUG MONITORING PROGRAM

REPORT 6, DECEMBER 2018

AUSTRALIAN CRIMINAL INTELLIGENCE COMMISSION

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

University of South Australia



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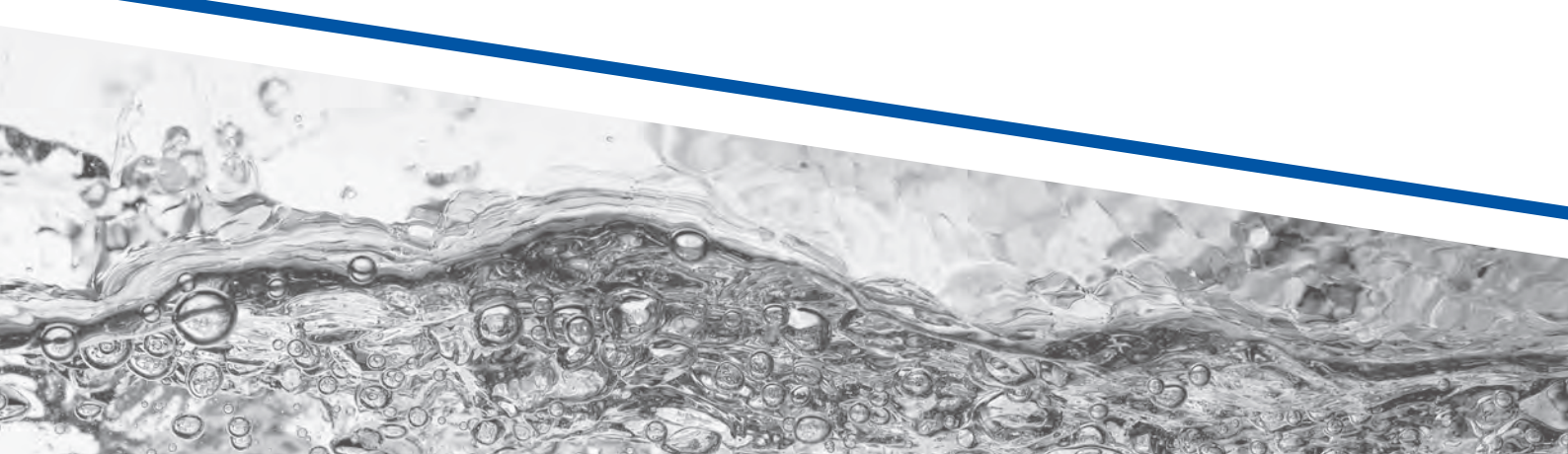


CEO FOREWORD

The Australian Criminal Intelligence Commission has a national responsibility to provide information and intelligence on criminal activity. Much of the harm that Australians suffer at the hands of organised crime is due to the trade in illicit substances and abuse of licit substances, with serious and organised crime groups profiting from the importation, manufacture, trafficking and sale of drugs.

This National Wastewater Drug Monitoring Program report is the sixth in a series of nine public reports that will detail findings of the national wastewater program until the end of 2019. This report provides statistically valid datasets of drug use and distribution patterns across a large number of sites in capital cities and regional areas across Australia.

Wastewater analysis is widely applied internationally as a tool to measure and interpret drug use within national populations, with the current national program in Australia representing world best practice. Wastewater analysis provides a measure of one important aspect of national health—the demand for a range of licit and illicit drugs. An understanding of this behaviour allows governments to effectively direct resources to priority areas and monitor the progress of demand and supply reduction strategies.

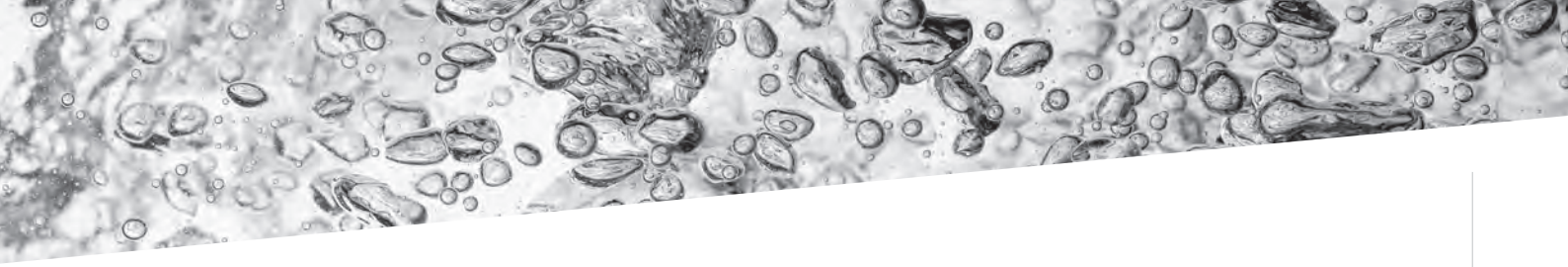
EVOLUTION OF THE PROGRAM

This report provides a national picture of drug use and includes wastewater data from all states and territories. In August 2018, 58 wastewater sites were monitored nationally. Based on 2016 Census data, these sites cover approximately 56 per cent of the Australian population—around 13 million people. This report contributes further data to permit the identification of changes in usage patterns and to build a comprehensive and increasingly detailed picture of national drug consumption.

The National Wastewater Drug Monitoring Program continues to evolve, with the total number of drugs monitored by the program increasing to 13 from Report 6 following the inclusion of cannabis. Cannabis is one of the most used illicit drugs, both domestically and internationally, and its inclusion in the program provides valuable insight. In August 2018, there was apparent variation in consumption between the states and territories, with regional average cannabis consumption more than double capital city average consumption. We are grateful to our partners at the University of Queensland and University of South Australia for extending the program in this manner and their ongoing efforts to deliver and enhance our leading edge program.

TRENDS IDENTIFIED DURING THIS REPORTING PERIOD

With the exception of cocaine and heroin, regional average consumption exceeded capital city consumption for drugs monitored by the program in August 2018. Of the drugs measured by the program that have available dose data, alcohol and nicotine continue to be the most consumed drugs in Australia, with methylamphetamine remaining the most consumed illicit drug. The consumption of other drugs measured by the program remains considerably lower, with mephedrone and methylone consumption at or below detection levels. Overall, the average consumption of most drugs monitored by the program increased between April and August 2018.



ADDITIONAL INSIGHTS GAINED FROM WASTEWATER ANALYSIS

Wastewater analysis provides a measure of the demand for a range of licit and illicit drugs. Analysis of wastewater data offers opportunities to address emerging problems, identify previously unknown drug threats and consumption patterns, and assists to measure the effectiveness of harm reduction initiatives and supply disruption strategies. This report reflects two years of data for most of the drugs monitored by the program and highlights the benefits and valuable insights that longitudinal data can provide, including the ready comparison of data across various reporting periods to assist in identifying changes in drug consumption, both in the short and long term.

Following on from the national consumption estimates for methylamphetamine, cocaine, MDMA and heroin derived from the program and included in Report 4, this report includes national consumption estimates for the second year of the program. These estimates have been calculated using the refined population estimates of wastewater treatment catchments derived from the latest Census data from the Australian Bureau of Statistics, and geographical information system analysis of populations reported within wastewater treatment catchments. In comparing estimated annual consumption across the two reporting periods, national methylamphetamine and cocaine consumption has increased, while national MDMA and heroin consumption has decreased. To put the estimated size of the Australian methylamphetamine market into context, the total estimated combined weight of cocaine, MDMA and heroin consumed annually continues to equate to around 60 per cent of the estimated weight of methylamphetamine consumed annually. Of the estimated $9.3 billion Australians spent on these four drugs last year, methylamphetamine accounted for 78 per cent of the money spent.

Data from the program illustrate the variation that can exist in a single drug market—both within and between jurisdictions—across drug types and time periods. Drug markets are not static and consumption data show the resilience of drug markets and the enduring demand for drugs in Australia. It again reinforces that no single strategy can achieve sustained impacts and the ongoing necessity to employ a shared approach that targets supply, demand and harm reduction.

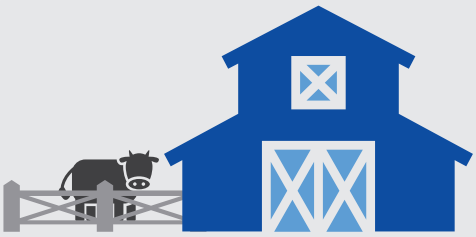
I would like to thank the Australian Government for contributing the funding which made this initiative possible and to acknowledge the Australian Criminal Intelligence Commission officers who contributed to the project. I also acknowledge the valuable support and specialist expertise of the University of Queensland and the University of South Australia, who undertook the data collection and analysis which underpins this report.

Michael Phelan APM
Chief Executive Officer
Australian Criminal Intelligence Commission

SNAPSHOT

The August 2018 collection covers around **56 per cent** of Australia's population—about **13 million Australians.**

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

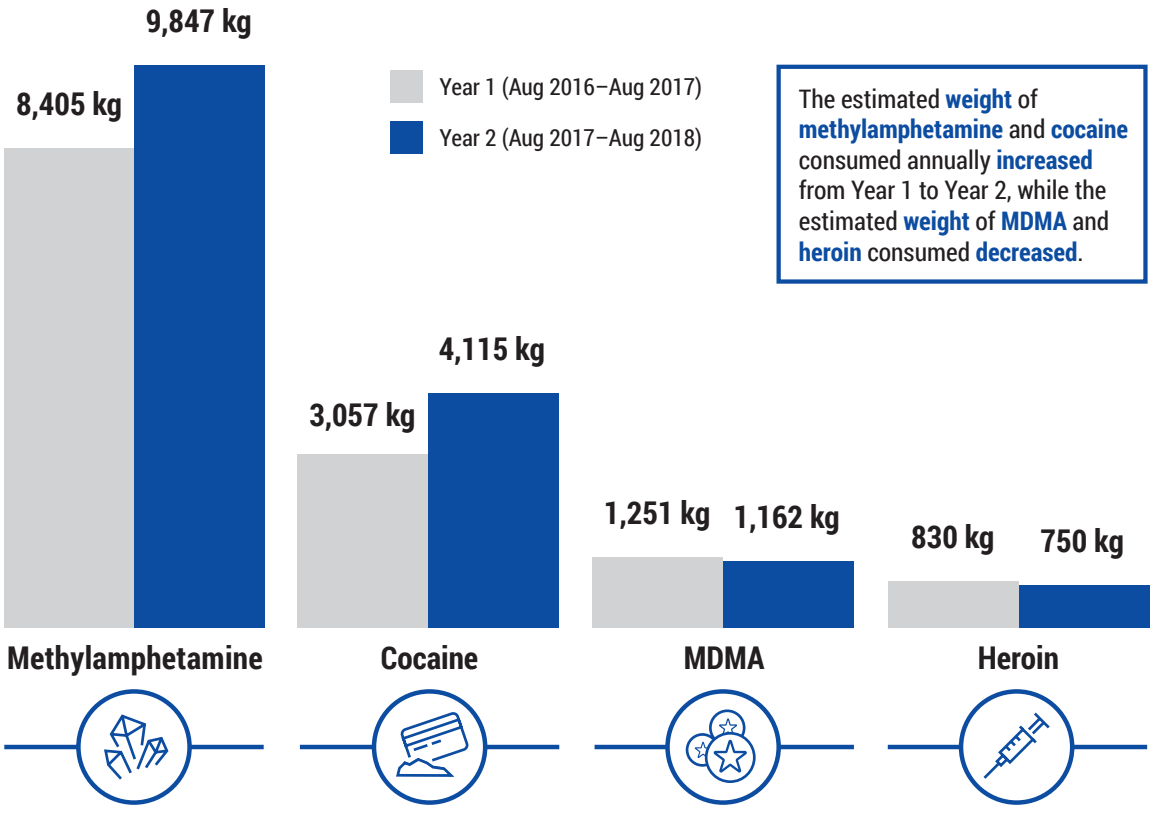


Regional **nicotine, alcohol, methylamphetamine, MDMA, MDA, oxycodone, fentanyl and cannabis** average consumption exceeded capital city consumption.

Alcohol and **nicotine** are the **most consumed substances** of those measured with available dose data.

As the program concludes its second year, it is able to provide longer term insights into drug consumption.

When comparing data from August 2016 to August 2018, the **population-weighted average** consumption of **methylamphetamine**, **cocaine**, **fentanyl**, **nicotine** and **alcohol** in both capital city and regional sites **increased**, while consumption of **MDMA** and **oxycodone** in both capital city and regional sites **decreased**.



The estimated **weight** of **methylamphetamine** and **cocaine** consumed annually **increased** from Year 1 to Year 2, while the estimated **weight** of **MDMA** and **heroin** consumed **decreased**.

INTRODUCTION

This is the sixth in a series of nine National Wastewater Drug Monitoring Program reports to be publicly released by the Australian Criminal Intelligence Commission. The program aims to deliver on the recommendations of the *Final Report of the National Ice Taskforce*. It is the first program to provide leading-edge, coordinated national research and intelligence on illicit and licit drugs, with a specific focus on methylamphetamine and 12 other substances.

In 2016, the Australian Criminal Intelligence Commission received $3.6 million in funding under the Proceeds of Crime Act to deliver the National Wastewater Drug Monitoring Program over three years. The program provides a measure, rather than an estimate, of the use 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 of drug consumption across Australia and can identify new sources of threat.

The findings presented in the nine reports will give law enforcement, policy, regulatory and health agencies additional and more objective data on the use of methylamphetamine and other drugs. This data creates opportunities to shape the response to both the demand and the supply side of the illicit drug market, particularly in high-use areas.

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 first five substances are widely recognised illicit stimulants. Heroin and cannabis are illicit depressants. The next two substances, mephedrone and methylone, are illicit synthetic stimulants and are described as new psychoactive substances (NPS).[2] Oxycodone and fentanyl are opioid pharmaceuticals with therapeutic application, but are also diverted to the illicit market. Nicotine and alcohol are licit drugs. The Australian Criminal Intelligence Commission will continue to review the appropriateness of the monitored substances with its partners, stakeholders and the universities.

Both contracted universities will monitor wastewater at approximately 50 sites across Australia until the end of 2019. It is the intention of the program that capital city sites cover all state and territory capital cities, with the remaining sites covering regional cities and towns. Capital city sites will be monitored for the duration of the program, while the remaining sites will be re-assessed periodically. 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 local authorities have established relationships with the two universities. In August 2018, 58 wastewater treatment plants participated nationally.

The breakdown of sites by jurisdiction for August 2018 is as follows:

2 From Report 4, the two synthetic cannabinoids JWH-018 and JWH-073 are no longer monitored by the National Wastewater Drug Monitoring Program as they had not been detected since monitoring commenced in August 2016.

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 decide 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 three years of the contract.

REPORTING

National Wastewater Drug Monitoring Program reports will be published as comprehensive public reports three times a year. In accordance with current wastewater analysis conventions, the terms of the contract, and to protect the integrity of the program, the exact locations of wastewater treatment plants will not be publicly released by the Australian Criminal Intelligence Commission.

To maintain the confidentiality of the participating sites, each site was allocated a unique code so that results could be de-identified. However, trends in particular states and territories are still able to be identified. The public reports will incorporate a discussion of trends in drug use where distinct trends are seen—for example, between regional areas and capital cities, or between states and territories and nationally—and include comparisons with testing from previous years where that data is available.

In order to inform appropriate responses, stakeholders in law enforcement, health and other relevant policy agencies may be provided with classified information identifying actual sampling locations.

EXPLOITATION OF THE NATIONAL WASTEWATER DRUG MONITORING PROGRAM DATA

Wastewater has been identified as offering an important, unified and consistent guiding tool in developing holistic drug responses. The National Wastewater Drug Monitoring Program is based on a well-established and internationally recognised methodology which has been applied to varying extents by many other nations. Because the collection and analysis protocols are similar, it is also possible to compare domestic drug consumption with international drug consumption.

The Australian Criminal Intelligence Commission intends that the findings of the National Wastewater Drug Monitoring Program analysis will be fundamental to the development of government policy and decision making, as the reports provide a regular, timely, unambiguous and detailed measure of the level of demand for the listed commodities in the Australian population, complementing other drug datasets published in Australia. The sixth National Wastewater Drug Monitoring Program report measures drug use by around 56 per cent of the Australian population.[3] It is hoped that wastewater data will be used with other available data sources to obtain a more comprehensive and accurate understanding of drug markets nationally and in the respective states and territories.

3 The August 2018 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.

Australia is one of the few countries in the world where the program is funded by a national government, with the scope of sampling in Australia generating data which will help governments at both a state and national level to formulate appropriate responses. Making the National Wastewater Drug Monitoring Program data available to the public and to stakeholder agencies enriches understanding and informs the national conversation on drug trends and related demand.

The Australian Criminal Intelligence Commission continues to engage with academic institutions, industry and public sector agencies concerning potential uses for data generated by the National Wastewater Drug Monitoring Program. Discussions have centred upon focusing responses in particular high risk areas, measuring drug use in particular local areas, estimating the size of specific illicit markets, comparing wastewater data with other drug-related data and exploring options for monitoring the effectiveness of existing demand, supply and harm reduction initiatives. The advantage the National Wastewater Drug Monitoring Program offers in all these contexts is that the data is collected on an ongoing basis, is reported regularly and can be shaped to accommodate changing circumstances.

EVOLUTION OF THE PROGRAM

The Australian Criminal Intelligence Commission continues to work with the participating universities to enhance the program. Since its launch, the program has explored and implemented various enhancements that contribute to the delivery of better data and building a better and more granular understanding of drug consumption in Australia. These enhancements include the ability to compare Australia's drug consumption with measured consumption in different countries and the inclusion of additional substances in the monitoring program as new methodologies are developed and endorsed by the scientific community.

The sixth National Wastewater Drug Monitoring Program report reflects a further evolution of the program. For the first time the program reports nationally on cannabis consumption. Its inclusion in the program illustrates the variation in consumption that exists both within and between the states and territories, providing further insight into one of the largest illicit drug markets in Australia. Moreover, as the program concludes its second year, it is able to provide longer term insights into drug consumption for the majority of drugs monitored by the program. The program will continue to build on this longitudinal data and seek to capitalise on the valuable insight such data provides.

ESTIMATED NATIONAL CONSUMPTION

The Australian Criminal Intelligence Commission used wastewater data collected between August 2016 and August 2017 (Year 1) and August 2017 and August 2018 (Year 2) to estimate the annual weight of methylamphetamine, MDMA, cocaine and heroin consumed in Australia (see Table 1). This includes revised consumption estimates for the first year of the program. These estimates have been calculated using the refined population estimates of wastewater treatment catchments derived from the latest Census data from the Australian Bureau of Statistics and geographical information system analysis of populations reported within wastewater treatment catchments. While the estimates remain conservative, they provide valuable insight into Australia's demand for illicit drugs that could not have been gained without the program.

Table 1. Estimated annual national methylamphetamine, cocaine, MDMA and heroin consumption.

Drug	Estimated consumption Kilograms per year (revised) Year 1 of program	Estimated consumption Kilograms per year Year 2 of program	% Change	Estimated street price for drugs consumed in Year 2 $AUD[4]
Methylamphetamine	8,405	9,847	↑ 17.2	7.3 billion
Cocaine	3,057	4,115	↑ 34.6	1.5 billion
MDMA	1,251	1,162	↓ -7.1	114 million
Heroin	830[5]	750	↓ -9.6	375 million

The estimated weight of methylamphetamine and cocaine consumed annually has increased from Year 1 to Year 2, while the estimated weight of MDMA and heroin consumed annually has decreased. Consistent with estimates from the first year of the program, the total estimated combined weight of cocaine, MDMA and heroin consumed annually in the second year of the program equates to around 60 per cent of the estimated weight of methylamphetamine consumed annually.[6]

Using price data for the 2016–17 financial year, conservative consumption estimates suggest that Australians spent more than $9.3 billion in methylamphetamine, cocaine, MDMA and heroin between August 2017 and August 2018. More than 78 per cent of this was spent on methylamphetamine.

A shared 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 self-report data—provide greater insight into the related markets and the potential impact of supply, demand and harm reduction strategies.

RESULTS FROM THE COLLECTION

Wastewater data is an important part of the suite of datasets available to increase our understanding of drug consumption, demand and supply in Australia. This sixth report of the National Wastewater Drug Monitoring Program builds on national drug consumption data contained in the preceding five public reports to identify drug use patterns 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. This, and future reports, will contribute further data to identify trends, changes in patterns of use and emerging issues, building a more comprehensive and increasingly detailed picture of national drug consumption.

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 substance, to facilitate comparison between substances.

4 Estimates used price data from the Illicit Drug Data Report 2016-17 to calculate the monetary value of the illicit drug if it were to be sold at the end of the supply chain or 'on the street'.
5 Heroin estimates for Year 1 are based on one collection period.
6 In order to compare the scale of use of different types of drugs, it is necessary to compare drug consumption by the number of doses consumed. Further information in relation to doses and related consumption estimates is contained in the Research Findings of the report.

RESEARCH FINDINGS

Prepared by the University of Queensland (B Tscharke, R Mackie, J O'Brien, S Grant, J Mueller, K Thomas) and University of South Australia (M Ghetia, R Bade, 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
LOR	Limit of reporting
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
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

Wastewater analysis has become a standard method for measuring population-scale use of a range of different chemical compounds. The underlying concepts involved in wastewater analysis were demonstrated in the first national Australian report released in March 2017. Estimates of drug usage in a population were back-calculated from measured concentrations of drug metabolites (excreted into the sewer system after consumption) in wastewater samples. Spatial and temporal trends in drug use have since been included using this approach for several sites across Australia. The National Wastewater Drug Monitoring Program (NWDMP) for the Australian Criminal Intelligence Commission (ACIC) monitors selected substances of concern in most populated regions of Australia. The NWDMP now focuses on thirteen licit and illicit drugs, including nicotine, alcohol, methylamphetamine, cocaine and MDMA (ecstasy), with cannabis included for the first time in Report 6. Trends in estimated drug consumption are being established over the three-year project. 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 sixth report, wastewater samples were collected during weeks of June and August 2018. Twenty-four-hour composite wastewater samples were collected using time-proportional or flow-proportional autosamplers at the influent of 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 spectrometry (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 22 WWTPs in capital cities and a further 36 regional sites participated in the project for the August 2018 period, covering a population of 13 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 48 per cent and 56 per cent of Australia's population for June and August, respectively. A total of 2,801 individual daily samples have been collected and analysed since the beginning of the program, with new results from 517 additional samples added in this report. The collected samples provide comprehensive, Australia-wide baseline data against which subsequent results can continue to be compared to ascertain both spatial and temporal trends.

The estimated drug usage across the 58 sites (August 2018) was mostly consistent with previous reports. 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, since dose sizes vary and using an averaged dose was not deemed appropriate for the purposes of the study. Estimated consumption of nicotine was generally higher in regional areas compared to capital cities. In the case of alcohol, there was virtually no difference between regional and capital city use. The Northern Territory had the highest consumption of nicotine and alcohol, but with only two participating sites, the result may not be representative of the Territory as a whole. In other parts of Australia, alcohol consumption was similar for the most part, except in regional South Australia, where it was relatively low.

Methylamphetamine remains high amongst the illicit drugs included in the report, both in capital cities and regional sites. Aside from recent declines in capital city WWTPs in South Australia, consumption levels are generally steady or on the rise. Western Australia had the highest overall per capita consumption of the drug, but regional New South Wales, Queensland and Victoria have been increasing to match levels in capital city South Australia and Western Australia.

Amphetamine is a metabolite of methylamphetamine and measured amphetamine concentrations across the sites were consistent with the observed levels being primarily related to methylamphetamine metabolism rather than sourced from direct amphetamine consumption.

Compared to methylamphetamine, estimated usage of other stimulants was generally much lower, and no consistent pattern of usage for these other drugs could be observed between states and territories. Cocaine consumption in Australia is mostly centred in New South Wales across several capital city and regional sites. Levels in Queensland and the Australian Capital Territory have trended upwards and are second highest in the nation. Regional use of the drug is generally lower than in capital cities. MDMA usage was similarly low across most sites with a few site-specific exceptions.

Oxycodone and fentanyl, which are both prescription pharmaceutical substances with abuse potential, had elevated consumption levels at several sites, noticeably across Tasmania. Regional areas had average oxycodone use well above capital city sites in many states. Fentanyl consumption has been increasing in several regions, particularly Victoria and New South Wales. Consumption of heroin varied widely, with minimal amounts detected in the Northern Territory and many regional areas of other states. High levels were recorded in sites in New South Wales, Victoria and the Australian Capital Territory.

Cannabis was included for the first time this reporting period. Recognising that the metabolite, 11-nor-9-carboxy-tetrahydrocannabinol (THC-COOH), a specific marker for cannabis consumption, is excreted in extremely small amounts which may be a cause of variability in back-calculated results, spatial differences were evident across the nation. Use was relatively low in New South Wales compared to other parts of the country, while Tasmania had the highest overall levels. A feature of national cannabis consumption was the elevated regional average compared to capital cities.

After removing the proportion of MDA attributable from MDMA metabolism, use of the drug appeared variable across the nation, with South Australia being the lowest and more widespread use in Tasmania in the current reporting period. For the other drugs included in the NWDMP, methylone and mephedrone concentrations were generally at or below detection levels at all participating sites.

The collection of wastewater samples at regular intervals allowed for the temporal comparison of consumption data. While small overall changes were evident at both a site and a state or territory level, as more data is accumulated, longer term conclusions can be drawn. The recent decline in methylamphetamine use in South Australia from February 2018 levels remains a clear change from the longer-term upward trend since 2009. A gradual rise in regional pharmaceutical opioid use, particularly fentanyl, was also apparent.

2: INTRODUCTION

2.1 PREAMBLE

Wastewater analysis is a technique for delivering population-scale consumption of substances. The University of Queensland and University of South Australia have been commissioned to provide drug consumption data to the ACIC for a period of three years, beginning in August 2016. 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 establish baseline data of substance use across Australia. This sixth NWDMP report compares consumption data from the first five reports with results obtained subsequently from June and August 2018.

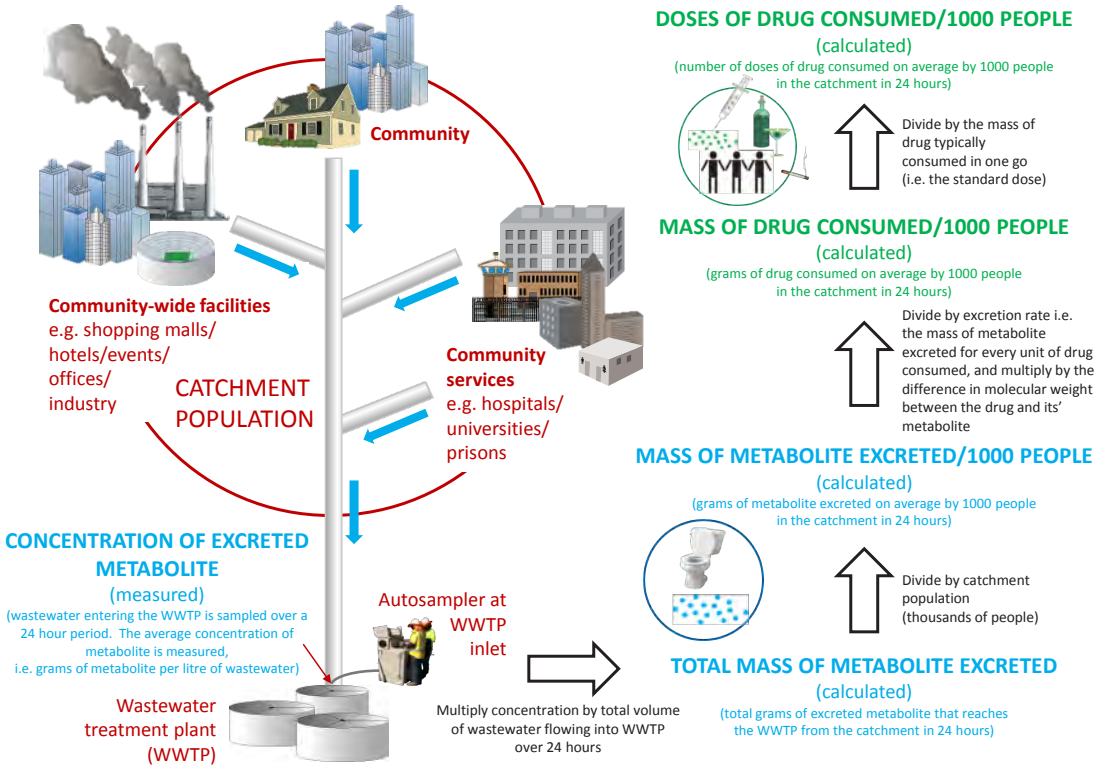
Compounds of concern include nicotine from nicotine intake (cigarettes, gum, patches, e-cigarettes, etc.), ethanol from alcohol intake, pharmaceutical opioids with abuse potential, illicit substances such as methylamphetamine, MDMA, cocaine and heroin, as well as a number of new psychoactive substances (NPS). Initially, amphetamine and MDA were measured but not included in the earlier reports. Amphetamine is a by-product of methylamphetamine pyrolysis and is also one of its metabolites. We found the levels of amphetamine to correspond consistently with the expected values from the excretion of methylamphetamine. MDA is a metabolite of MDMA, but since the proportion of MDA derived from MDMA is known, the difference between measured MDA and MDMA metabolite has now been included in the current report. 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). 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 states and territories, and nationally.

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 (either in the chemical form it is 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 in this study are given in the first NWDMP report (available at www.acic.gov.au), as well as an in-depth description of the methodologies involved.[7] Collectively, waste products in the sewer system arrive at a wastewater treatment plant (WWTP) where wastewater samples are collected over a defined sampling period. Measuring the amount of 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.

7 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. For the August 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 and dose table including THC-COOH 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-eight WWTPs across Australia participated in the NWDMP for the August 2018 collection (Figure 2). Of these, 22 sites were located in capital cities and a further 36 were regional sites, covering a wide range of catchment population sizes. Sites were selected by the ACIC. The number of participating sites for June and August 2018 is listed in Table 2 and Appendix 2. A complete list of participating sites, number of samples and relative catchment sizes are listed in Appendix 3. 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 August 2018, 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.

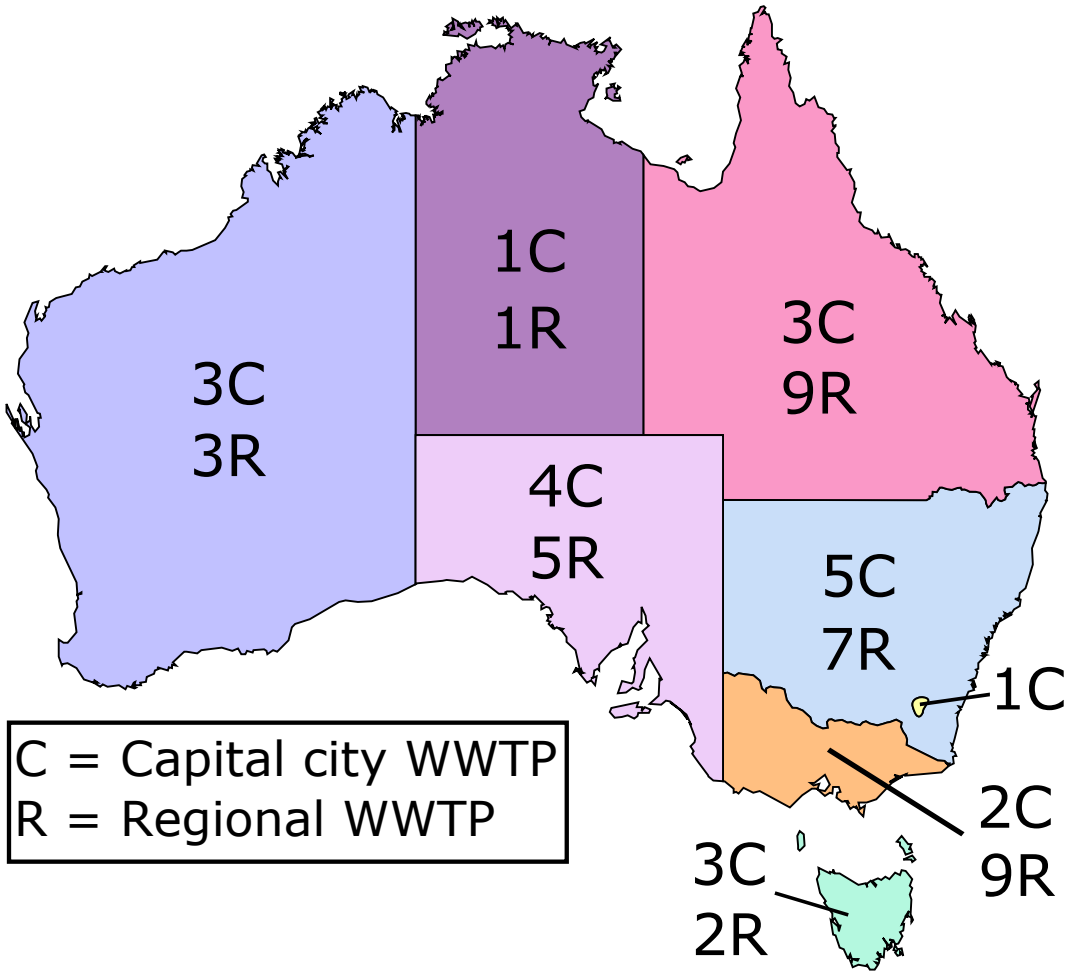


Table 2: Number of participating WWTPs for the periods covered in this report. Every second collection period aims to collect data from both regional (R) and capital city (C) sites (August), while the in-between collection periods (June) aim to collect data from capital city sites only.

	Jun–18		Aug–18	
State/territory	**C**	**R**	**C**	**R**
ACT	1	–	1	–
NSW	3	–	5	7
NT	1	–	1	1
Qld	3	–	3	9
SA	4	–	4	5
Tas	3	–	3	2
Vic	2	–	2	9
WA	3	–	3	3
Sites	**20**	**–**	**22**	**36**
Population (millions) C & R	**11.2**	**–**	**11.5**	**1.5**
Total population (millions)	**11.2**		**13.0**	
% of Australian population	**47.9%**		**55.6%**	

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 provided weekend samples, which should be considered when interpreting historical results where number of samples was 5—see Appendix 3. Samples were stored at 4°C or were frozen prior to transport to Adelaide or Brisbane. 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) and Tscharke et al. (2016). 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).

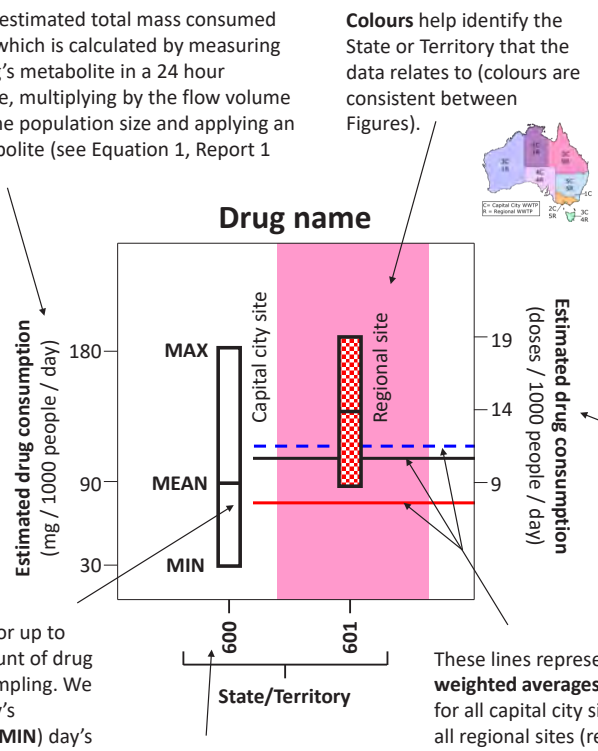
3.3 PRESENTATION OF DATA AND INTERPRETATION OF GRAPHS

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 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 for this drug we can only express the results 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 of Report 6. In this example, at Site 600, the minimum consumption was 30 mg in one day, the maximum was 180 mg and average was 90 mg per day over the sampling period (for every 1,000 people).

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

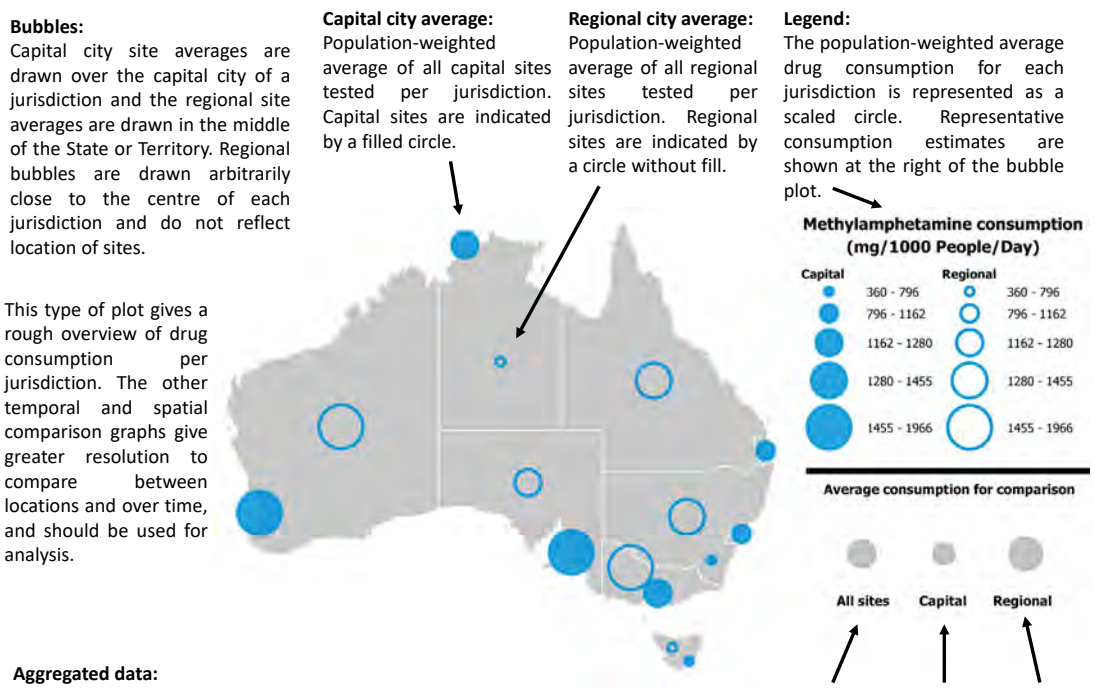
Colours help identify the State or Territory that the data relates to (colours are consistent between Figures).

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

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

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

Figure 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).



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 reporting: 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 reporting (LOR) 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 LOR 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 practise, for back calculations to estimate per capita consumption, a concentration below the LOD is included as a value of LOD. A concentration above the LOD but below LOR, is included at the midpoint between the LOD and LOR (i.e. (LOD + LOR)/2). The frequency of detection of each analyte of interest is included in Appendix 4.

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 since the start of collection weeks did not always correspond for every plant. We present only maximum, minimum and average (for the individual sites) (Figure 3) and only average (or population weighted average, see above) values for all other graphs. Consistent patterns of drug use in Australia from previous wastewater-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 appear 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 August 2018 (section 4.1), temporal trends for states and territories since August 2016 (section 4.2) and within each state and territory (section 4.3). 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 4. 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 are particularly evident in smaller regional communities or sites where short-term population changes occur due to employment opportunities, tourism or festival events.

4.1 INDIVIDUAL SITE COMPARISON OF DRUG USE IN AUGUST 2018

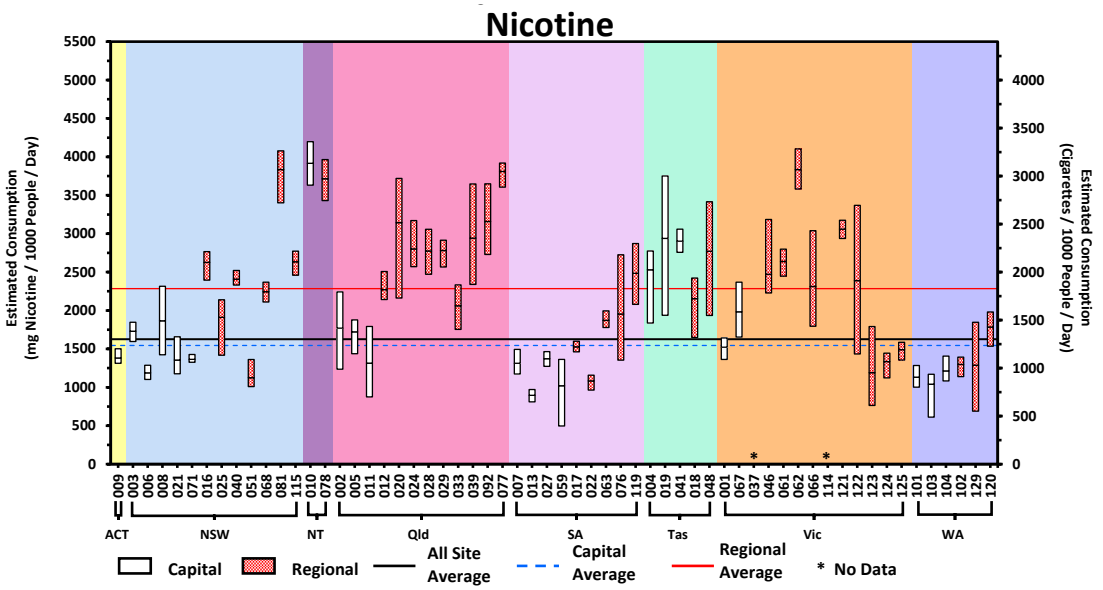
4.1.1 NICOTINE AND ALCOHOL

Consumption of tobacco was estimated by measuring two nicotine metabolites. Since the method does not distinguish between nicotine intake from tobacco or electronic cigarettes and nicotine replacement therapies such as patches and gums, the estimate is reported as nicotine in this report. Nicotine consumption varied significantly across the nation (Figure 4). The regional average was well above that of the capital cities during August 2018 (red horizontal and dotted blue lines). Regional Western Australia defied the high national trend. Capital city sites in Northern Territory and Tasmania had the highest weekly consumption, while capital cities in South Australia and Western Australia had below average levels.

Alcohol was measured using a specific metabolite of ethanol. Similar to previous reporting periods, the capital city average was virtually identical to the regional value in terms of alcohol consumption (Figure 5). Some sites showed a wide range over the collection week, particularly in New South Wales and the Northern Territory. The Northern Territory, in general, and some capital sites of New South Wales and Tasmania were above the national averages.

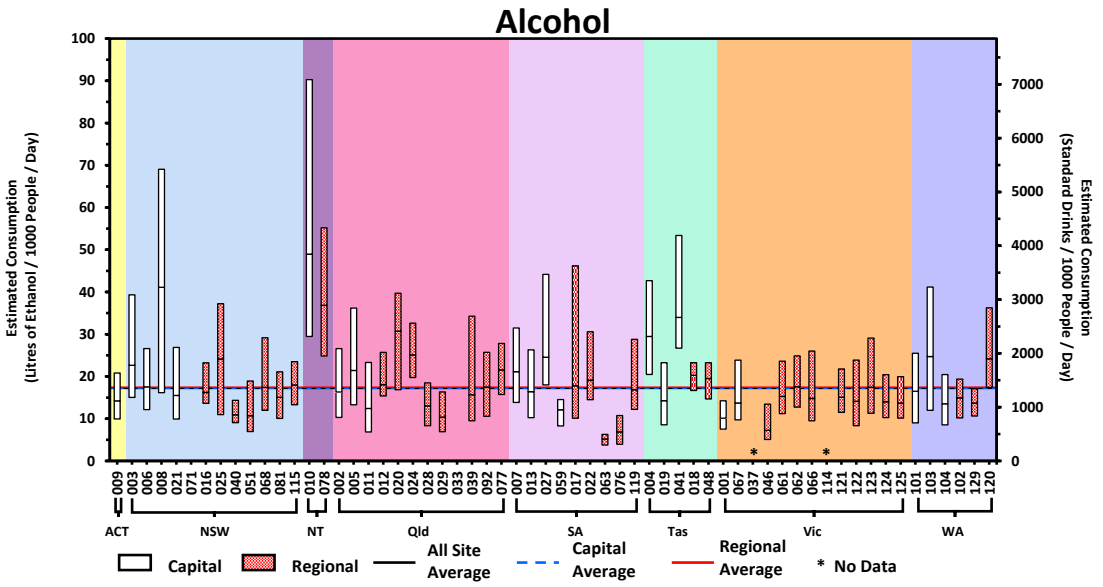
The same information can be represented in a pictorial way by showing the relative scale of use of nicotine (Figure 6) and alcohol (Figure 7) as capital city or regional ‘bubbles’ for each state and territory.

Figure 4: Estimated nicotine consumption for August 2018 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 weekly levels

Figure 5: Estimated alcohol consumption for August 2018 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.



- Wide weekly spread
- Relatively high level in the Northern Territory

Figure 6: Estimated average nicotine consumption per jurisdiction for August 2018 in number of cigarettes per day per thousand people. The number of collection days varied from 5–7.

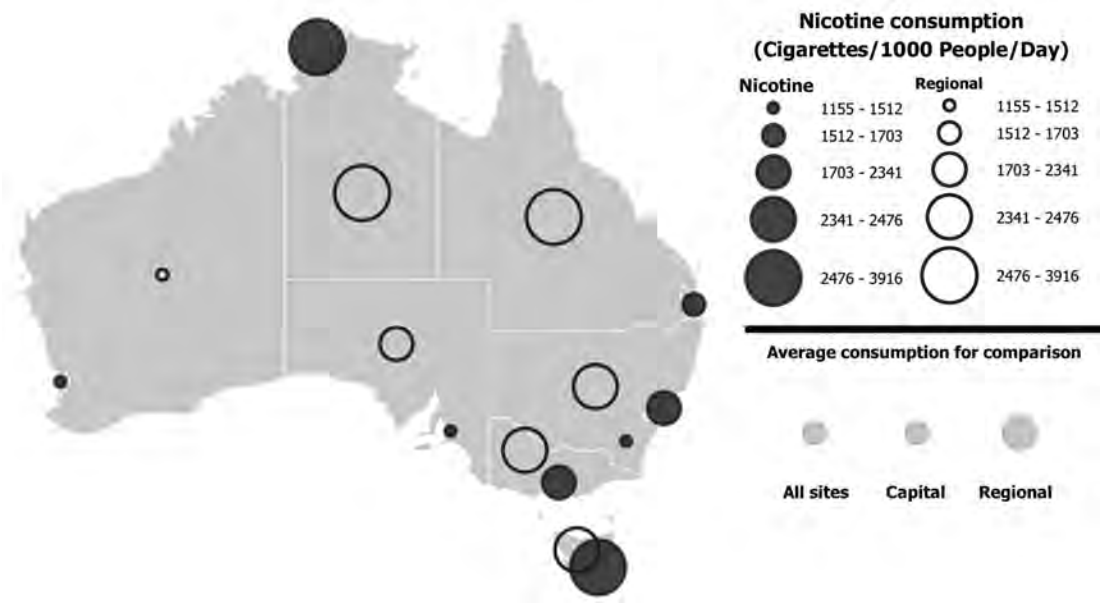
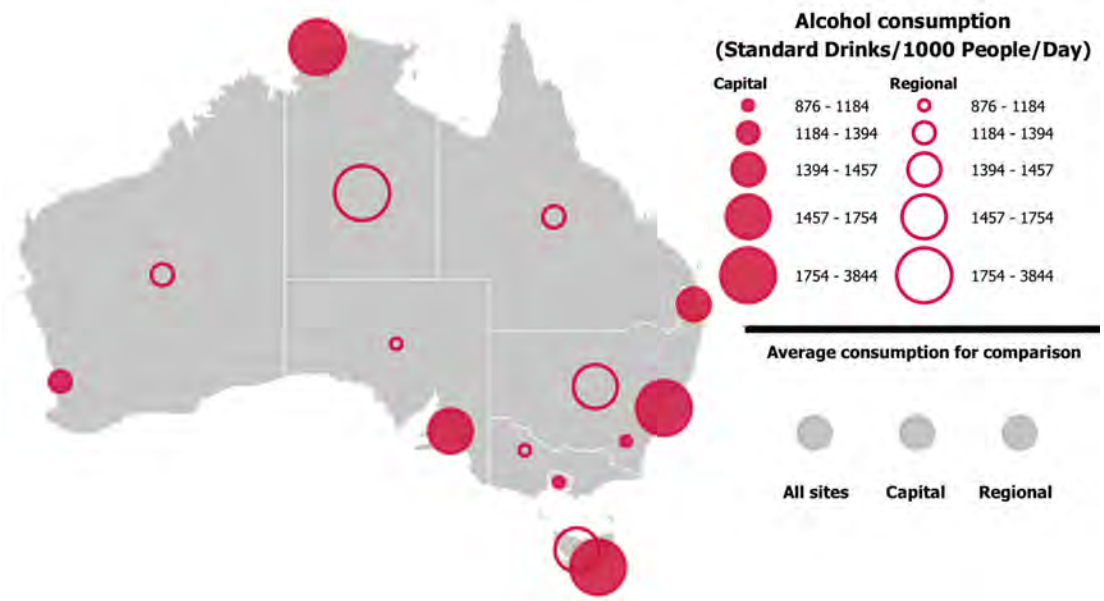


Figure 7: Estimated average alcohol consumption per jurisdiction for August 2018 in number of standard drinks per day per thousand people. The number of collection days varied from 5–7.



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

Estimated mass loads of methylamphetamine were high compared to other illicit substances. The average regional loads were well above capital city consumption levels (Figure 8). Large site differences were evident, mainly in regional areas across the country. Regional Northern Territory and capital city sites in the Australian Capital Territory, New South Wales and Tasmania tended to have the lowest levels, while a few regional sites in each state and territory had very high amounts. A feature of methylamphetamine use in August 2018 was the difference in regional areas in most states, particularly New South Wales and Victoria where amounts varied from highest in the nation to lowest.

4.1.2.2 AMPHETAMINE

The concentration of amphetamine observed in the current reporting period strongly correlated with the methylamphetamine concentrations, with approximately 7 times higher methylamphetamine measured than amphetamine for most sites (see Appendix 4 of Report 1) which is consistent with the reported amphetamine excretion range following methylamphetamine consumption (Gracia-Lor et al. 2016). Therefore, we assumed that the levels of amphetamine measured were predominantly metabolites of methylamphetamine. It is recognised that some of the amphetamine measured could be a result of amphetamine ingestion. But, due to the much higher methylamphetamine consumption and excretion profile, this cannot be confirmed by our present data.

4.1.2.3 COCAINE

Cocaine was measured using its specific metabolite, benzoylecgonine. Capital city areas on average had higher cocaine use than regional centres (Figure 9). However, the difference was compounded by the high consumption in capital city and parts of regional New South Wales where cocaine consumption rivalled methylamphetamine levels. Everywhere else, the scale of cocaine use in Australia remained well below that of methylamphetamine.

4.1.2.4 MDMA (3,4-METHYLENEDIOXYMETHYLAMPHETAMINE)

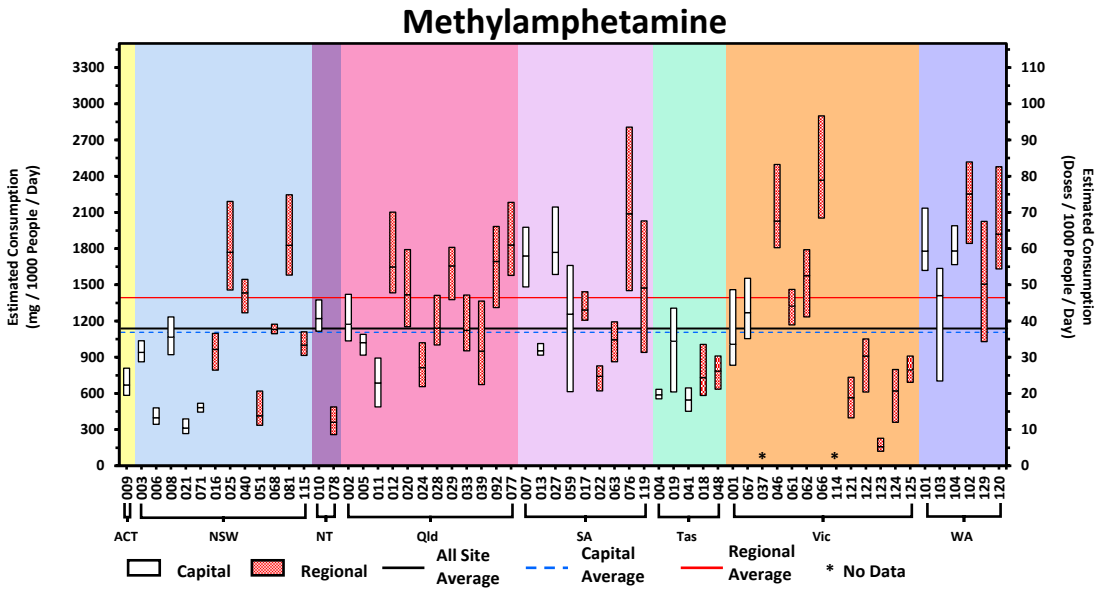
Estimated consumption of MDMA was low across the country (Figure 10). A site in each of capital city New South Wales and Northern Territory had relatively high levels, with a large spread across the week. In general, capital city levels were comparable across the nation, with the average being lower than regional sites. 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.

4.1.2.5 MDA (3,4-METHYLENEDIOXYAMPHETAMINE)

MDA may be consumed as a drug in its own right, but it is also a metabolite of MDMA. Although information is unavailable in the scientific literature for the proportion of MDA that is eliminated after MDA consumption, the proportion of MDA eliminated after MDMA consumption is known. Therefore, the proportion of MDA attributable to MDMA metabolism was subtracted from the total measured amount of MDA for each site. Results for MDA was expressed as mg excreted per 1,000 people per day and not as consumption due to the lack of metabolic information of MDA elimination following MDA consumption. Although the dosage of MDA is not known, it is likely to be similar to that of MDMA, at around 100 mg. The daily mass loads for regional sites were on average higher than capital cities (Figure 11). Capital city New South Wales, Northern Territory and Tasmania had the highest levels nationally. A feature of MDA levels across most sites was the large variations over the collection week.

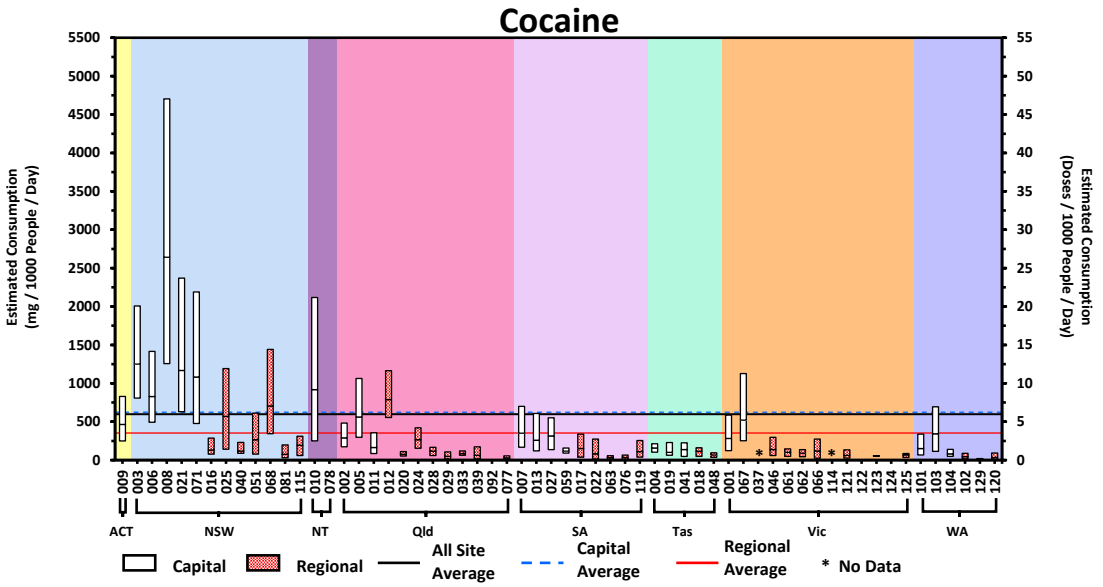
The scale of use of each stimulant is showed as bubble graphs. Regional and capital city use of methylamphetamine (Figure 12), cocaine (Figure 13), MDMA (Figure 14) and MDA (Figure 15) are all represented to reflect the proportion of drug use across the country. The popularity of cocaine on the eastern seaboard remains apparent.

Figure 8: Estimated methylamphetamine consumption for August 2018 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.



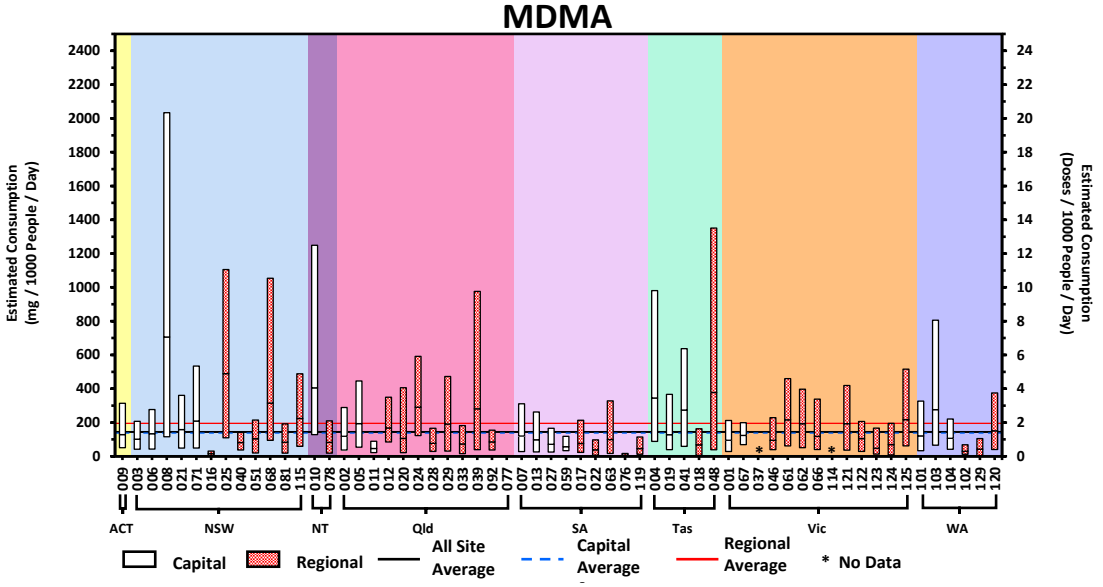
- Regional averages higher than capital cities
- Variable across sites
- Highest capital city consumption in South Australia and Western Australia

Figure 9: Estimate cocaine consumption for August 2018 in mass consumed per day per thousand people (left axis) and doses per day (right axis). The number of collection days varied from 5–7.



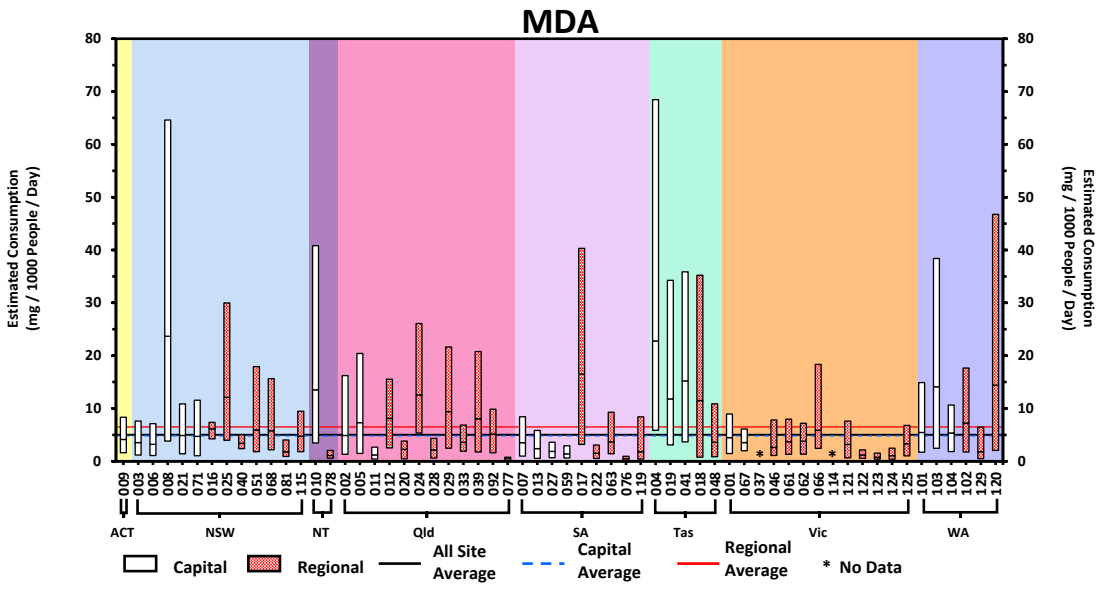
- Higher levels in city sites, specially NSW
- Regional consumption low

Figure 10: Estimated MDMA consumption for August 2018 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.



- Low use across the country
- Wide weekly spread indicates higher weekend use

Figure 11: Estimated MDA consumption for August 2018 in mass consumed per day per thousand people. The number of collection days varied from 5–7.



- Higher regional average
- Tasmania capital city levels highest

Figure 12: Estimated methylamphetamine consumption per jurisdiction for August 2018 in mg consumed per day per thousand people. The number of collection days varied from 5–7.

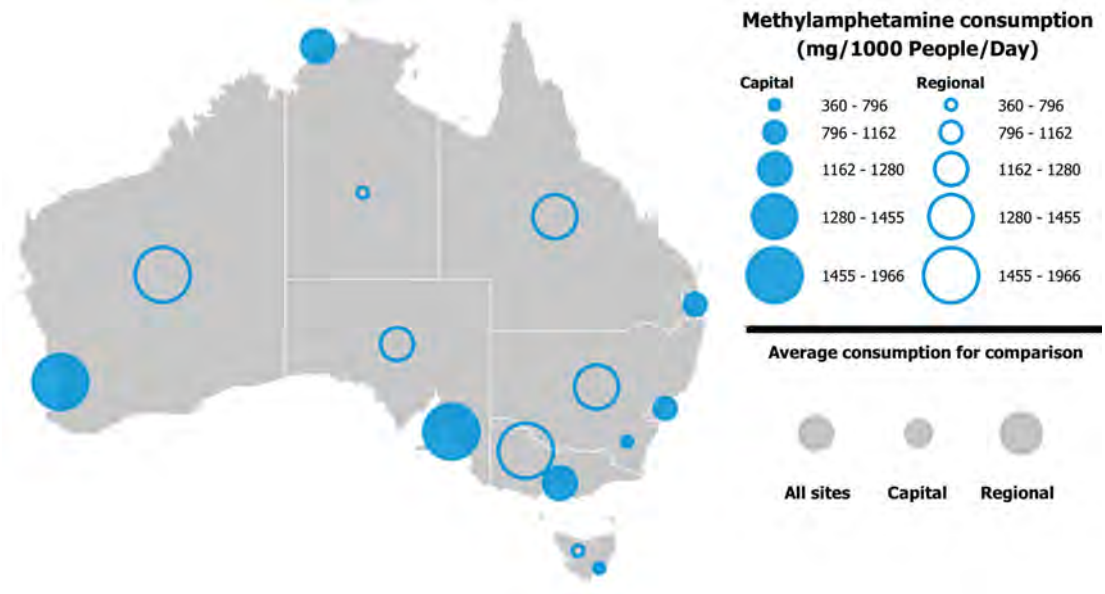


Figure 13: Estimated cocaine consumption per jurisdiction for August 2018 in mg consumed per day per thousand people. The number of collection days varied from 5–7.

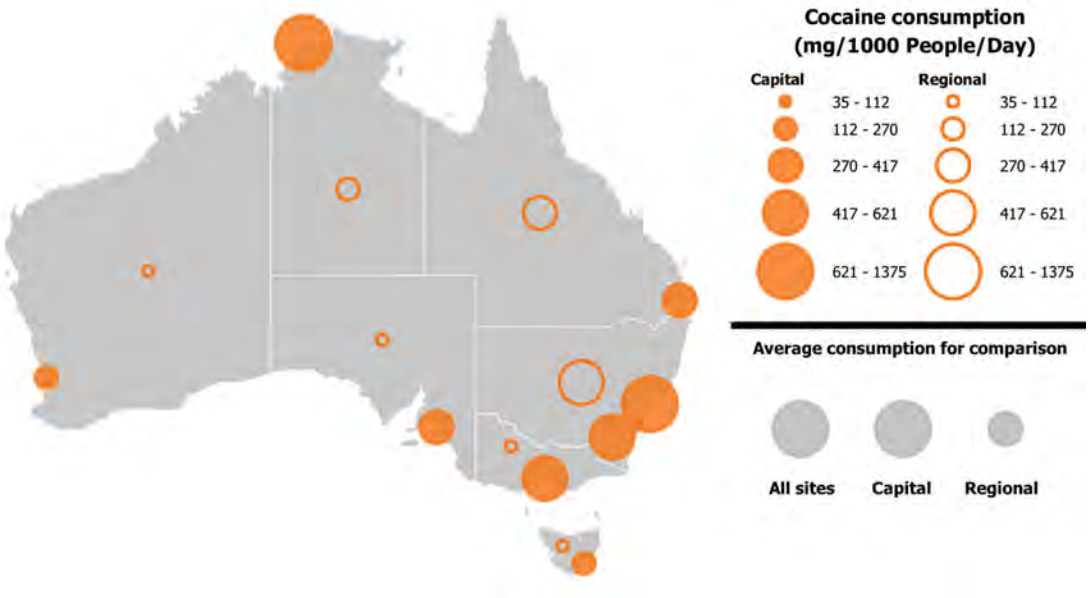


Figure 14: Estimated MDMA consumption per jurisdiction for August 2018 in mg consumed per day per thousand people. The number of collection days varied from 5–7.

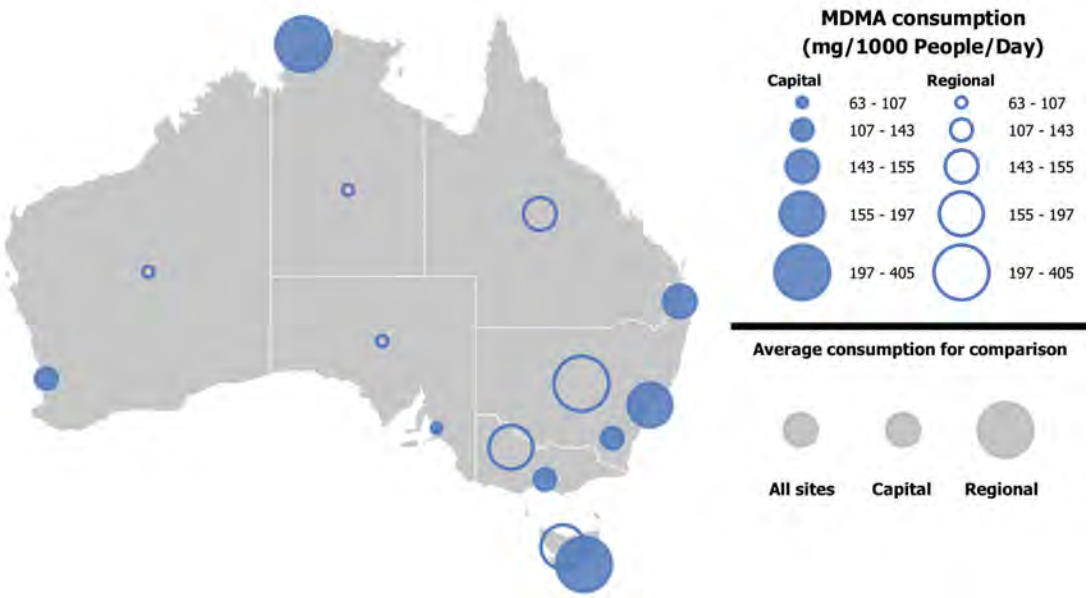
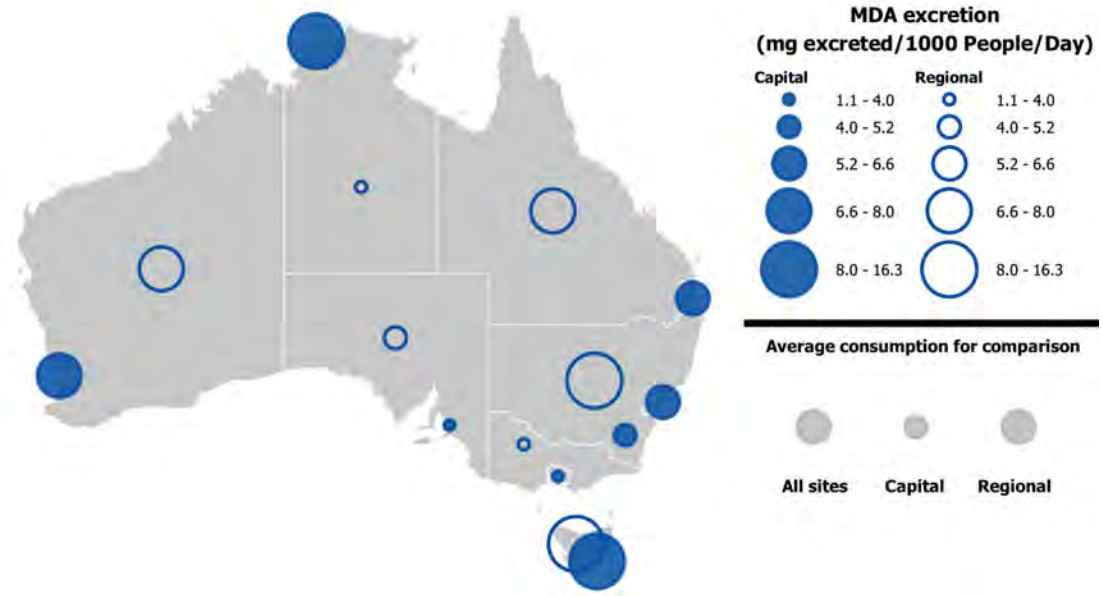


Figure 15: Estimated MDA consumption per jurisdiction for August 2018 in mg consumed per day per thousand people. The number of collection days varied from 5–7.



4.1.3 OPIOIDS

Two prescription opioids were measured, as well as heroin, an illicit drug.

4.1.3.1 PHARMACEUTICAL OPIOIDS

Oxycodone and fentanyl are legally prescribed pharmaceuticals with abuse potential. Although wastewater analysis cannot be used to differentiate between prescribed and illicit use, the relative scale of use of these substances remain of interest. The metabolism and excretion of both compounds are well characterised. The major metabolite of each compound was measured to estimate drug consumption.

Oxycodone consumption in Tasmania was high compared to national levels (Figure 16). Overall, the regional national average was substantially higher than that of the capital cities. Some regional Victoria sites matched the high Tasmanian levels, while use in capital city Australian Capital Territory and parts of New South Wales was also above the national average. Oxycodone consumption in Western Australia was low compared to other regions.

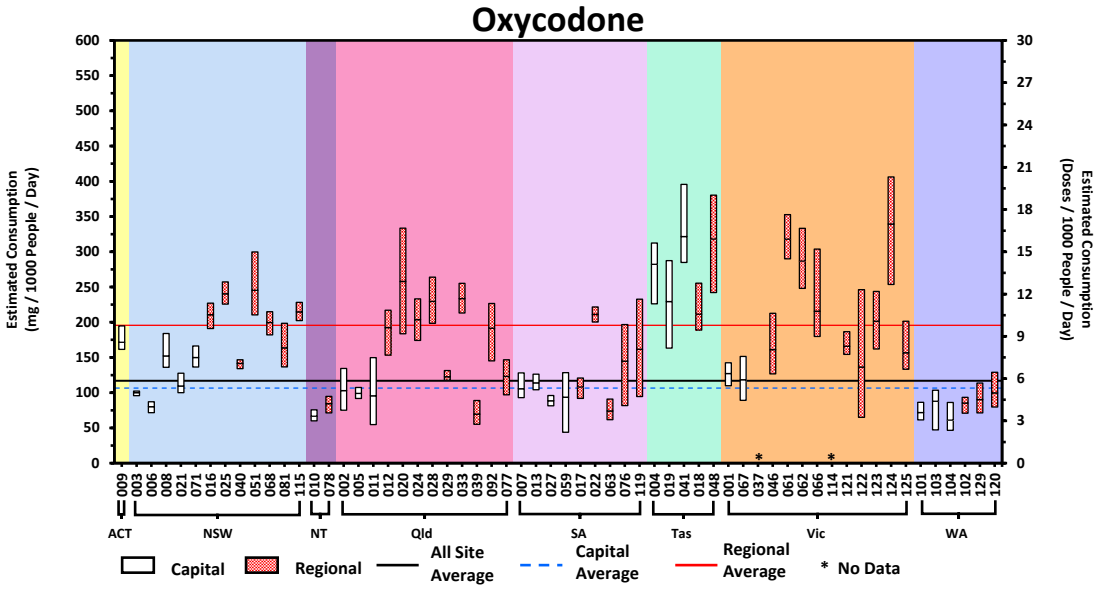
The extent of fentanyl use was very variable across the nation (Figure 17). Similar to oxycodone, regional average consumption exceeded that of capital cities by a large margin. Some regional sites in almost every state and territory had high use. In Tasmania, the capital city use was also well above the national average, matching regional use. Rates of fentanyl consumption in other capital cities across Australia were mostly of comparable levels.

The relative scale of oxycodone and fentanyl use is apparent when results are presented in bubble graph form. Oxycodone consumption in capital cities and Western Australia was noticeably lower (Figure 18), with fentanyl use in regional centres high compared to capital cities (Figure 19).

4.1.3.2 HEROIN

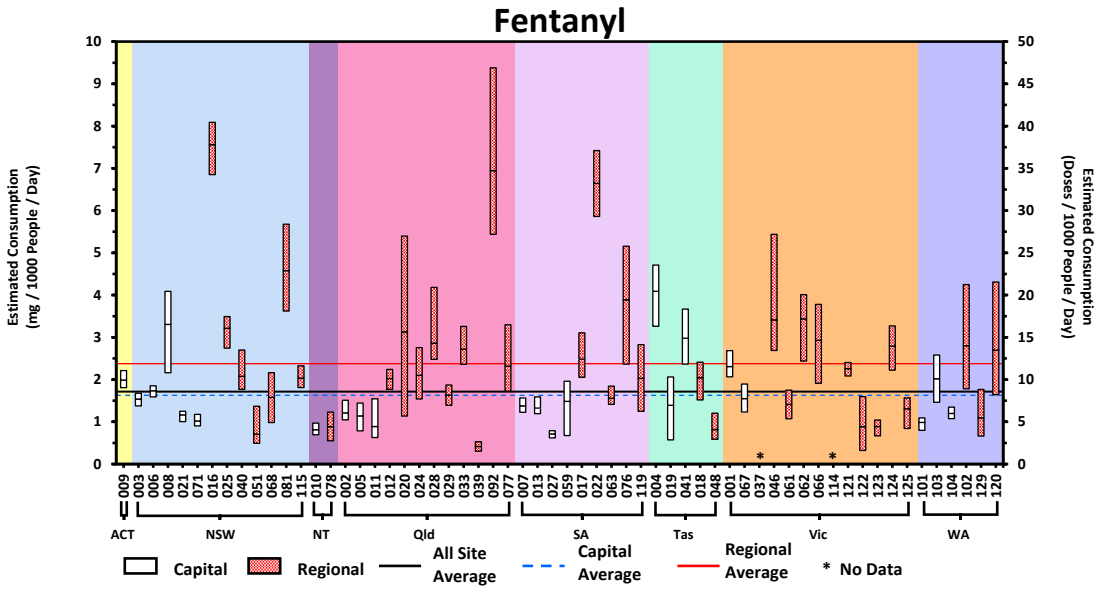
Heroin is metabolised by users and excreted in low amounts as the unique metabolite, 6-monoacetylmorphine (6-MAM). A method to detect heroin by 6-MAM was described in a paper by Tscharke et al. (2016). Since 6-MAM is characteristic of heroin use, it can be used to distinguish heroin from other opioids such as morphine and codeine. Heroin consumption in Australia in August 2018 was relatively low, with regional centres having lower consumption on average compared to capital cities (Figure 20). Capital city areas of New South Wales and part of Victoria recorded the highest levels of all measured locations. The elevated heroin consumption in the south eastern parts of the country is clearly evident from the bubble graph (Figure 21).

Figure 16: Estimated oxycodone consumption for August 2018 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
- Highest capital sites in Tasmania

Figure 17: Estimated fentanyl consumption for August 2018 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
- Highest capital city use in Tasmania
- Regional New South Wales, Queensland and South Australia high

Figure 18: Estimated oxycodone consumption per jurisdiction for August 2018 in mg consumed per day per thousand people. The number of collection days varied from 5–7.

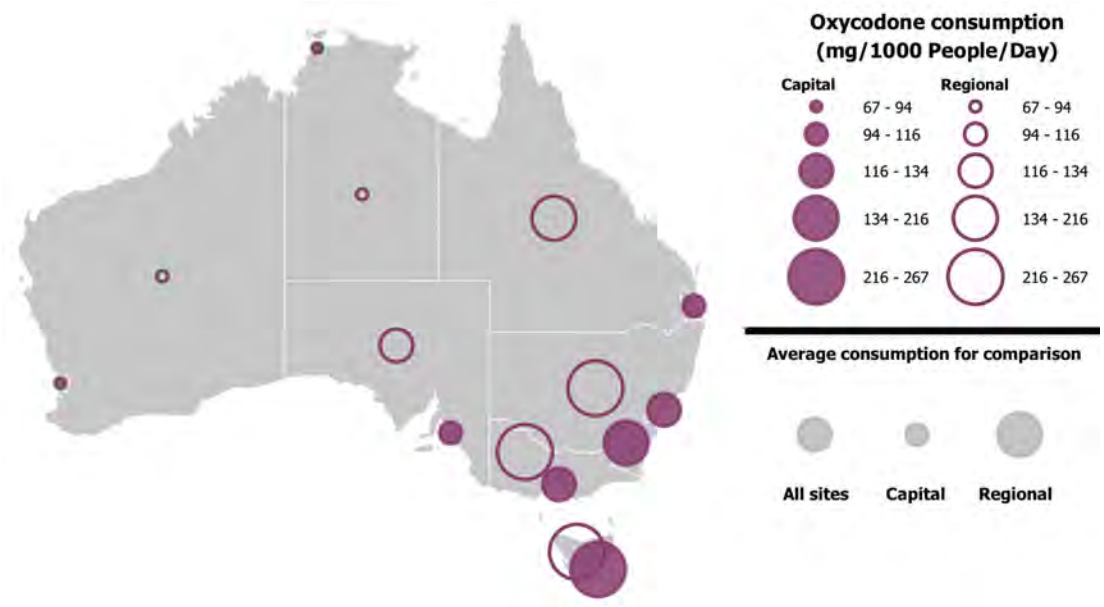


Figure 19: Estimated fentanyl consumption per jurisdiction for August 2018 in mg consumed per day per thousand people. The number of collection days varied from 5–7.

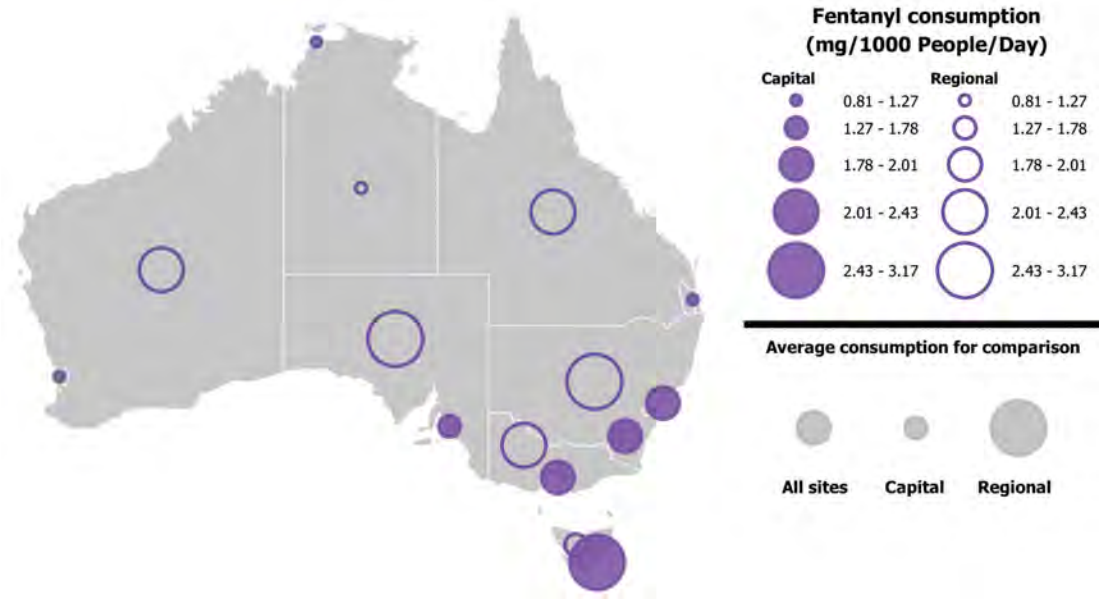
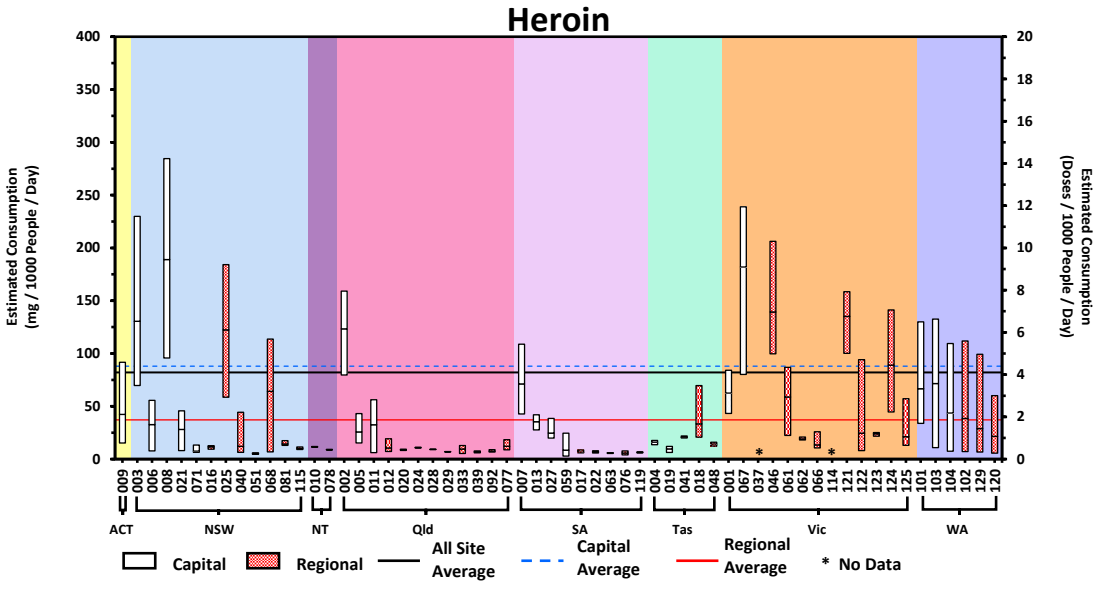
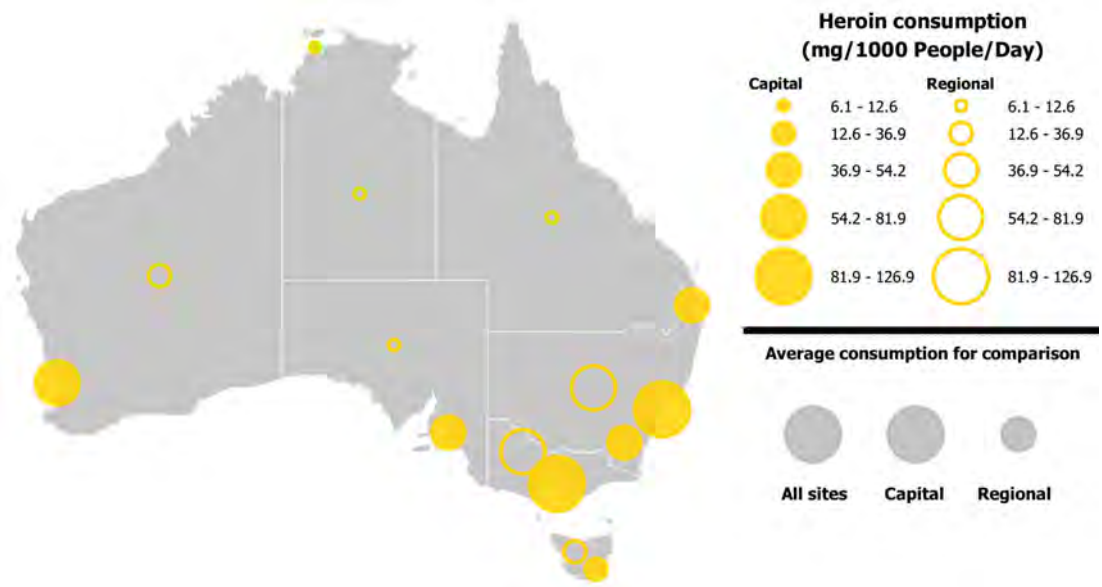


Figure 20: Estimated heroin consumption for August 2018 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 5–7.



- Lower regional use
- High consumption in New South Wales and Victoria

Figure 21: Estimated heroin consumption per jurisdiction for August 2018 in mg consumed per day per thousand people. The number of collection days varied from 5–7.



4.1.4 NEW PSYCHOACTIVE SUBSTANCES

The compounds included under the NPS class in the NWDMP are methylone and mephedrone. Limited information is available on the human metabolism and excretion of these drugs. Therefore, the parent compound was measured. It is probable that a significant proportion of the ingested drug is converted into different metabolites. Sites that showed the presence of the two compounds are qualitatively listed in Table 3 for the current period. There were a number of instances of mephedrone detections in New South Wales and Queensland, while methylone use appeared to be largely confined to Queensland. The measured levels were mostly below the limits of reporting. The temporal changes in detections per state and territory (number of samples above LOD) is shown in Figure 22. It is evident that the number of detections of methylone has dropped since a peak in late 2017. Mephedrone detections have remained low, but with a slightly increasing frequency. The national spread of detections is shown in Figure 23.

Table 3: 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 355.

	Number of detections Aug 2018		Sites detected Aug 2018	
State/territory	**Mephedrone**	**Methylone**	**Mephedrone**	**Methylone**
NT	0	2		010
ACT	0	0		
NSW	10	3	006, 068,	008
Qld	19	6	005, 011, 012, 020, 024	005, 012, 024
SA	0	10		007
Tas	0	0		
Vic	0	0		
WA	1	0	104	
Total	**30**	**21**	**8 sites**	**6 sites**

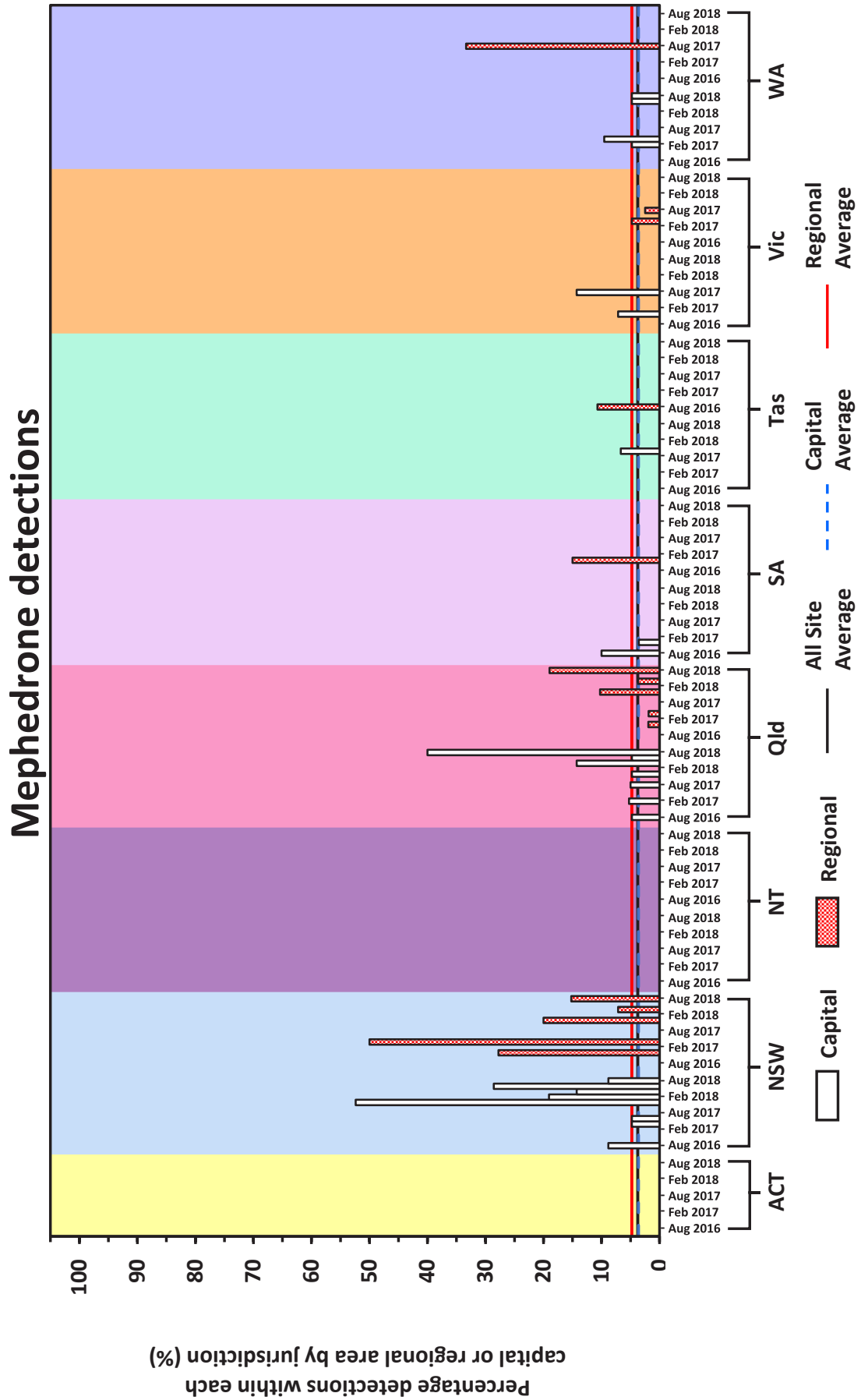


Figure 22: The percentage of all samples where mephedrone and methylone were detected.

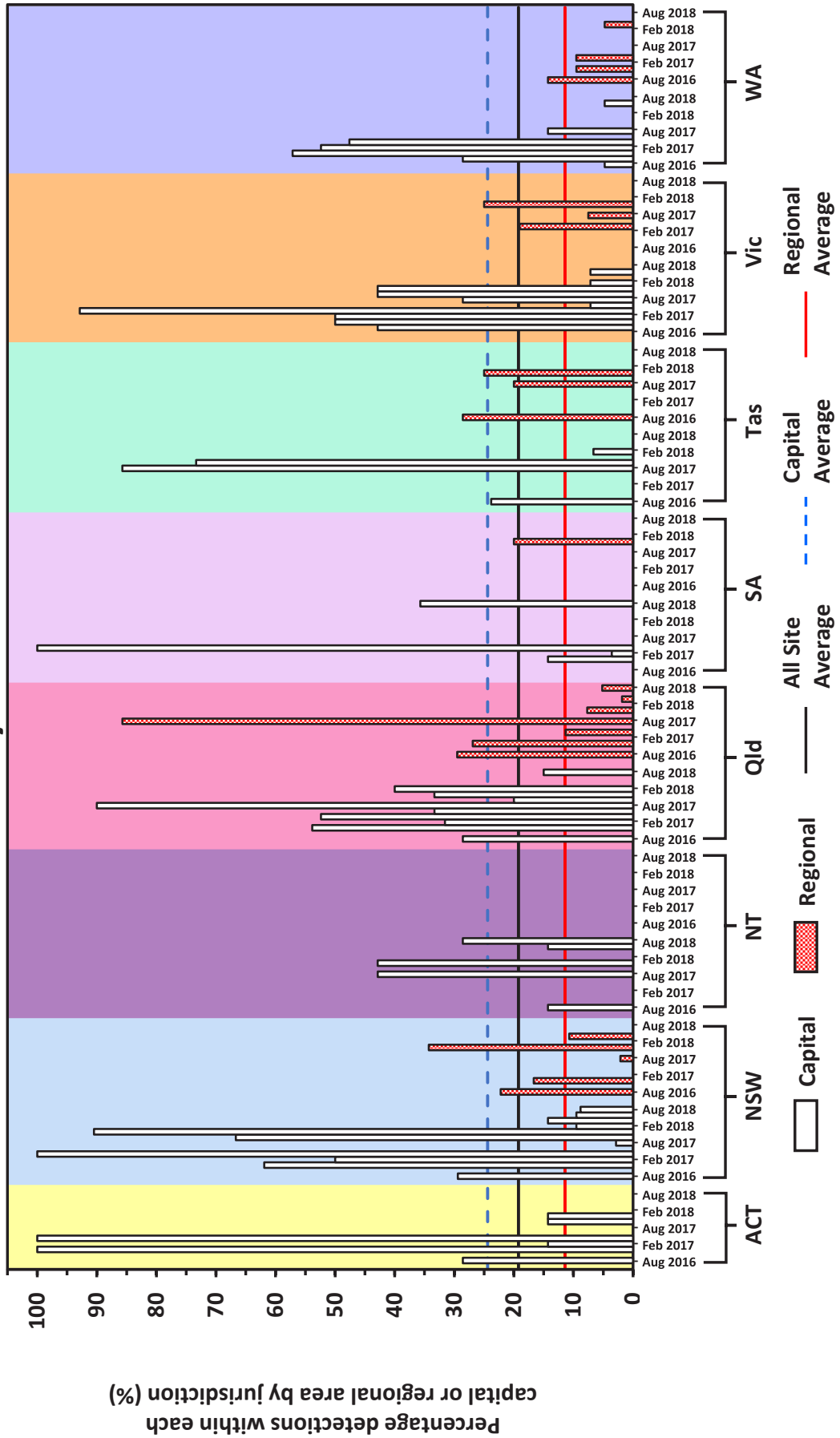


Figure 22 (continued): The percentage of all samples where mephedrone and methylone were detected.

Figure 22 (continued): The percentage of all samples where mephedrone and methylone were detected.

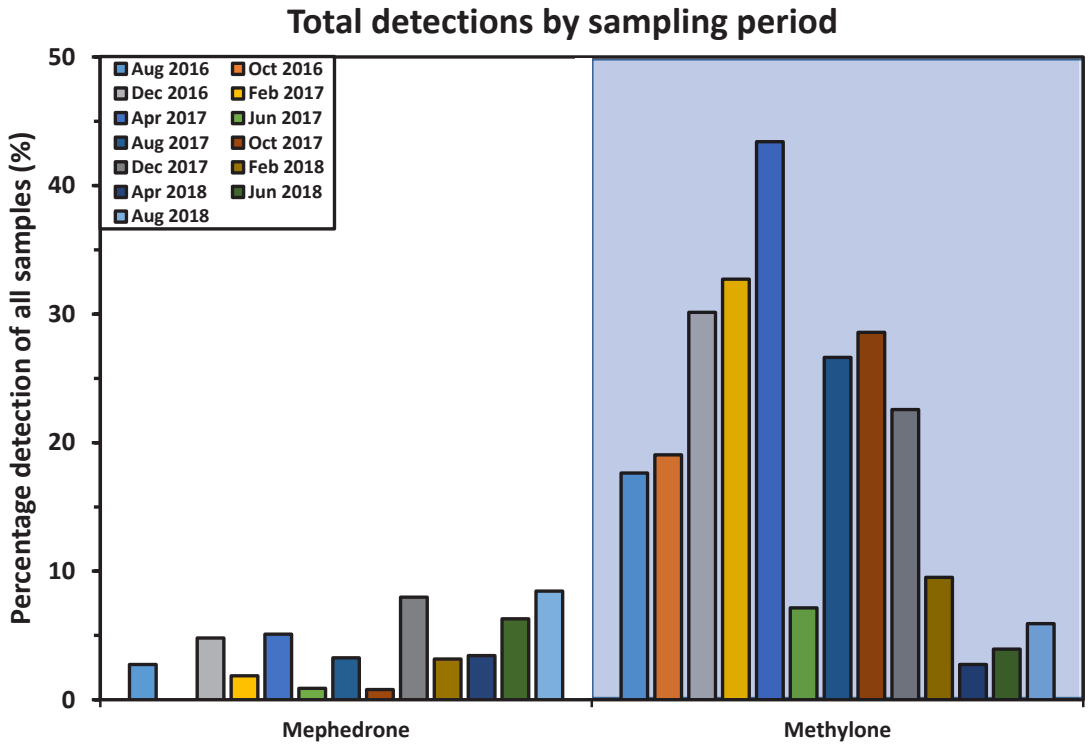


Figure 23: Estimated percentage positive detections per jurisdiction for mephedrone and methylone for August 2018. This is the number of detections as a percentage of the total number of samples analysed per jurisdiction. The number of collection days varied from 5–7.

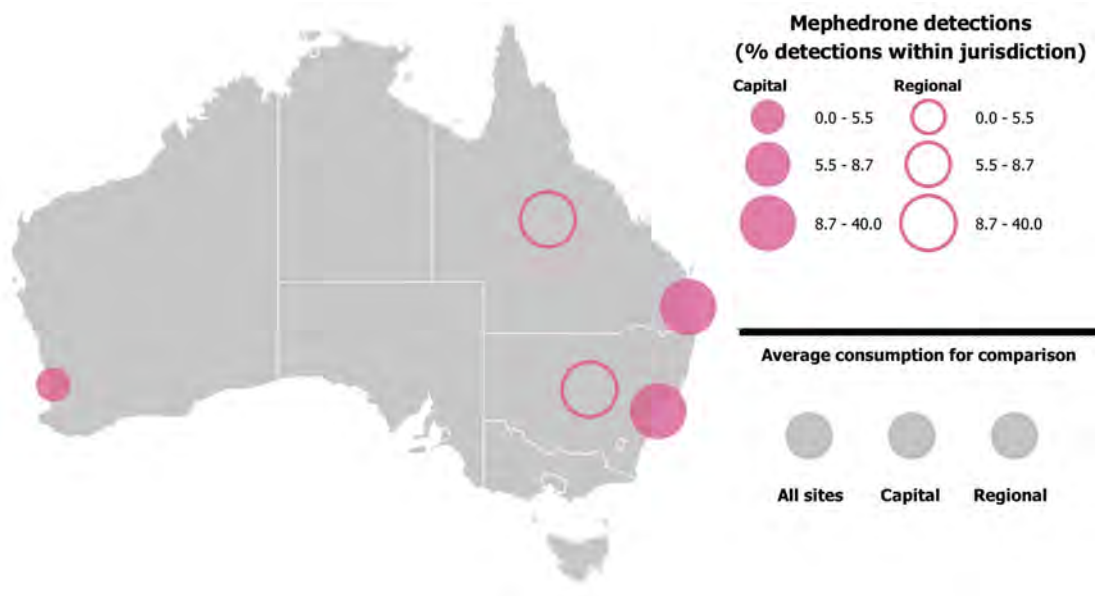
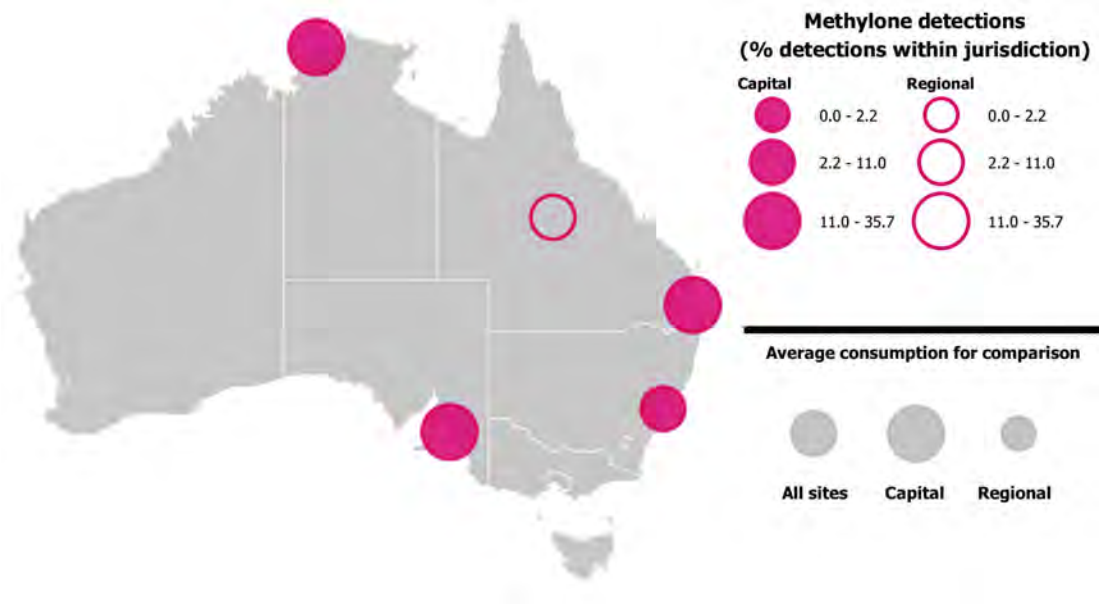


Figure 23 (continued): Estimated percentage positive detections per jurisdiction for mephedrone and methylone for August 2018. This is the number of detections as a percentage of the total number of samples analysed per jurisdiction. The number of collection days varied from 5–7.

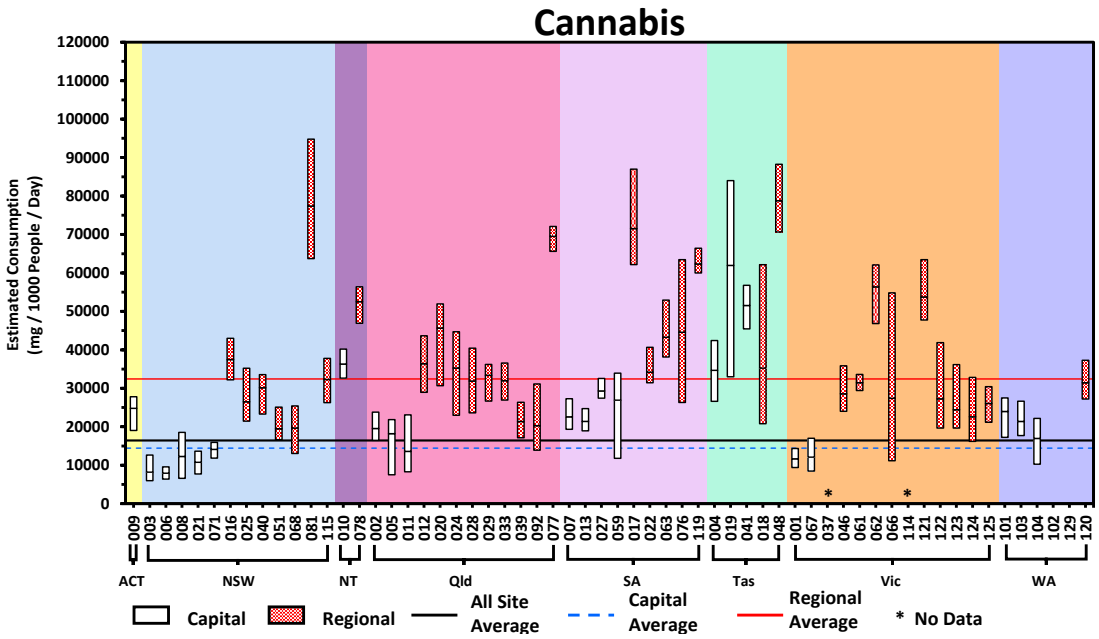


4.1.5 CANNABIS

The main psychoactive compound found in cannabis is tetrahydrocannabinol (THC). 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-THC (THC-COOH). Detection of the compound is affected by adsorption to various surfaces. Therefore, in terms of wastewater analysis, the sewer design and collection method may play a part in the detectable levels of the target metabolite used for the purposes of the NWDMP. Upon collection, samples have to be preserved to avoid degradation of THC-CA (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 employed.

Results for cannabis consumption were expressed as mg of active ingredient (THC) consumed per 1,000 people per day. The dose of cannabis depends on several factors, such as the part of the plant, strain, or whether an extract was used. For that reason, an average dose was not included as for other drugs in the report. Based on consumed mass of THC, spatial differences were evident across Australia (Figure 24). Regional use exceeded capital city levels, as demonstrated by the varying site averages (red vs dotted blue line). Tasmania had the highest overall use, while several regional sites in New South Wales, South Australia and Victoria had above average levels. Sites 102 and 129 in Western Australia were unable to provide a second daily composite sample for cannabis analysis.

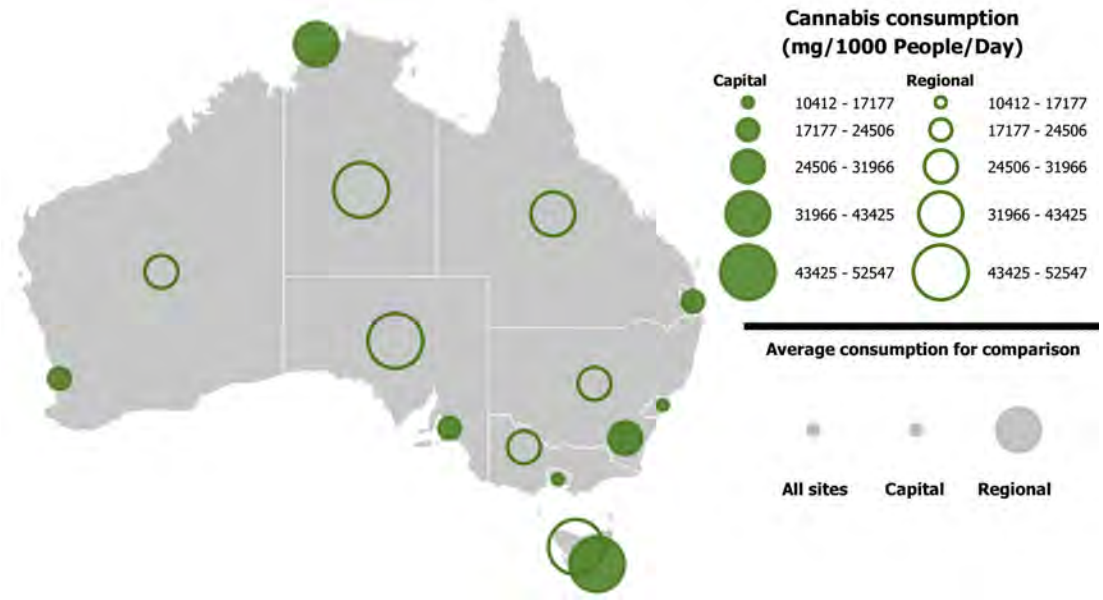
Figure 24: Estimated cannabis consumption for August 2018 in mass consumed per day per thousand people. The number of collection days varied from 5–7.



- **High regional use**
- **Tasmania highest overall use**

The bubble plot and jurisdictional differences of cannabis use across Australia shows the generally higher consumption in regional areas (open circles of Figure 25 and in Figure 37).

Figure 25: Estimated cannabis consumption per jurisdiction for August 2018 in mg consumed per day per thousand people. 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. Every effort was made to assess the same sites for each period. However, as 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 for a comprehensive list of participating sites and number of days assessed per sampling campaign).

Note: the lines on each graph representing averages are the cumulative average across all sampling time points.

4.2.1 NICOTINE AND ALCOHOL

Nicotine consumption remained relatively steady over the total collection periods in most states and territories. Western Australia remained the exception with a continued overall decrease apparent for both capital city and regional areas (Figure 26). The high regional use of nicotine is reflected in the average use remaining well above capital city levels.

In the case of alcohol, the difference between overall capital city and regional centre consumption within each state or territory was minimal. South Australia had a different pattern, where regional use is remaining well below that of the capital city (Figure 27). For the most part, national consumption levels remained steady with no clear pattern in terms of changes in use over recent time within each region.

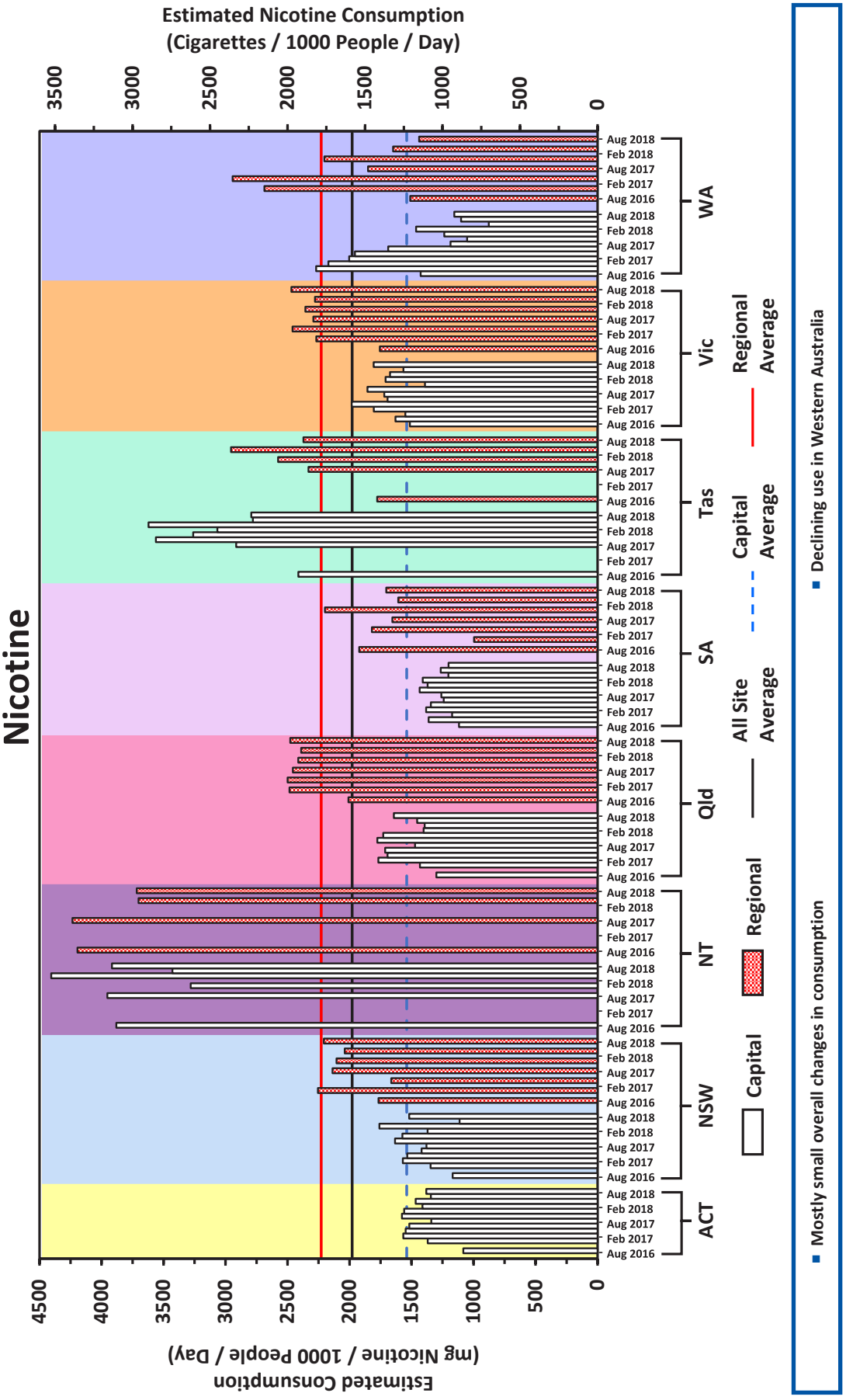


Figure 26: Estimated average consumption of nicotine by state/territory, where 1 cigarette provides 1.25 mg of nicotine.

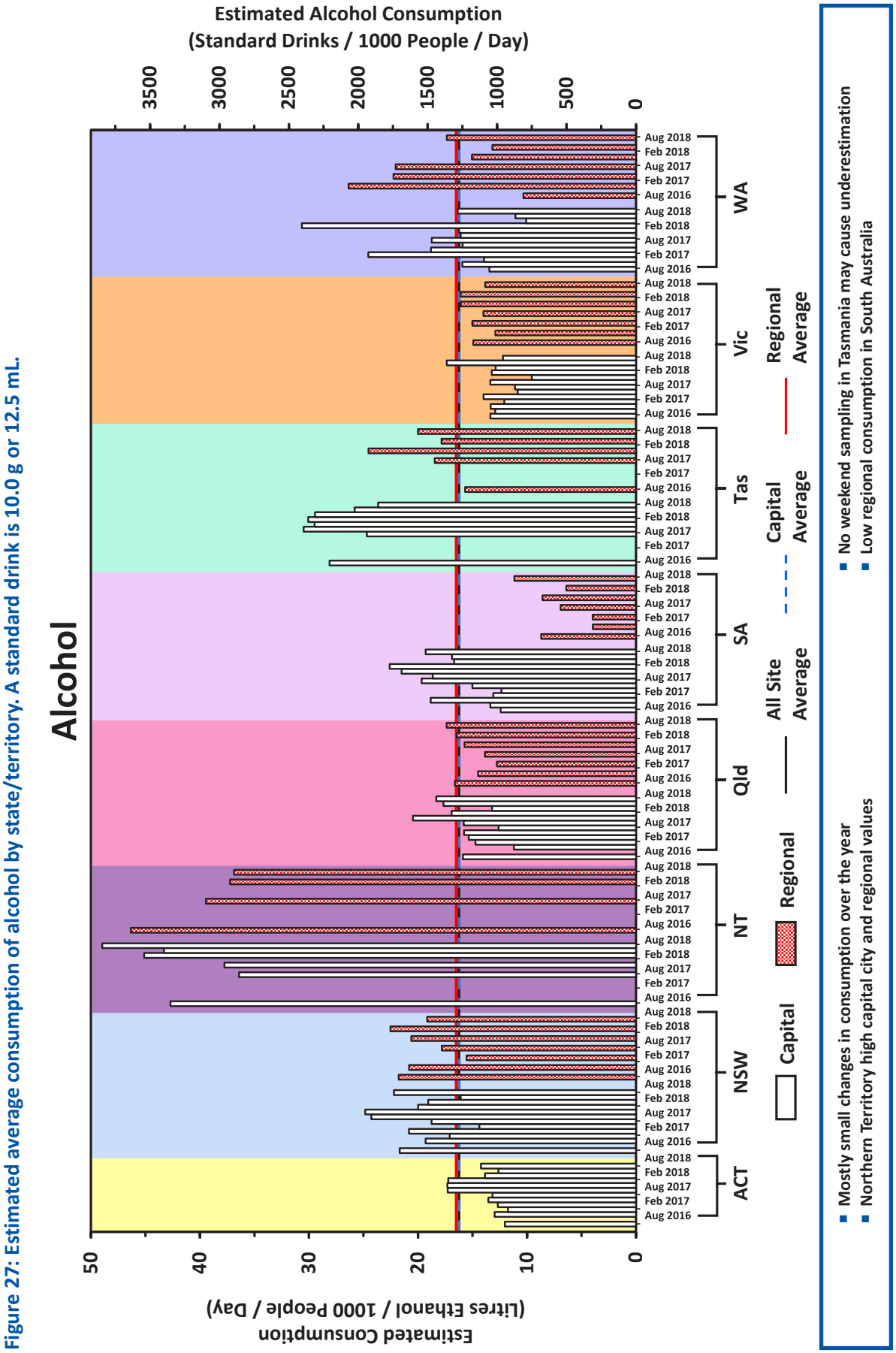


Figure 27: Estimated average consumption of alcohol by state/territory. A standard drink is 10.0 g or 12.5 mL.

4.2.2 ILLICIT DRUGS

The trend in methylamphetamine use was variable in many parts of the country (Figure 28). Consumption in Queensland, as well as regional New South Wales and Victoria has been increasing, while capital city Western Australia is showing short term changes without a clear trend emerging. Levels in South Australia remains high, but in the capital city areas are well down from historical peaks. Regional South Australia is showing rising trends, similar to many parts of the country.

When plotted against historical levels recorded in three of the study regions, the sudden drop-off in use of methylamphetamine in capital city South Australia was a striking feature in early 2018 (Figure 29). The decline in Western Australia at about the same time was also evident. However, since then, levels in Western Australia appear to be on the rise. Measured amounts of the drug in regional Queensland and Victoria are slowly increasing but have remained essentially steady in the capital cities.

The consumption of cocaine in capital city sites in New South Wales remained high for the duration of the monitoring period compared to other Australian regions (Figure 30). A sharp increase in the recent collection period in Northern Territory was also apparent, while the decrease in Australian Capital Territory has been maintained since late 2017. Some changes were evident in other states, but these are from a very low base. Regional consumption was noticeably lower than in capital cities in every state and territory, except Queensland. Western Australia, Tasmania and regional South Australia remained well below the national average.

Use of MDMA across Australia is low, with small fluctuations evident on a state or territory level. Slight variations in some areas were offset by opposite changes elsewhere (Figure 31). The amount of drug in the capital city of the Northern Territory remained high compared to other parts of the country. Regional centres showed levels slightly above the capital city locations.

MDA use, corrected for the proportion derived from MDMA (Khan & Nicell 2011), showed that levels in regional Queensland had dropped from the highest of the measured sites to below national averages (Figure 32). South Australian sites were at levels below the national average. The regional average was skewed somewhat by the high MDA levels detected at site 012 in Queensland in August 2017.

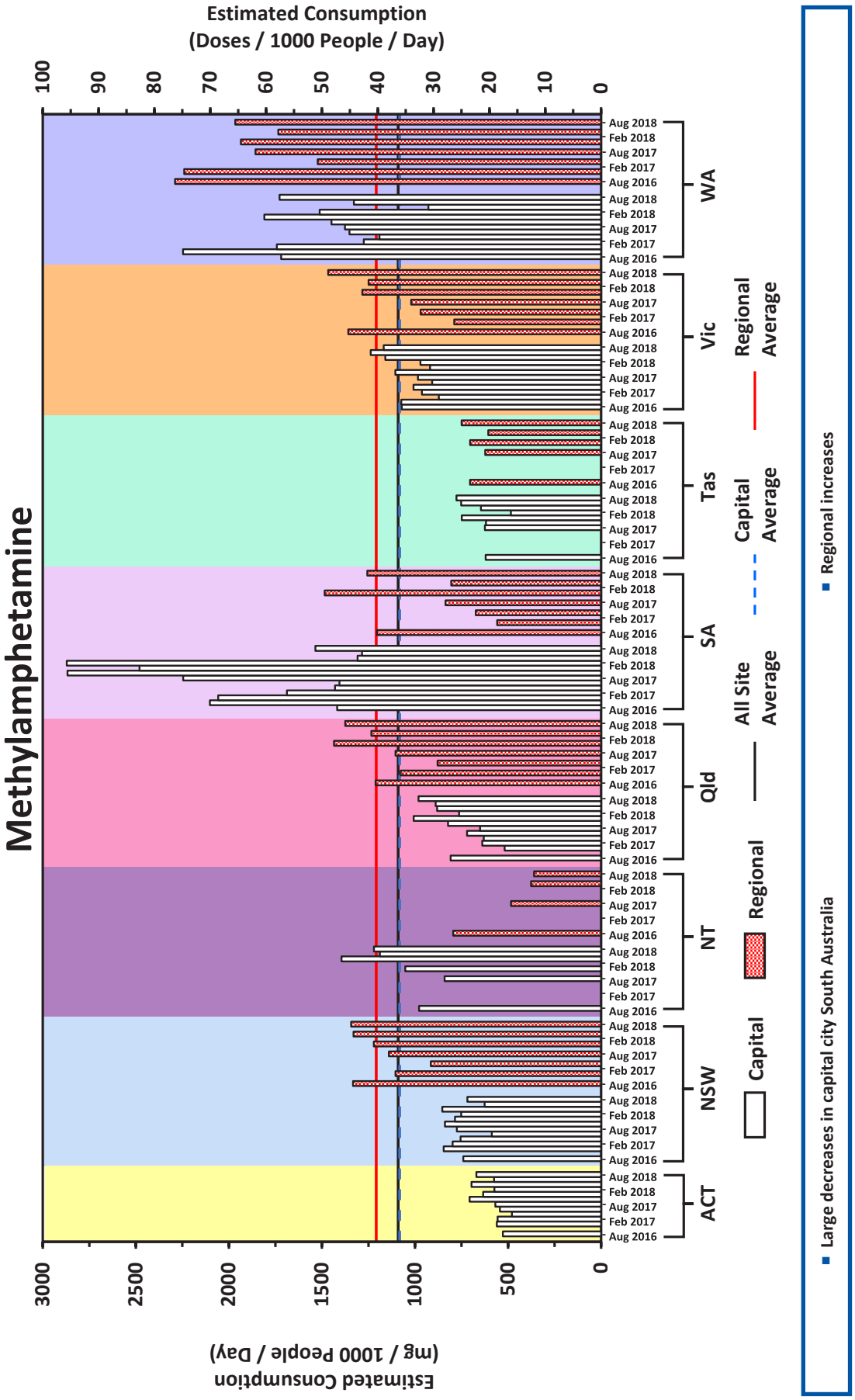


Figure 28: Estimated average consumption of methylamphetamine by state/territory

Figure 29: Change in methylamphetamine consumption for sites with historical data.

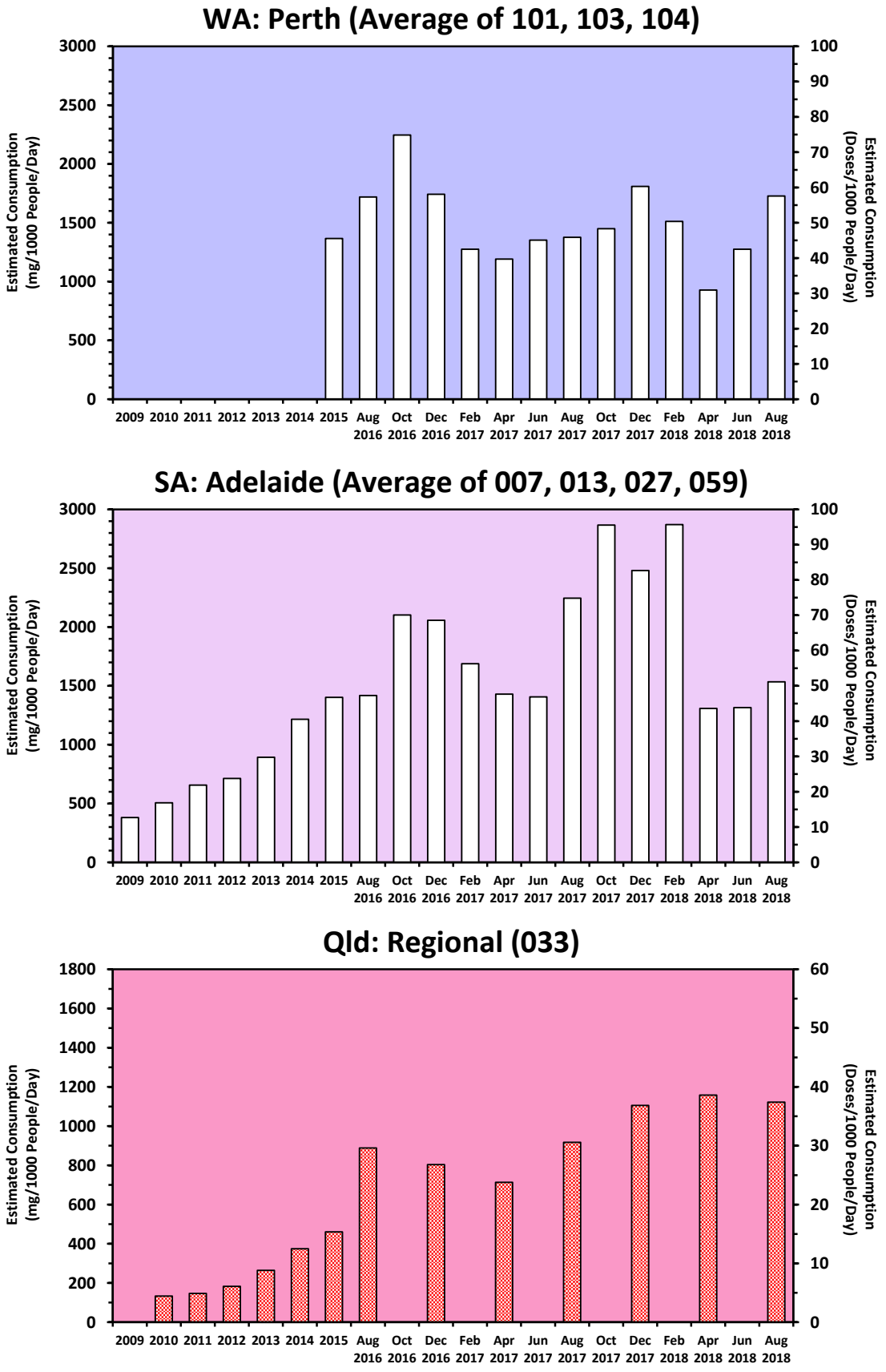
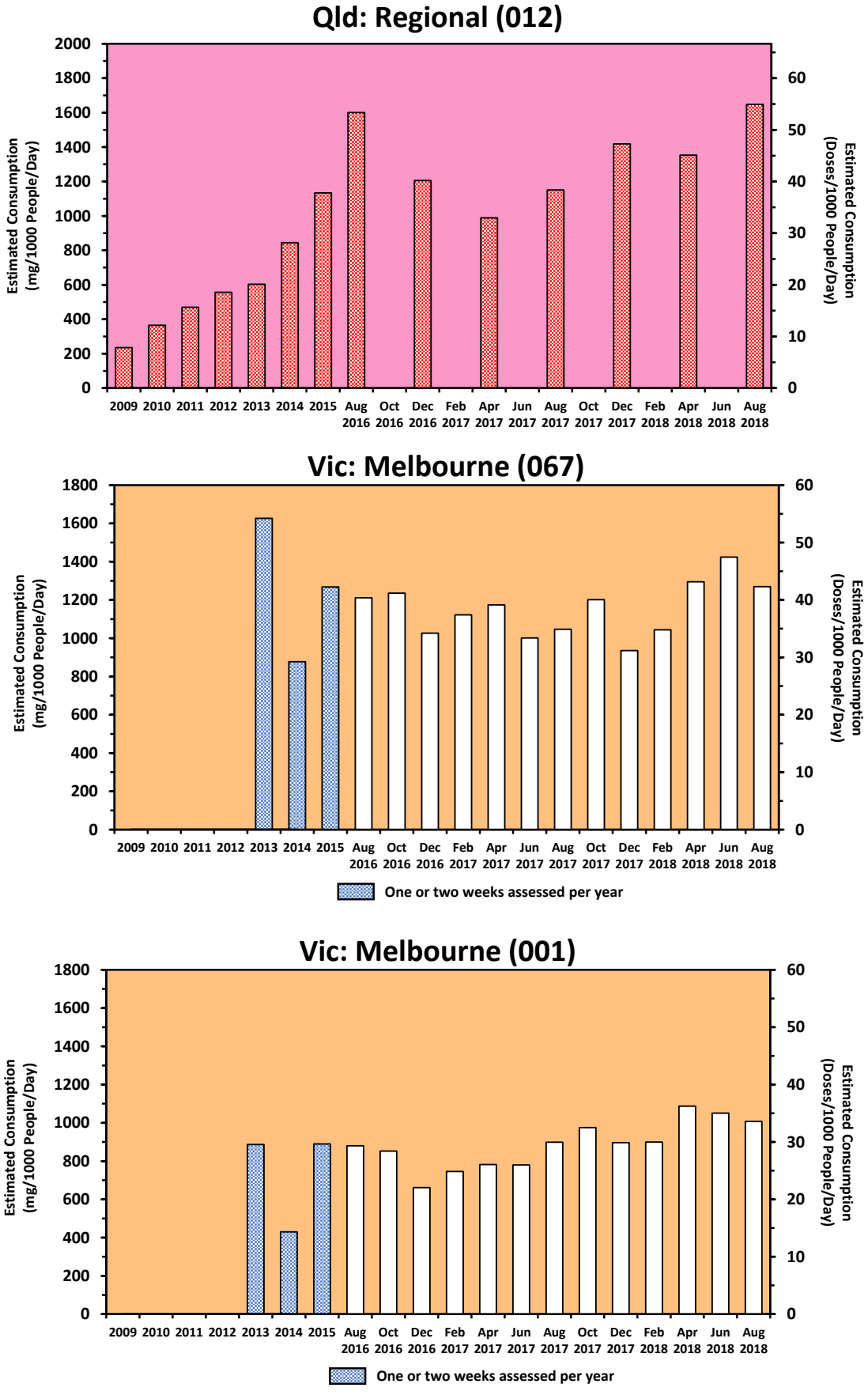


Figure 29 (continued): Change in methylamphetamine consumption for sites with historical data.



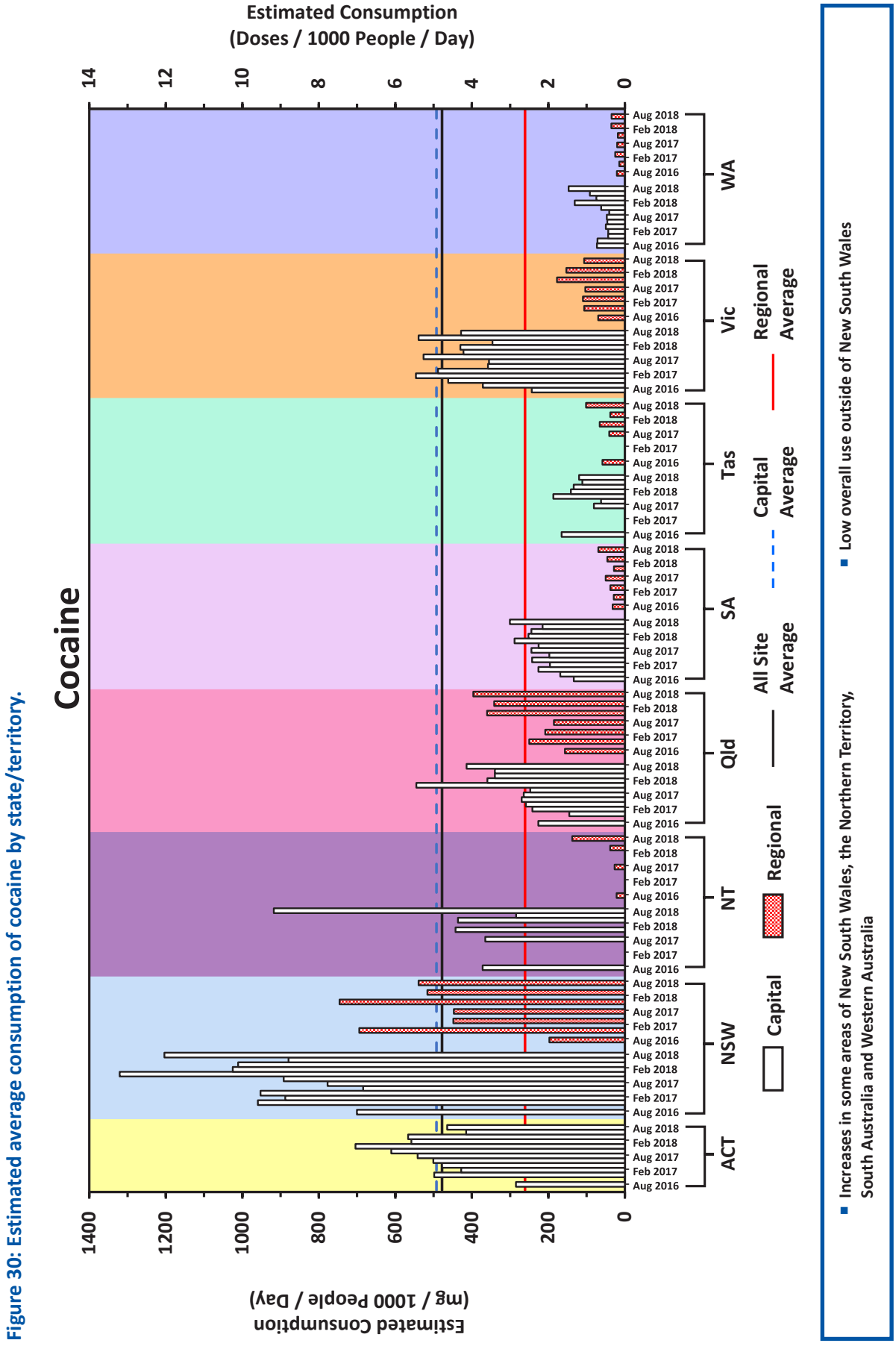


Figure 30: Estimated average consumption of cocaine by state/territory.

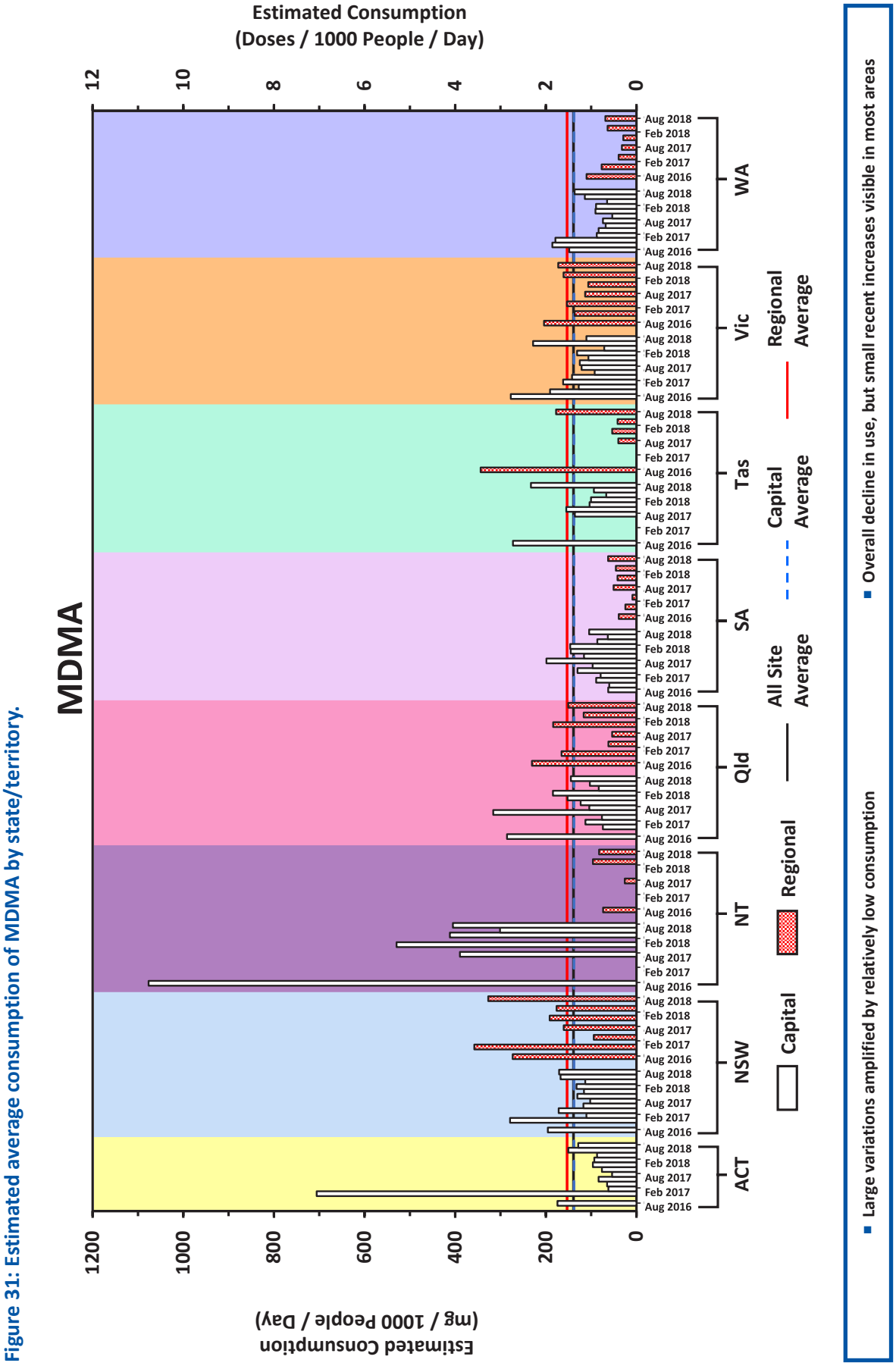


Figure 31: Estimated average consumption of MDMA by state/territory.

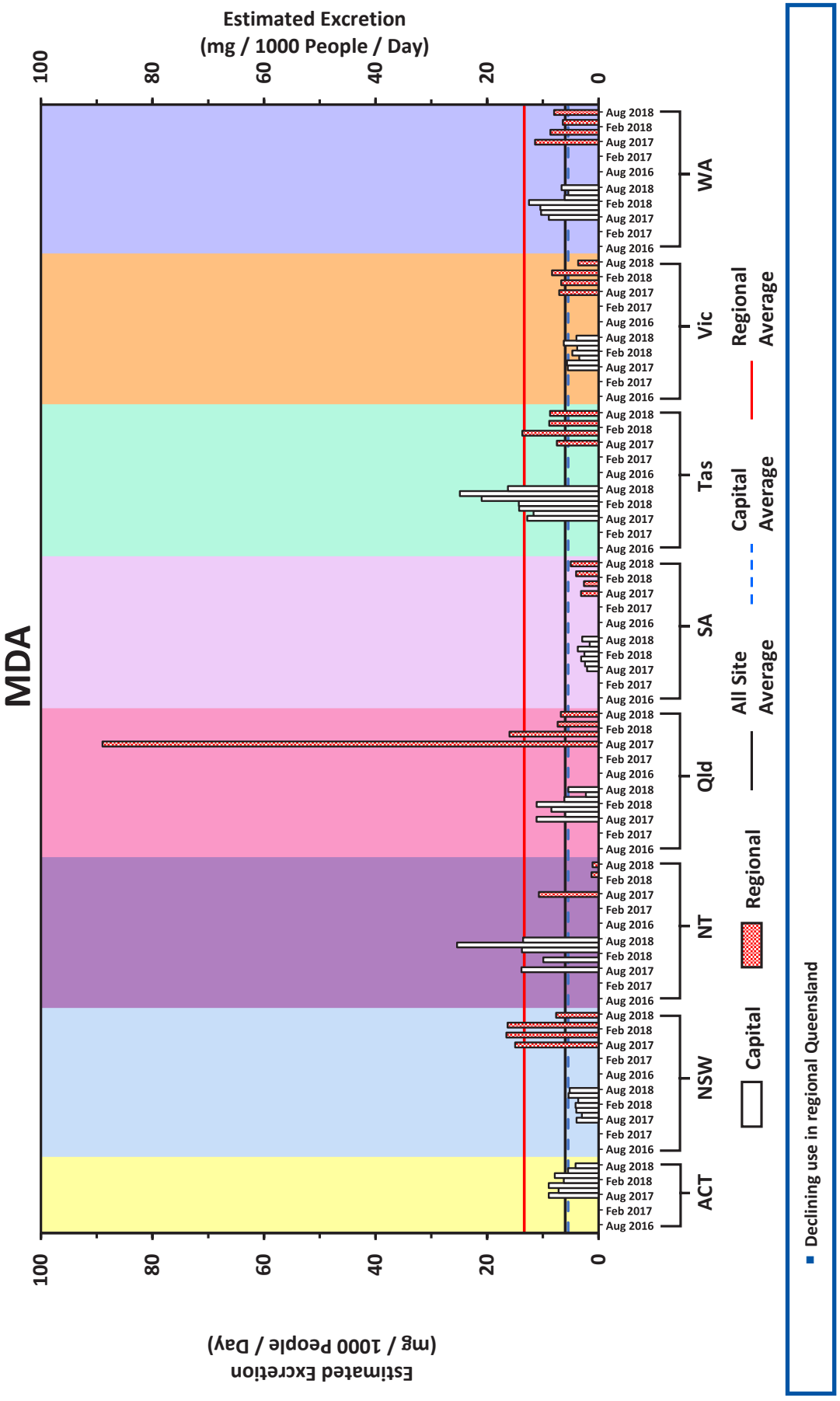


Figure 32: Estimated average consumption of MDA by state/territory.

4.2.3 OPIOIDS

The consumption of oxycodone in capital cities remained relatively unchanged since the previous reporting period of February and April 2018. Capital city Victoria and New South Wales showed recent increases, while the Northern Territory had a decline. Further sampling will indicate if these are part of longer term trends or not (Figure 33). Average levels of oxycodone use were higher in regional areas of several states compared to capital cities. Over the past year, consumption has increased in regional areas of a number of states.

Fentanyl use in regional Australia remais high in comparison to capital cities (Figure 34). An upward trend was apparent in many regional parts of Australia since mid-2017. Capital city Australian Capital Territory, New South Wales, Northern Territory, Victoria and Tasmania all showed rising levels of fentanyl use.

The state and territory comparison of the use of heroin show that consumption was highest in Victoria and low in Northern Territory and Tasmania (Figure 35). In general, regional areas of each state had lower levels of heroin consumption with steady or declining trends in most parts of the country. The extent of heroin consumption has been measured in capital city South Australia since 2013. Together with the current reporting period, levels of heroin consumption for the region have been slightly declining (Figure 36).

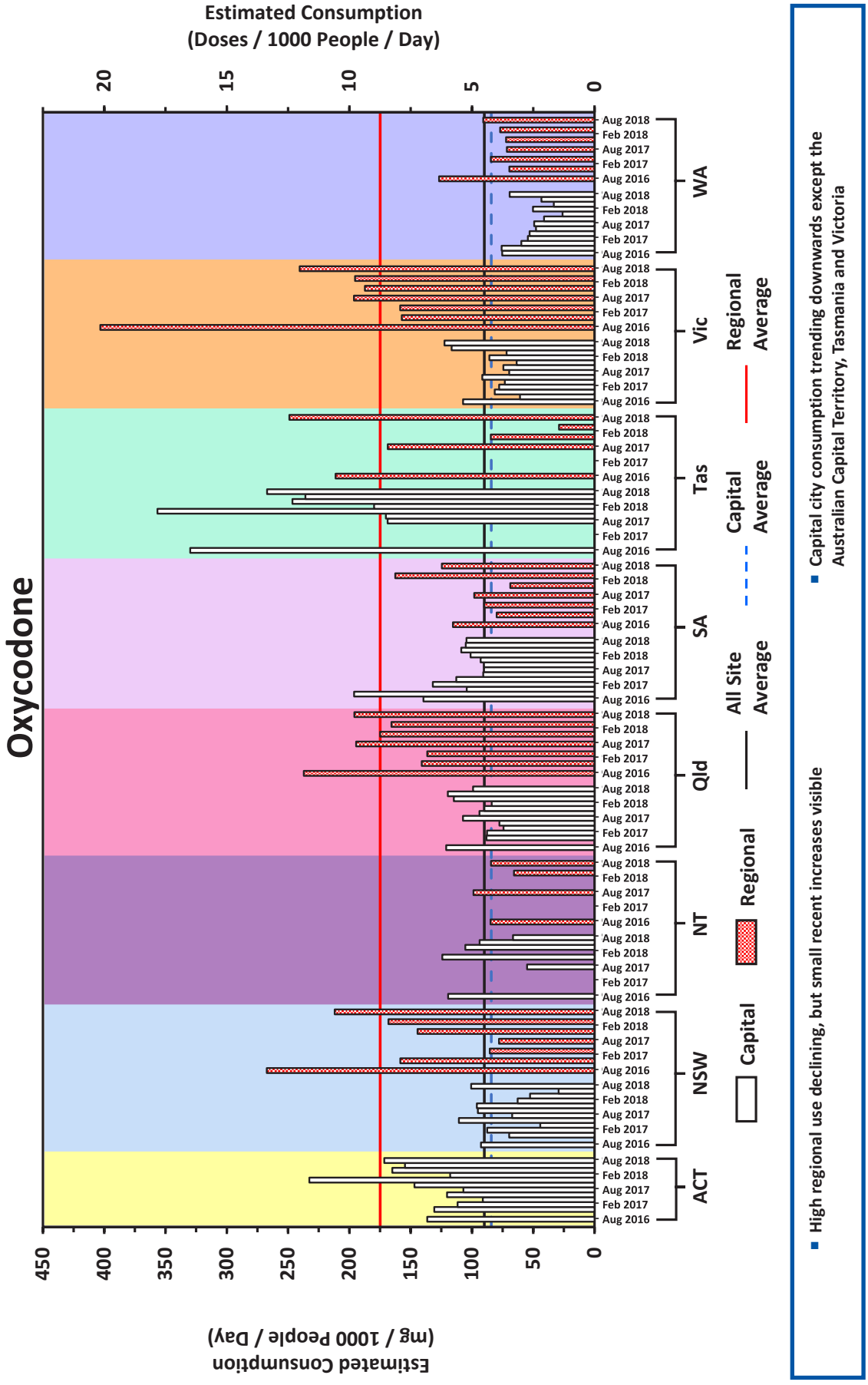


Figure 33: Estimated average consumption of oxycodone by state/territory.

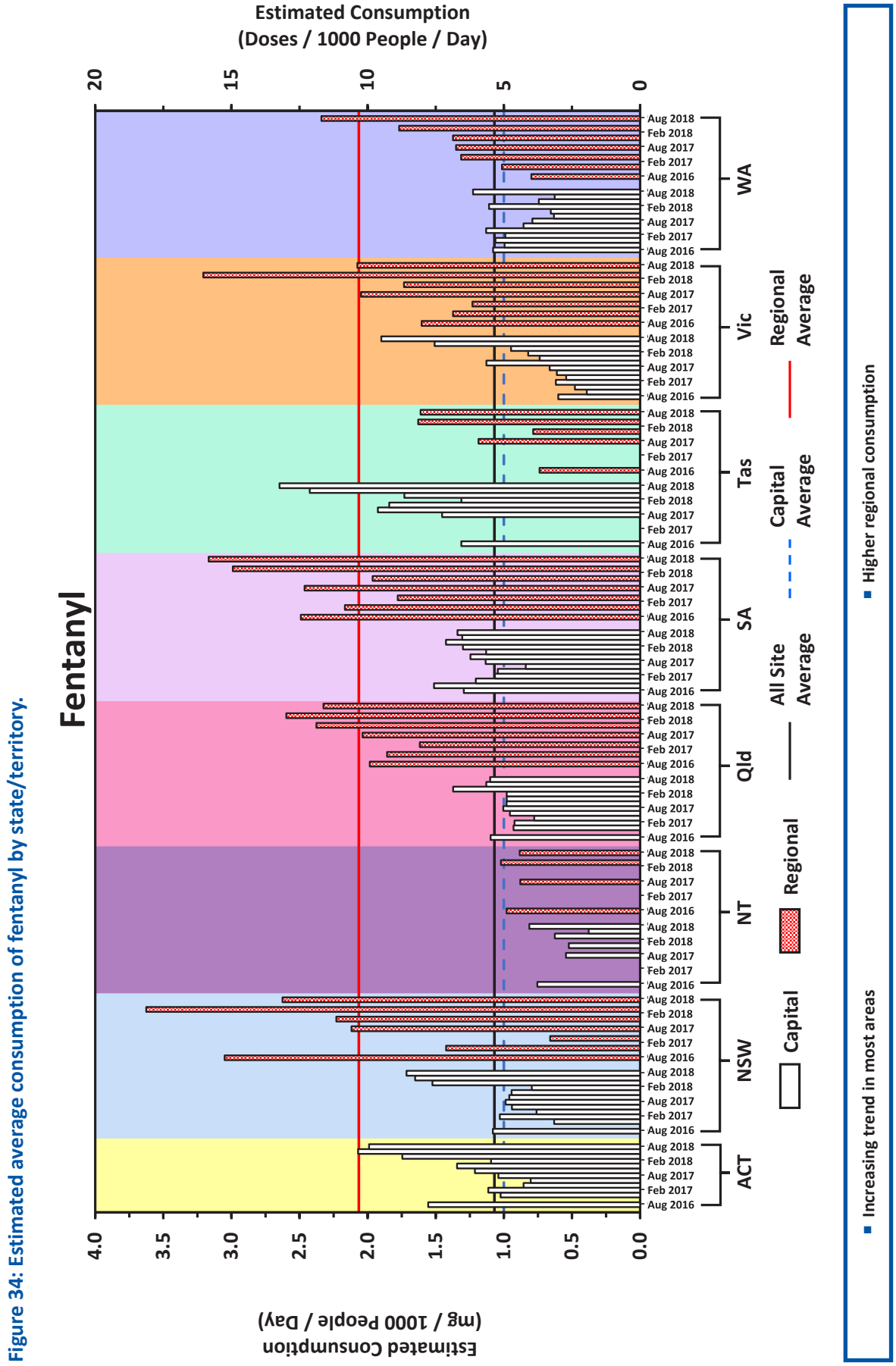


Figure 34: Estimated average consumption of fentanyl by state/territory.

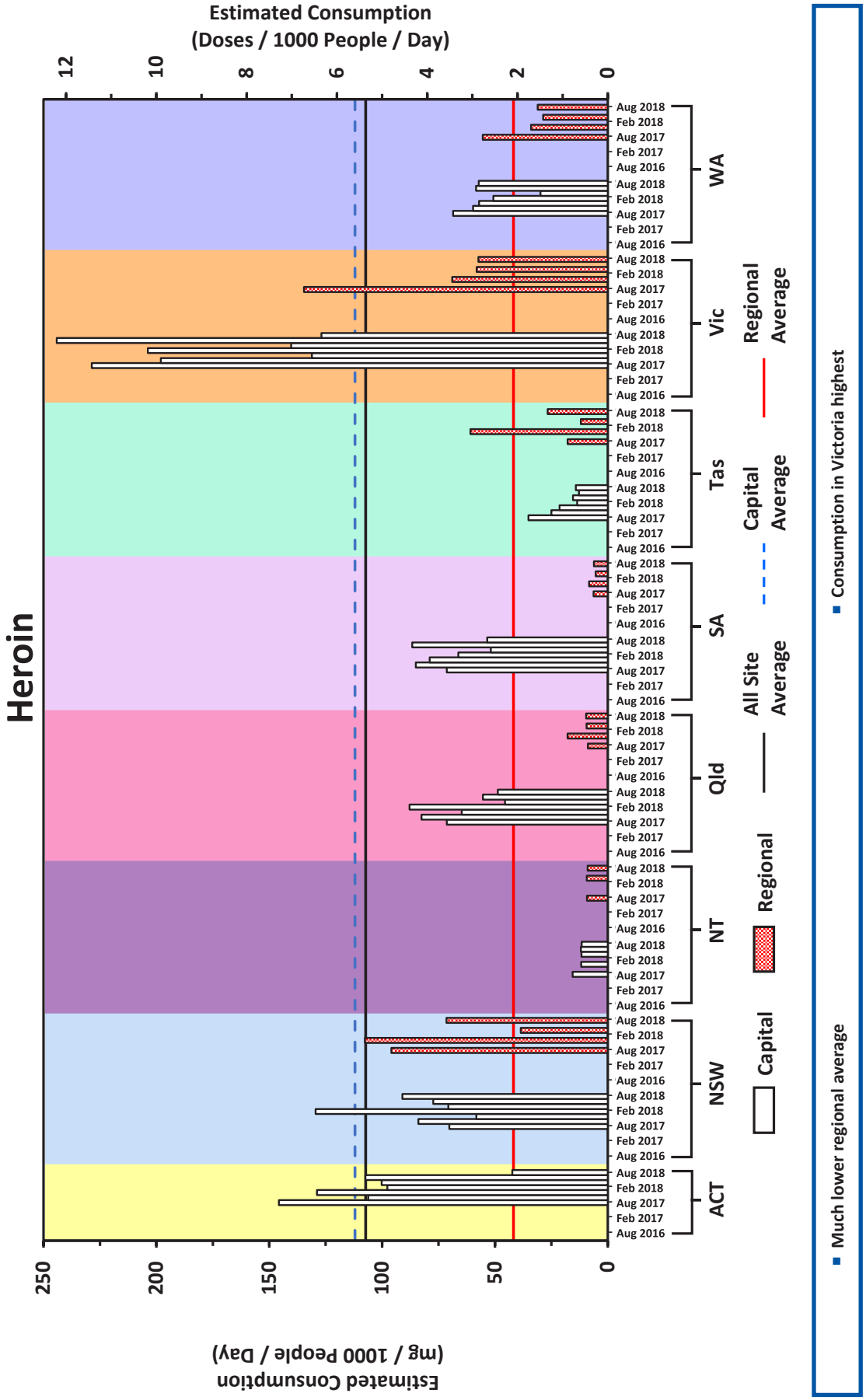
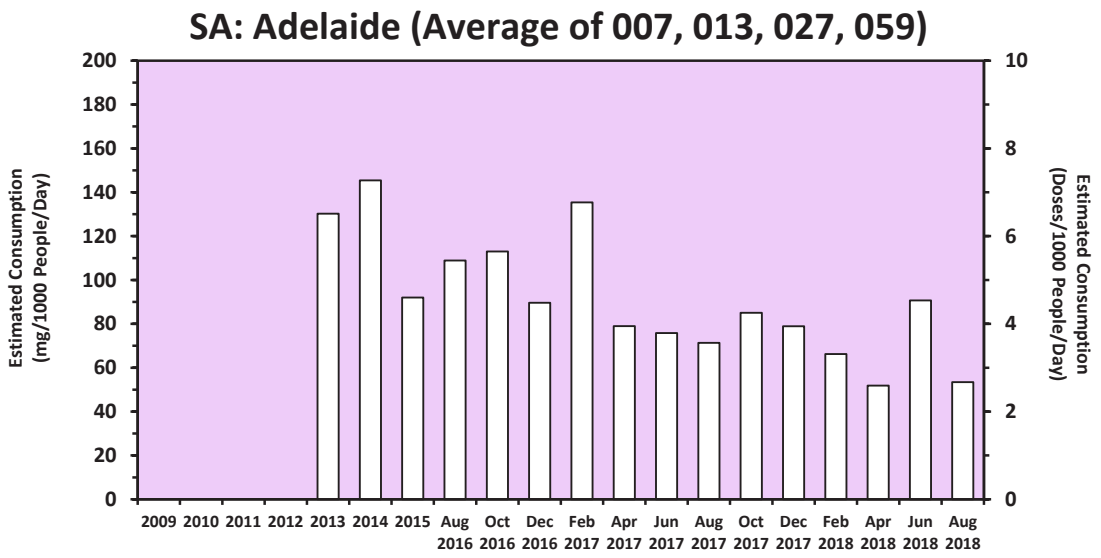


Figure 35: Estimated average consumption of heroin by state/territory.

Figure 36. Change in heroin consumption for South Australia.

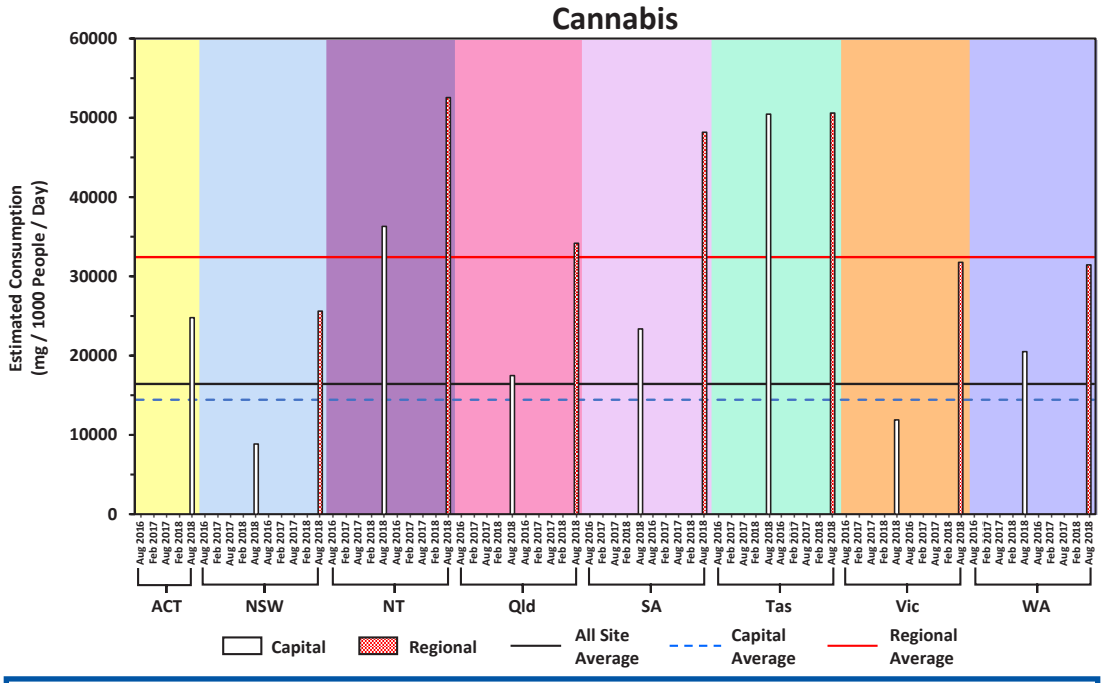


4.2.4 CANNABIS

Spatial differences in THC consumption were present across Australia (Figure 37). Regional consumption was higher than capital city levels. Regional and capital Tasmania, regional Northern Territory and regional South Australia had the highest overall use, while several other states had high regional levels above that of capital areas. Two regional sites in Western Australia were unable to provide a second daily composite sample for cannabis analysis, and so the Western Australia regional aggregated value is calculated on one site only for cannabis.

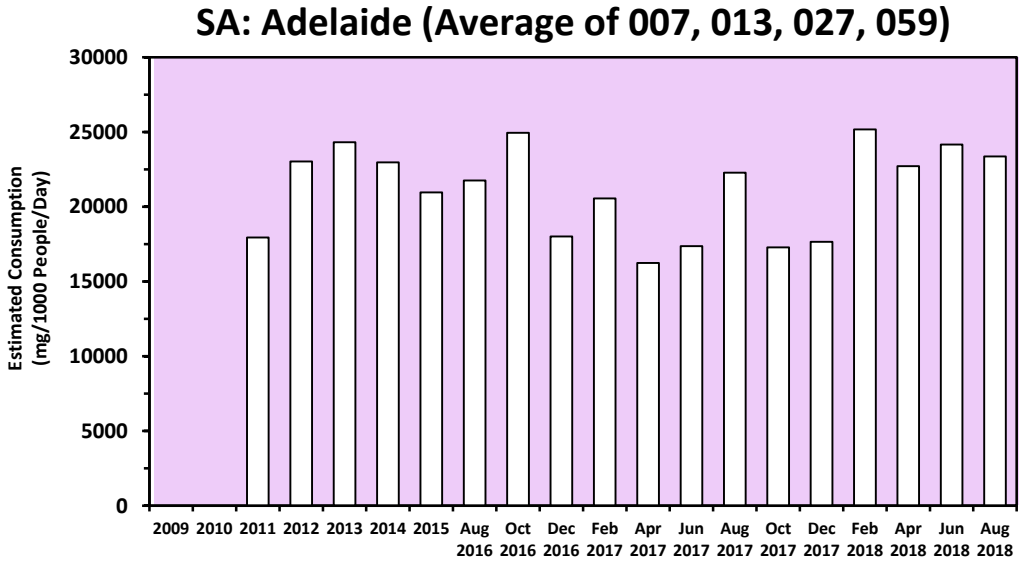
Consumption of cannabis has previously been measured in capital city South Australia. Some seasonality was observed initially as generally higher use in winter periods, but more recently, the use has been steady over bimonthly reporting periods (Figure 38).

Figure 37: Estimated average consumption of cannabis by state/territory.



- Generally higher consumption in regional areas
- Some variation between states

Figure 38: 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)

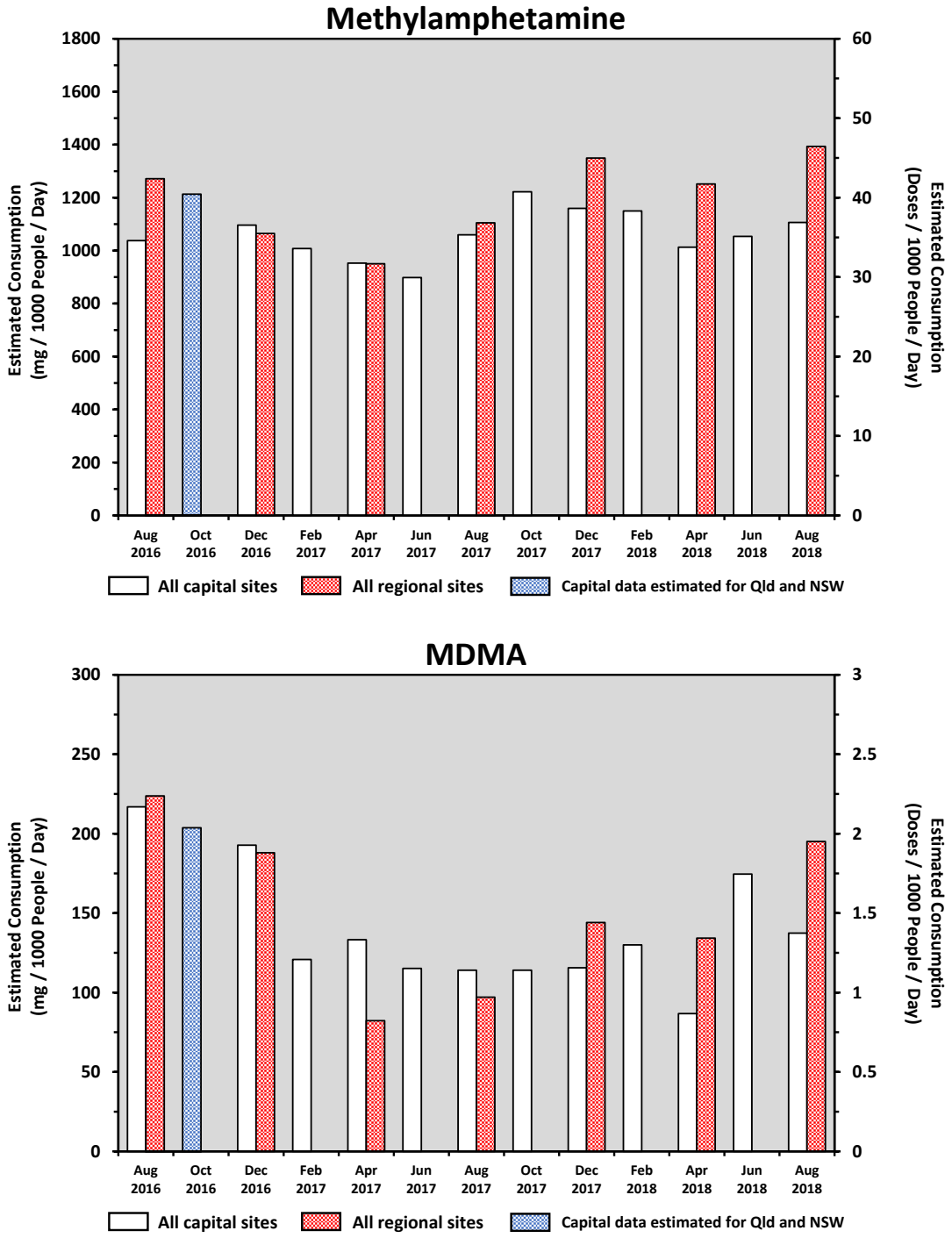
Methylone and mephedrone were only detected sporadically and at very low levels compared to other substances included in the report (August 2018 mephedrone and methylone results are shown in Table 3).

4.2.6 CAPITAL CITY AND REGIONAL AVERAGES

For the purposes of determining representative population trends for the collective catchments included in the report over the total sampling period, the averaged capital city and regional site populations were expressed as the total capital or regional average consumption of illicit stimulants (Figure 39). Since fewer sites were sampled in between August 2016 and December 2017, the contributing population was smaller between these dates. Some approximations had to be made to account for the absence of some densely populated regions (e.g. October 2016 for capital city New South Wales and Queensland).

For the total population included in the report, methylamphetamine appeared to show a steady decline from October 2016 to June 2017, followed by an increase to October 2017, and largely steady levels since then. The gap between regional and capital city use has been increasing in favour of regional centres. MDMA levels declined overall over the first part of the project, after which regional areas have been increasing at a higher rate than capital cities. Since detected levels are very low, the result may not be significant. Cocaine consumption showed some short-term variations, with capital city levels remaining above that of regional areas. Heroin levels appeared to have decreased in regional Australia, with some degree of variability observed in capital cities. In terms of legal substances with abuse potential, alcohol and nicotine consumption remained largely unchanged over the reporting period (Figure 40). Elevated regional consumption was more evident for nicotine than for alcohol. The two pharmaceutical opioids monitored by the NWDMP showed similar recent trends. Oxycodone and fentanyl consumption in both capital city and regional areas have started to increase after a period of relatively constant levels.

Figure 39: The population-weighted average of all sites for methylamphetamine, MDMA, and cocaine.



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

Figure 39 (continued): The population-weighted average of all sites for methylamphetamine, MDMA and cocaine.

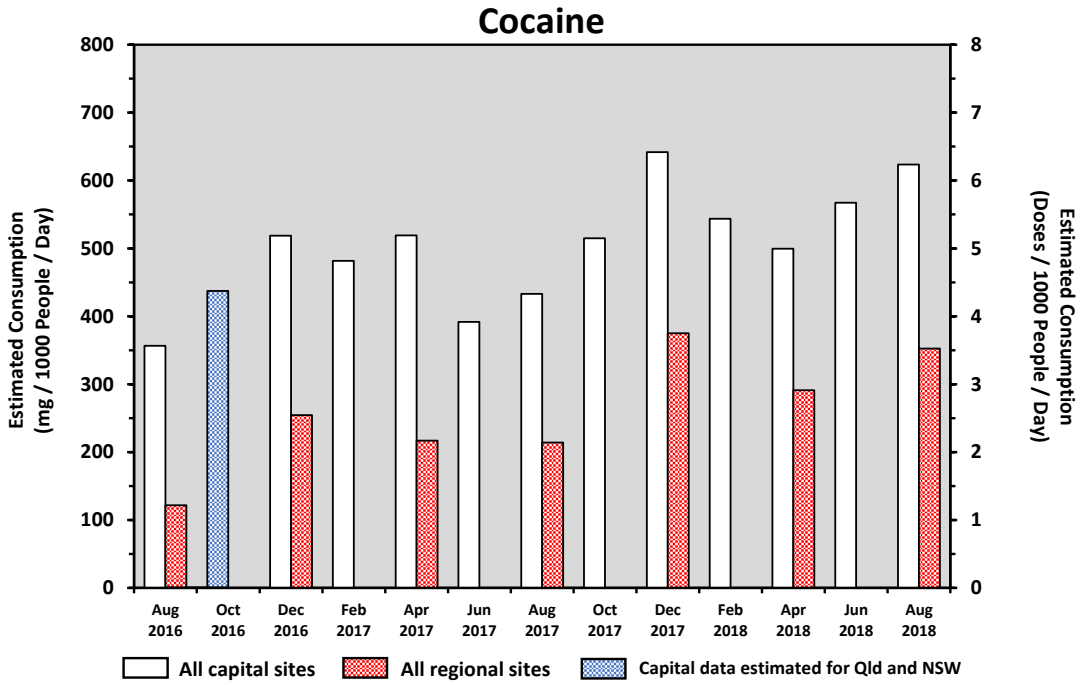


Figure 40: The population-weighted average of all sites for nicotine, alcohol, oxycodone, fentanyl and heroin.

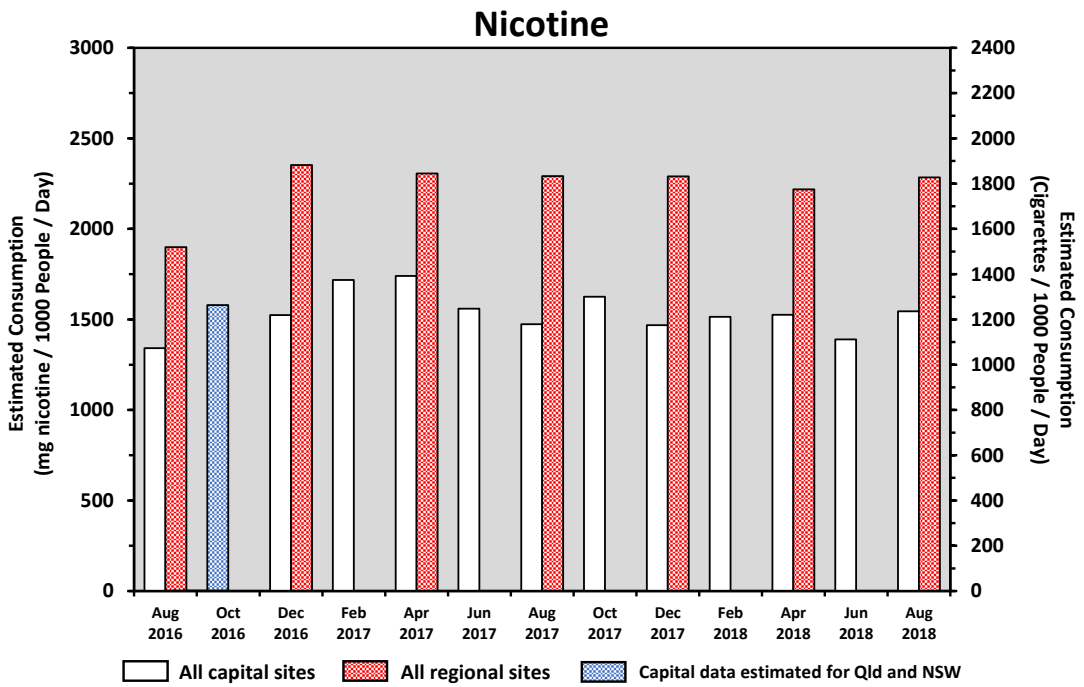


Figure 40 (continued): The population-weighted average of all sites for nicotine, alcohol, oxycodone, fentanyl and heroin.

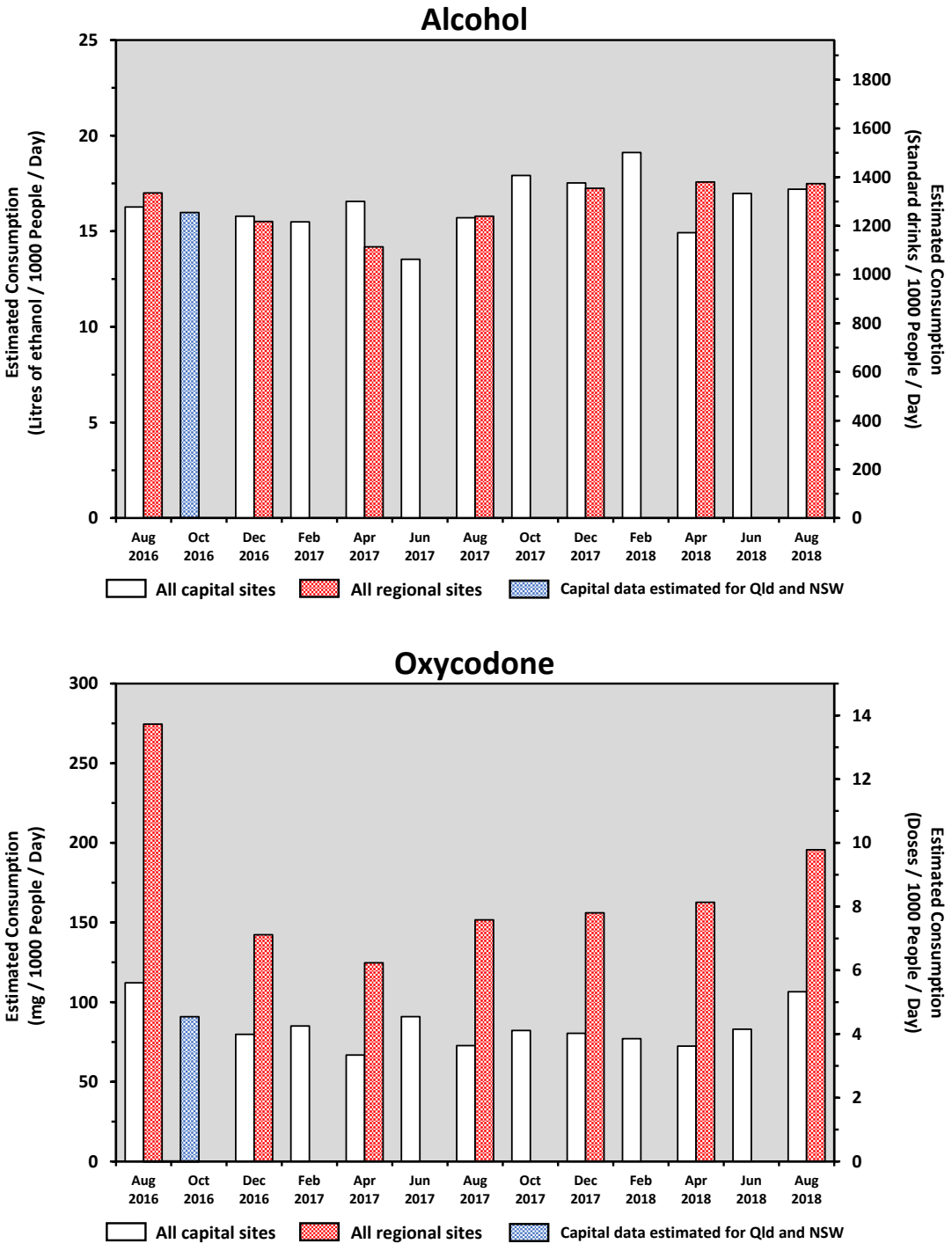


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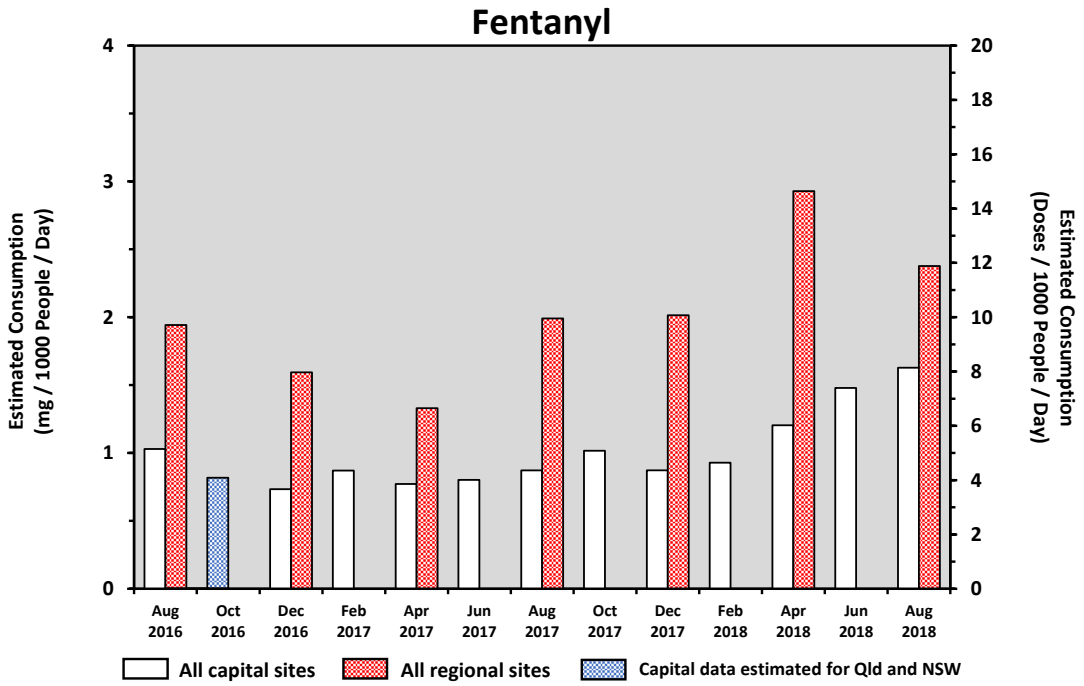
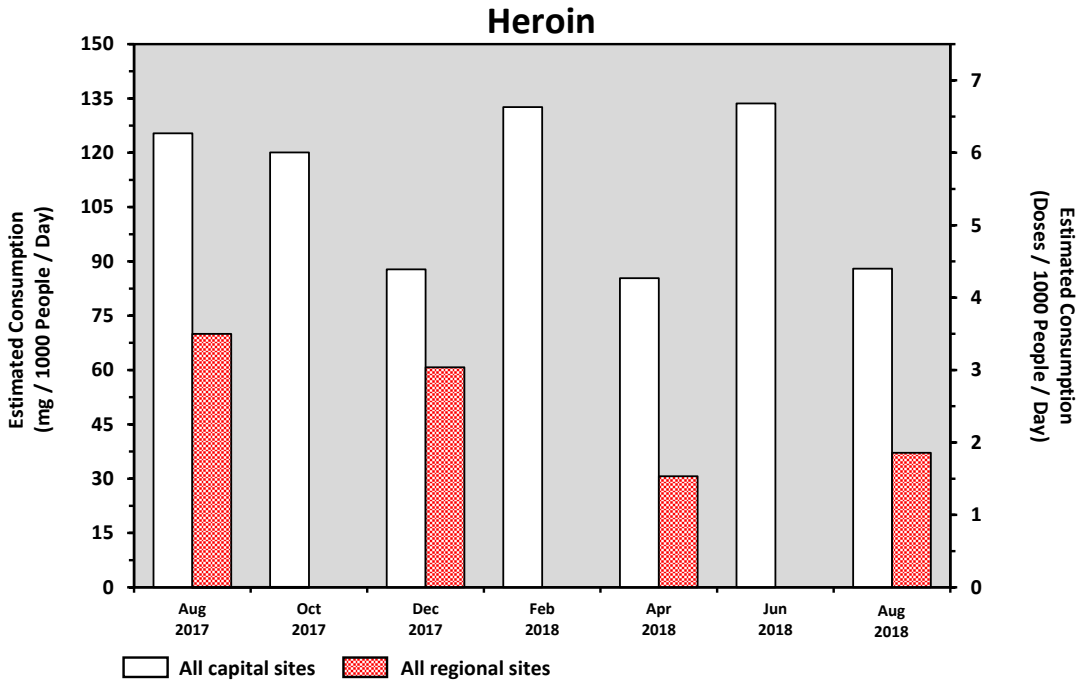
Figure 40 (continued): The population-weighted average of all sites for nicotine, alcohol, oxycodone, fentanyl and heroin.



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. Regional areas were only sampled every second collection period.



4.3 DRUG PROFILE FOR EACH STATE AND TERRITORY

To compare 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. 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 were approximately 1,300 cigarettes per 1,000 people (Figure 4) and 1,400 standard drinks per day per 1,000 (Figure 5), whereas for methylamphetamine, the national average consumption was closer to 37 doses per 1,000 people per day (Figure 8).

Since only mass loads and not doses of cannabis were estimated, the drug was not included in the graphs. Consistent with previous reports, methylamphetamine consumption remained high amongst the measured illicit drugs and opioids in this report, across all regions of Australia (Figure 41). This scale of use of methylamphetamine was consistent for both capital cities and regional sites. Based on the consumption profiles of other drugs monitored by the NWDMP (cocaine, MDMA, oxycodone and fentanyl), no other consistent patterns of usage within the different states and territories were observed. Oxycodone and fentanyl use were very similar within almost all states and territories, with the relative proportions favouring regional over capital city areas.

Figure 41: Profile of average drug consumption by state or territory. 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).

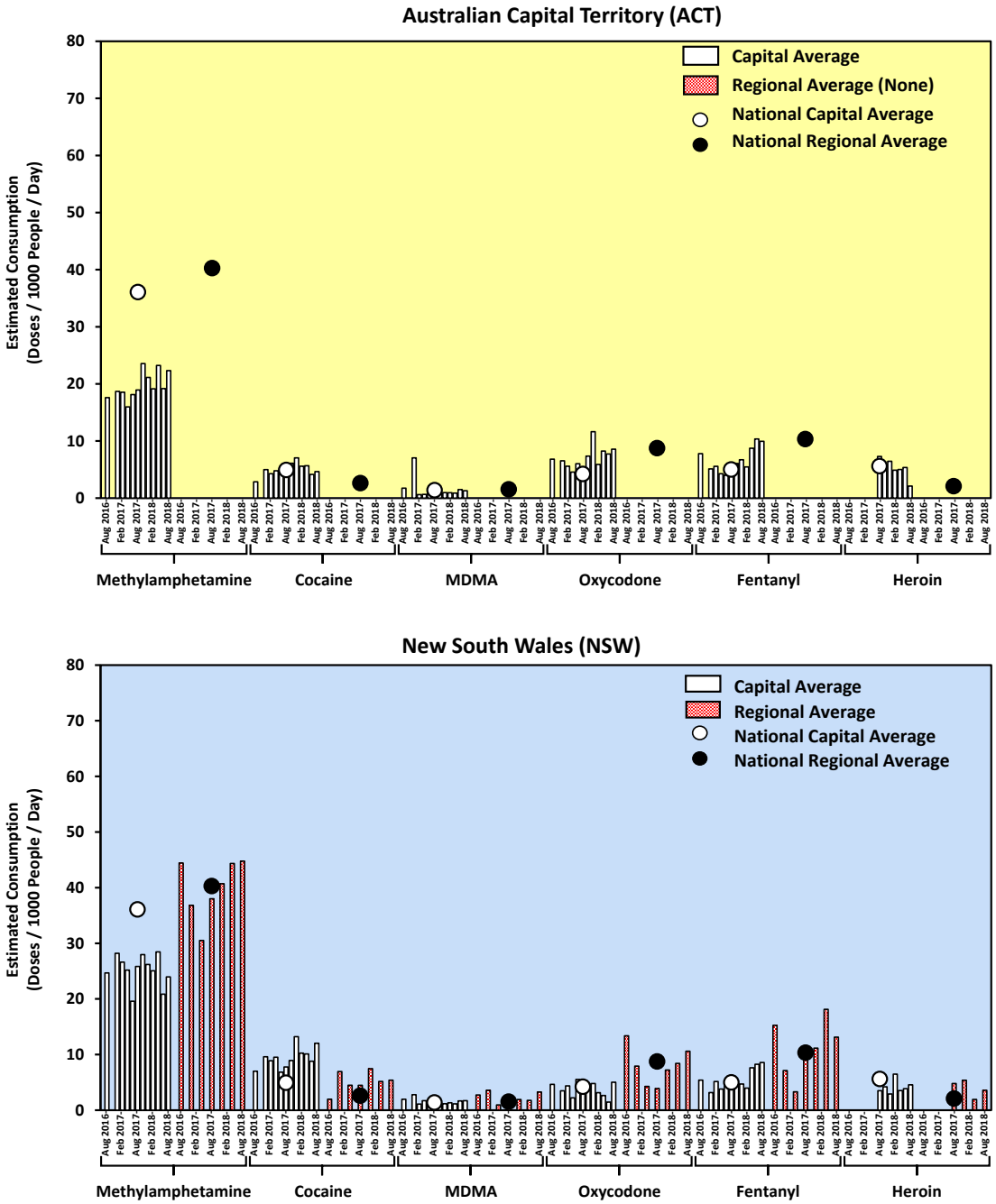


Figure 41 (continued): Profile of average drug consumption by state or territory. Consumption is shown as the number of doses per 1,000 people per day to allow comparison of drugs of different types within the same region (state or territory).

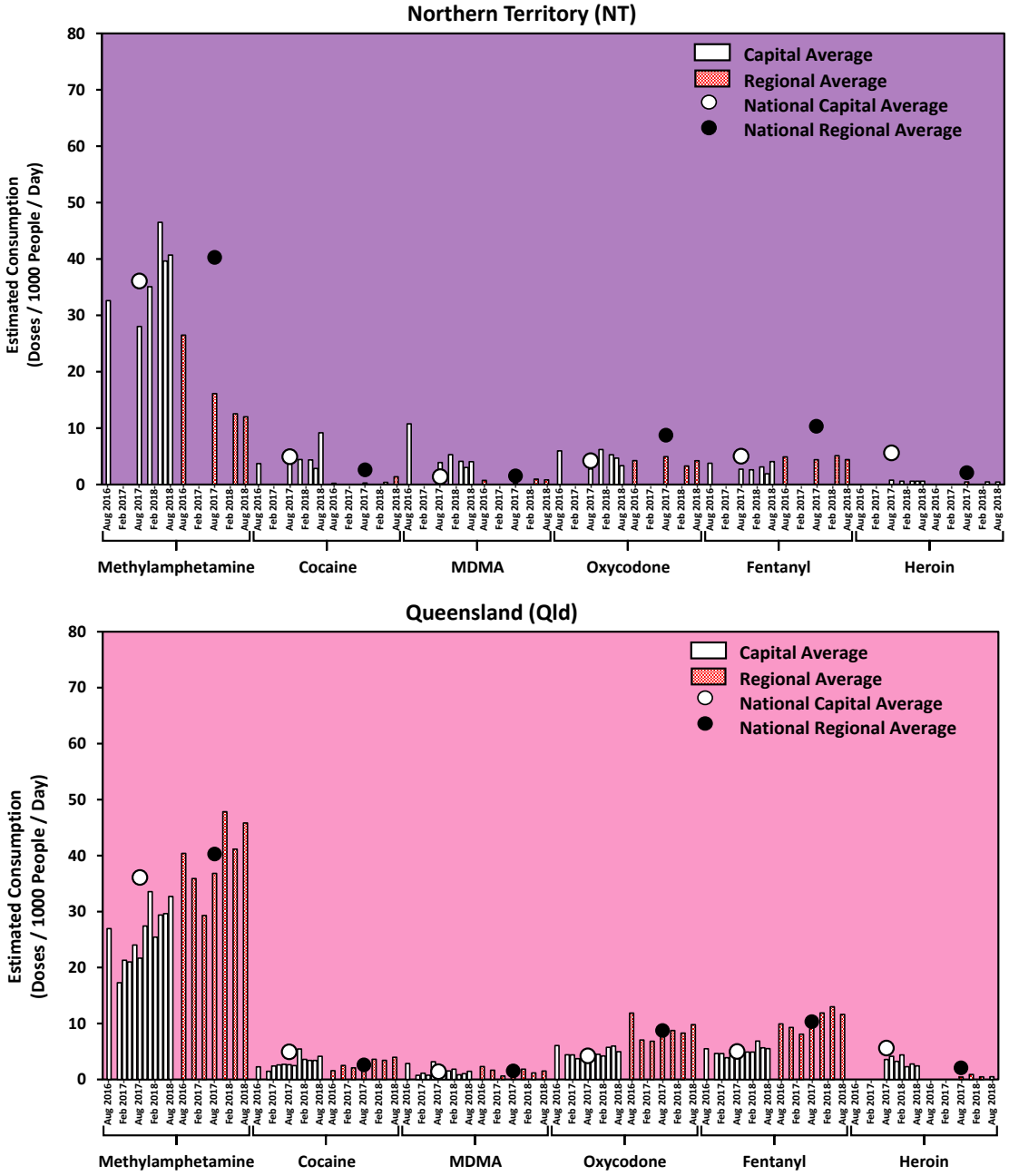


Figure 41 (continued): Profile of average drug consumption by state or territory. Consumption is shown as the number of doses per 1,000 people per day to allow comparison of drugs of different types within the same region (state or territory).

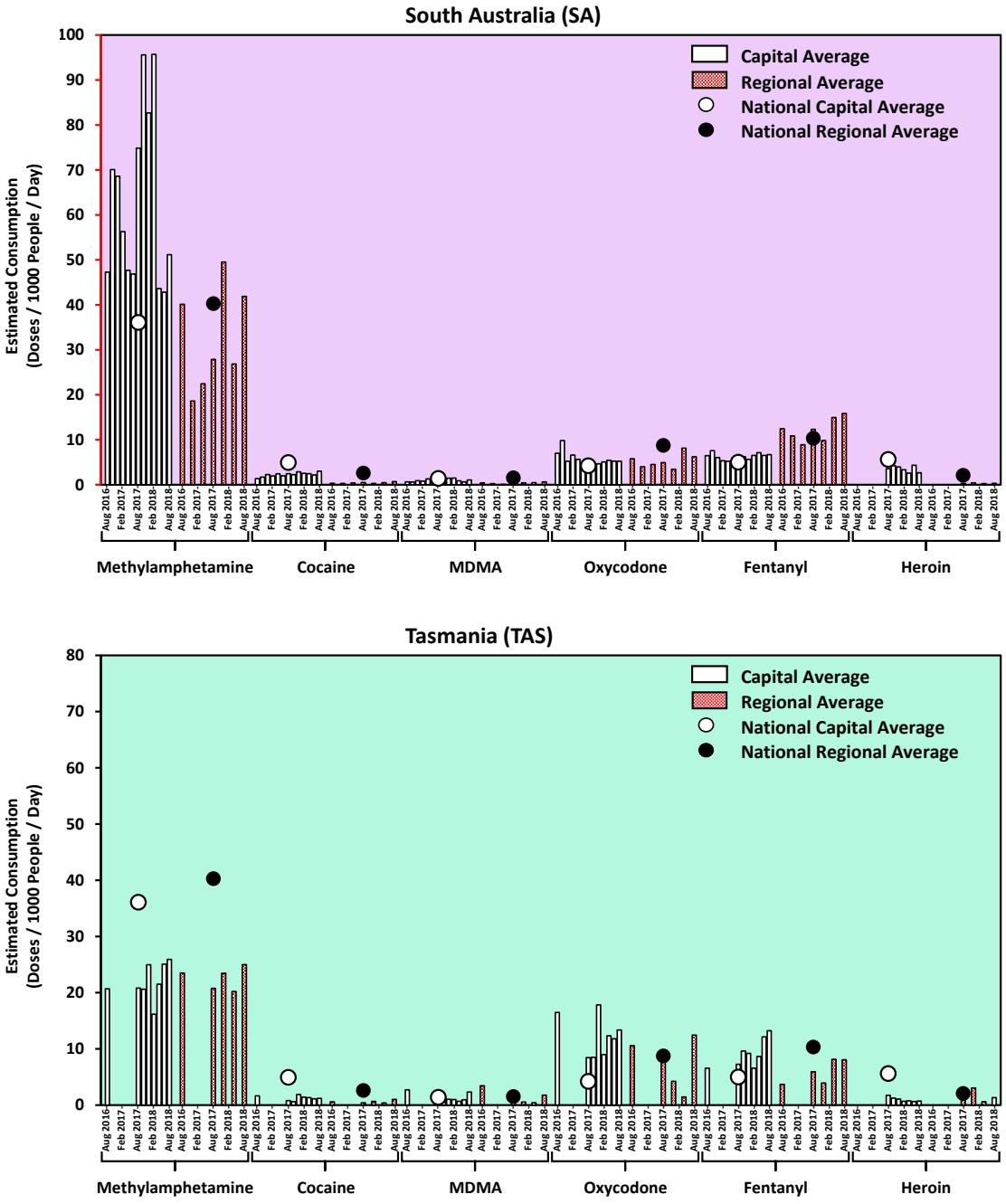
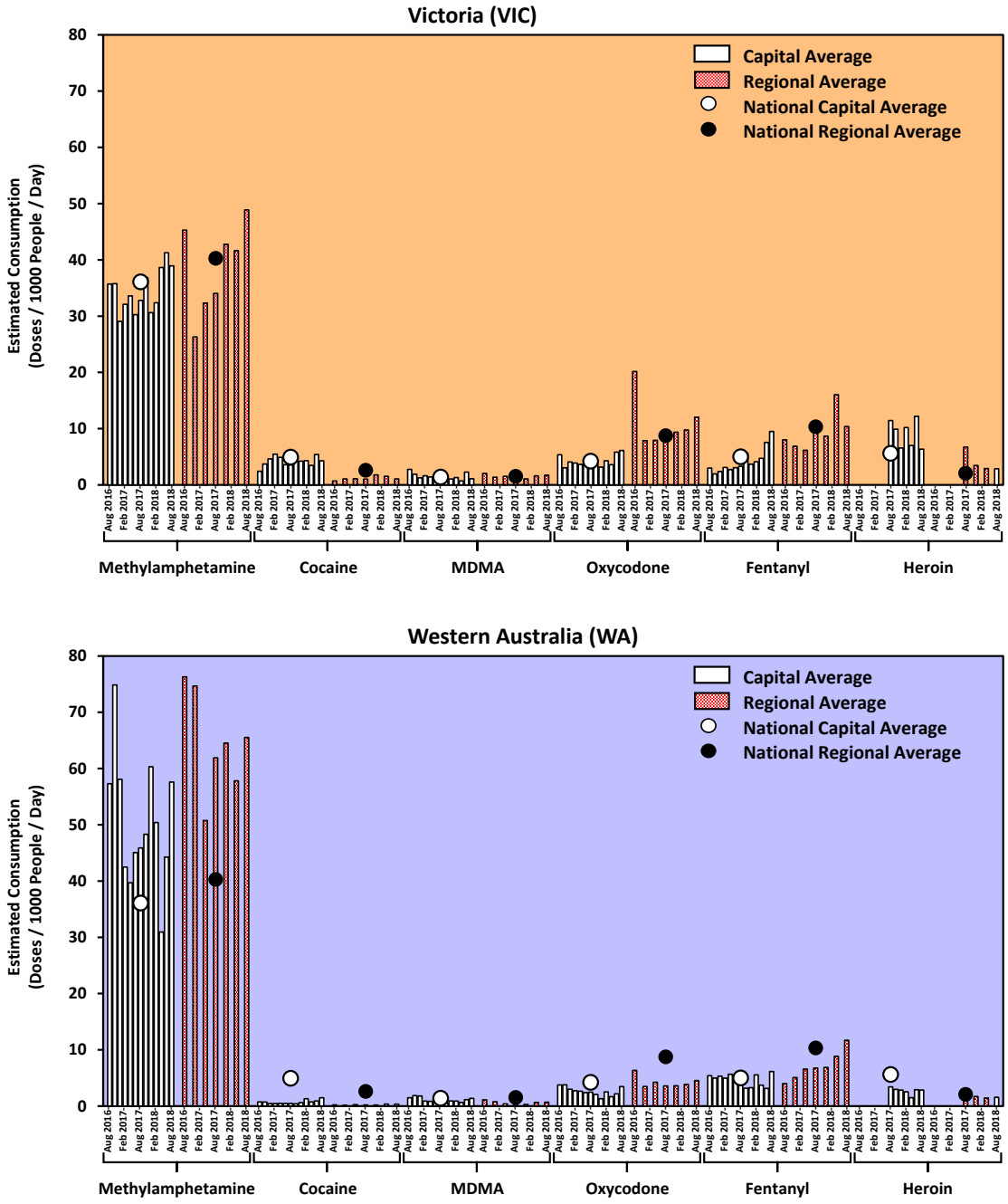


Figure 41 (continued): Profile of average drug consumption by state or territory. Consumption is shown as the number of doses per 1,000 people per day to allow comparison of drugs of different types within the same region (state or territory).



5: ACKNOWLEDGMENTS

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

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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	Level of detection (LOD) [ng/L]	Level of reporting (LOR) [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 & 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, of 100 mg.

APPENDIX 2: NUMBER OF SITES ASSESSED IN EACH REPORT

Number of sites assessed in each state and territory for each report and total populations assessed.
C = capital city wastewater treatment plant, R = regional wastewater treatment plant

	Report 1		Report 2						Report 3					
	Aug-16		*Oct-16		Dec-16		*Feb-17		Apr-17		*Jun-17		Aug-17	
State/territory	C	R	C	R	C	R	C	R	C	R	C	R	C	R
ACT	1	-	-	-	1	-	1	-	1	-	1	-	1	-
NSW	5	5	-	-	3	3	3	-	3	2	3	-	5	7
NT	1	1	-	-	-	-	-	-	-	-	-	-	1	1
Qld	3	9	-	-	2	8	3	-	3	8	3	-	3	7
SA	4	4	4	-	4	5	4	-	4	5	4	-	4	5
Tas	3	4	-	-	-	-	-	-	-	-	-	-	3	3
Vic	2	5	2	-	2	3	2	-	2	2	2	-	2	6
WA	3	1	3	-	3	3	3	-	3	3	3	-	3	3
Population (millions) C & R	11.5	1.6	6.5	-	10.6	1.3	11.1	-	11.1	1.2	11.1	-	11.5	1.7
Total population (millions)	13.1		6.5		11.9		11.1		12.3		11.1		13.2	
% of Australian population	55.9%		27.8%		50.9%		47.4%		52.4%		47.4%		56.3%	

* Every second time-point aims to sample from only capital city sites. Census 2016 population used (23,401,892) for population percentage estimates. Estimates have been rounded to the nearest 0.1 million. Note: catchment populations have been refined, and so population totals and percentages may have changed accordingly.

Number of sites assessed in each state and territory for each report and total populations assessed (continued).
C = capital city wastewater treatment plant, R = regional wastewater treatment plant

	Report 4				Report 5				Report 6			
	*Oct-17		Dec-17		*Feb 2018		Apr 2018		*Jun 2018		Aug 2018	
State/territory	C	R	C	R	C	R	C	R	C	R	C	R
ACT	1	-	1	-	1	-	1	-	1	-	1	-
NSW	3	-	3	5	3	-	3	4	3	-	5	7
NT	-	-	1	-	0	-	1	1	1	-	1	1
Qld	3	-	3	6	3	-	3	8	3	-	3	9
SA	4	-	4	5	4	-	4	5	4	-	4	5
Tas	3	-	3	2	3	-	3	2	3	-	3	2
Vic	2	-	2	4	2	-	2	4	2	-	2	9
WA	3	-	3	3	3	-	3	3	3	-	3	3
Population (millions) C & R	11.2	-	11.2	1.5	11.2	-	11.2	1.6	11.2	-	11.5	1.5
Total population (millions)	11.2		12.7		11.2		12.8		11.2		13.0	
% of Australian population	47.9%		54.3%		47.9%		54.8%		47.9%		55.6%	

* Every second time point aims to sample from only capital city sites. Census 2016 population used (23,401,892) for population percentage estimates. Estimates have been rounded to the nearest 0.1 million.

APPENDIX 3: FURTHER INFORMATION ON WWTPs

Sampling details of each wastewater treatment plant.

		Report 1	Report 2			Report 3			
		# Samples							
Site Code	Capital/Regional	Aug 16	Oct 16	Dec 16	Feb 17	Apr 17	Jun 17	Aug 17	Population Category
ACT: 009	Capital	7	-	7	7	7	7	7	>150,000
NSW: 003	Capital	7	-	7	4	7	7	7	>150,000
NSW: 006	Capital	7	-	7	7	7	7	7	>150,000
NSW: 008	Capital	6	-	7	7	7	7	7	>150,000
NSW: 021	Capital	7	-	-	-	-	-	7	30,000 to 150,000
NSW: 071	Capital	7	-	-	-	-	-	7	>150,000
NSW: 016	Regional	5	-	7	-	-	-	5	30,000 to 150,000
NSW: 025	Regional	7	-	-	-	-	-	7	30,000 to 150,000
NSW: 040	Regional	7	-	-	-	-	-	7	<30,000
NSW: 051	Regional	7	-	-	-	-	-	7	<30,000
NSW: 068	Regional	1	-	4	-	7	-	7	>150,000
NSW: 081	Regional	-	-	-	-	-	-	7	<30,000
NSW: 115	Regional	-	-	7	-	7	-	7	30,000 to 150,000
NT: 010	Capital	7	-	-	-	-	-	7	30,000 to 150,000
NT: 078	Regional	7	-	-	-	-	-	7	<30,000
QLD: 002	Capital	7	-	6	6	7	7	7	>150,000
QLD: 005	Capital	7	-	-	7	7	7	6	>150,000
QLD: 011	Capital	7	-	7	6	7	7	6	>150,000
QLD: 012	Regional	5	-	7	-	7	-	7	>150,000
QLD: 020	Regional	7	-	-	-	-	-	-	<30,000
QLD: 024	Regional	7	-	7	-	7	-	-	30,000 to 150,000
QLD: 028	Regional	7	-	7	-	7	-	7	30,000 to 150,000
QLD: 029	Regional	7	-	7	-	7	-	7	30,000 to 150,000
QLD: 033	Regional	7	-	7	-	7	-	7	30,000 to 150,000
QLD: 039	Regional	7	-	7	-	7	-	7	<30,000
QLD: 053	Regional	7	-	3	-	5	-	7	<30,000
QLD: 077	Regional	7	-	7	-	7	-	7	<30,000
SA: 007	Capital	5	7	7	7	7	7	7	>150,000
SA: 013	Capital	5	7	7	7	7	7	7	>150,000
SA: 027	Capital	5	7	7	7	7	7	7	30,000 to 150,000
SA: 059	Capital	5	7	7	7	7	7	7	>150,000
SA: 017	Regional	5	-	4	-	4	-	4	<30,000

Sampling details of each wastewater treatment plant (continued).

		Report 1	Report 2			Report 3			
		# Samples							
Site Code	Capital/Regional	Aug 16	Oct 16	Dec 16	Feb 17	Apr 17	Jun 17	Aug 17	Population Category
SA: 022	Regional	5	-	4	-	4	-	4	<30,000
SA: 063	Regional	5	-	4	-	5	-	4	<30,000
SA: 076	Regional	5	-	4	-	4	-	4	<30,000
SA: 119	Regional	-	-	4	-	4	-	4	<30,000
TAS: 004	Capital	7	-	-	-	-	-	5	<30,000
TAS: 019	Capital	7	-	-	-	-	-	5	<30,000
TAS: 041	Capital	7	-	-	-	-	-	4	<30,000
TAS: 018	Regional	7	-	-	-	-	-	5	<30,000
TAS: 038	Regional	7	-	-	-	-	-	-	<30,000
TAS: 048	Regional	7	-	-	-	-	-	5	<30,000
TAS: 058	Regional	7	-	-	-	-	-	5	<30,000
VIC: 001	Capital	7	7	7	7	7	7	7	>150,000
VIC: 067	Capital	7	7	7	7	7	7	7	>150,000
VIC: 037	Regional	7	-	7	-	-	-	7	>150,000
VIC: 046	Regional	7	-	-	-	-	-	7	30,000 to 150,000
VIC: 061	Regional	7	-	7	-	7	-	7	30,000 to 150,000
VIC: 062	Regional	7	-	-	-	-	-	5	<30,000
VIC: 066	Regional	6	-	7	-	7	-	7	30,000 to 150,000
VIC: 114	Regional	-	-	-	-	-	-	5	30,000 to 150,000
WA: 101	Capital	7	7	7	7	7	7	7	>150,000
WA: 103	Capital	7	7	7	7	7	7	7	>150,000
WA: 104	Capital	7	7	7	7	7	7	7	>150,000
WA: 102	Regional	7	-	7	-	7	-	7	30,000 to 150,000
WA: 118	Regional	0	-	7	-	7	-	7	<30,000
WA: 120	Regional	-	-	7	-	7	-	7	30,000 to 150,000
	Total Days	329	63	236	107	236	112	342	
	Total Sites	51	9	37	16	36	16	54	
	Total Capital	22	9	15	16	16	16	22	
	Total Regional	30	0	22	0	20	0	32	
		Total samples: 329 Report 1; Aug 2016		**Total samples: 406 Report 2; Oct & Dec 2016, Feb 2017**				**Total samples: 690 Report 3; Apr, Jun & Aug 2017**	

Sampling details of each wastewater treatment plant (continued).

		Report 4		Report 5		Report 6		
		# Samples						
Site Code	Capital/Regional	Oct 17	Dec 17	Feb 18	Apr 18	Jun 18	Aug 18	Population Category
ACT: 009	Capital	7	7	7	7	7	7	>150,000
NSW: 003	Capital	7	7	7	7	7	7	>150,000
NSW: 006	Capital	7	7	7	7	7	7	>150,000
NSW: 008	Capital	7	7	7	7	7	7	>150,000
NSW: 021	Capital	-	-	-	-	-	6	30,000 to 150,000
NSW: 071	Capital	-	-	-	-	-	7	>150,000
NSW: 016	Regional	-	7	-	7	-	5	30,000 to 150,000
NSW: 025	Regional	-	7	-	7	-	7	30,000 to 150,000
NSW: 040	Regional	-	-	-	-	-	7	<30,000
NSW: 051	Regional	-	-	-	-	-	7	<30,000
NSW: 068	Regional	-	7	-	7	-	7	>150,000
NSW: 081	Regional	-	7	-	-	-	7	<30,000
NSW: 115	Regional	-	7	-	7	-	6	30,000 to 150,000
NT: 010	Capital	-	7	-	7	7	7	30,000 to 150,000
NT: 078	Regional	-	-	-	7	-	6	<30,000
QLD: 002	Capital	7	7	7	7	7	6	>150,000
QLD: 005	Capital	6	7	6	7	7	7	>150,000
QLD: 011	Capital	7	7	7	7	7	7	>150,000
QLD: 012	Regional	-	6	-	7	-	5	>150,000
QLD: 020	Regional	-	-	-	-	-	7	<30,000
QLD: 024	Regional	-	-	-	7	-	6	30,000 to 150,000
QLD: 028	Regional	-	-	-	7	-	7	30,000 to 150,000
QLD: 029	Regional	-	7	-	7	-	7	30,000 to 150,000
QLD: 033	Regional	-	7	-	6	-	7	30,000 to 150,000
QLD: 039	Regional	-	7	-	7	-	6	<30,000
QLD: 053	Regional	-	5	-	6	-	7	<30,000
QLD: 077	Regional	-	7	-	7	-	6	<30,000
SA: 007	Capital	7	7	7	7	7	7	>150,000
SA: 013	Capital	7	7	7	7	7	7	>150,000
SA: 027	Capital	7	7	7	7	7	7	30,000 to 150,000
SA: 059	Capital	7	6	7	7	7	7	>150,000
SA: 017	Regional	-	4	-	7	-	7	<30,000
SA: 022	Regional	-	4	-	7	-	7	<30,000
SA: 063	Regional	-	4	-	7	-	7	<30,000
SA: 076	Regional	-	4	-	7	-	7	<30,000
SA: 119	Regional	-	4	-	7	-	7	<30,000

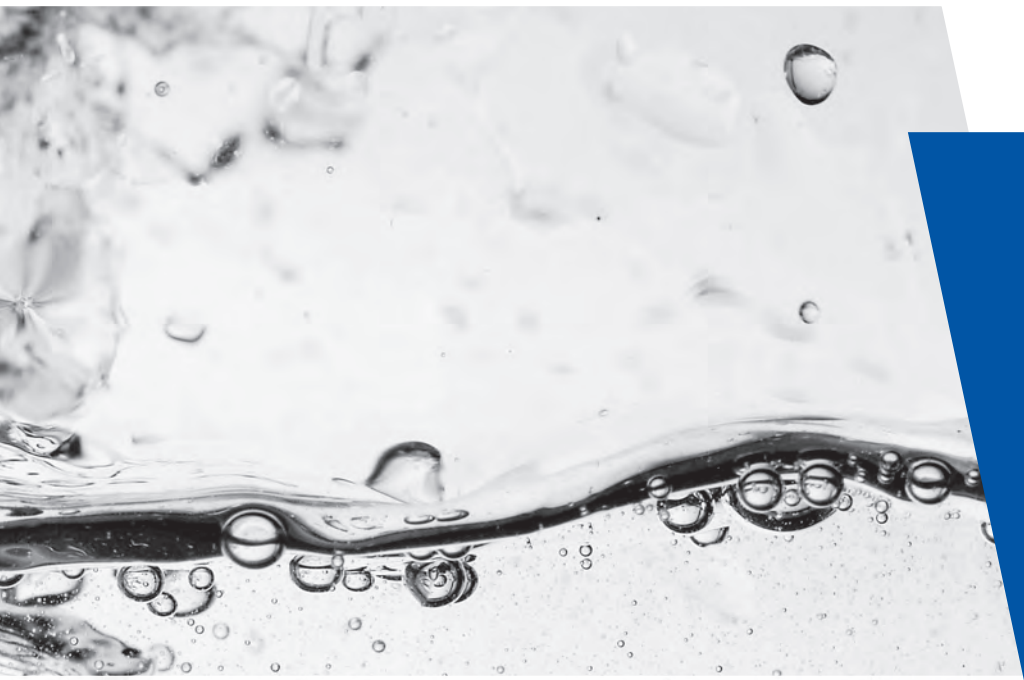
Sampling details of each wastewater treatment plant (continued)

		Report 4		Report 5		Report 6		
		# Samples						
Site Code	Capital/Regional	Oct 17	Dec 17	Feb 18	Apr 18	Jun 18	Aug 18	Population Category
TAS: 004	Capital	5	5	5	5	5	5	<30,000
TAS: 019	Capital	5	5	5	5	5	5	<30,000
TAS: 041	Capital	5	5	5	5	5	5	<30,000
TAS: 018	Regional	-	7	-	7	-	5	<30,000
TAS: 038	Regional	-	-	-	-	-	-	<30,000
TAS: 048	Regional	-	5	-	5	-	5	<30,000
TAS: 058	Regional	-	-	-	-	-	-	<30,000
VIC: 001	Capital	7	7	7	7	7	6	>150,000
VIC: 067	Capital	7	7	7	7	7	7	>150,000
VIC: 037	Regional	-	7	-	7	-	-	>150,000
VIC: 046	Regional	-	-	-	-	-	7	30,000 to 150,000
VIC: 061	Regional	-	7	-	7	-	7	30,000 to 150,000
VIC: 062	Regional	-	-	-	-	-	7	<30,000
VIC: 066	Regional	-	7	-	7	-	7	30,000 to 150,000
VIC: 114	Regional	-	7	-	7	-	-	30,000 to 150,000
VIC: 121	Regional	-	-	-	-	-	7	<30,000
VIC: 122	Regional	-	-	-	-	-	7	<30,000
VIC: 123	Regional	-	-	-	-	-	7	<30,000
VIC: 124	Regional	-	-	-	-	-	6	<30,000
VIC: 125	Regional	-	-	-	-	-	7	30,000 to 150,000
WA: 101	Capital	7	7	7	7	7	7	>150,000
WA: 103	Capital	7	7	7	7	7	7	>150,000
WA: 104	Capital	7	7	7	7	7	7	>150,000
WA: 102	Regional	-	7	-	7	-	7	30,000 to 150,000
WA: 129	Regional	-	7	-	7	-	7	<30,000
WA: 120	Regional	-	7	-	7	-	7	30,000 to 150,000
WA: 118	Regional	-	-	-	-	-	-	<30,000
Total Days		126	288	126	319	134	383	
Total Sites		19	45	19	47	20	58	
Total Capital		19	20	19	20	20	22	
Total Regional		0	25	0	27	0	36	
		Total samples: 414 Report 4; Oct & Dec 2017		**Total samples: 445 Report 5; Feb & Apr 2018**		**Total samples: 517 Report 6; Jun & Aug 2018**		**Grand total number of samples Report 1-6: 2,801**

APPENDIX 4: PERCENTAGE OF SAMPLES ABOVE LOD (%) FOR EACH DRUG AND PERIOD ASSESSED.

The proportion of samples that each drug was detected above LOD. Note: regional sites are only sampled every second period.

		Drug detections % (Above LOD) Report 1–6												
		Aug 2016	Oct 2016	Dec 2016	Feb 2017	Apr 2017	Jun 2017	Aug 2017	Oct 2017	Dec 2017	Feb 2018	Apr 2018	Jun 2018	Aug 2018
Methylamphetamine	**Capital**	100	100	100	100	100	100	100	100	100	100	100	100	100
Methylamphetamine	**Regional**	100	-	100	-	100	-	100	-	100	-	100	-	100
Cocaine	**Capital**	97	97	96	96	97	96	90	90	95	99	97	99	99
Cocaine	**Regional**	45	-	52	-	53	-	53	-	56	-	82	-	77
MDMA	**Capital**	100	100	100	100	100	96	100	100	100	100	100	100	100
MDMA	**Regional**	95	-	96	-	100	-	98	-	100	-	98	-	100
MDA	**Capital**							98	92	100	100	100	100	100
MDA	**Regional**							86	-	95	-	95	-	95
Oxycodone	**Capital**	100	100	100	100	100	100	100	100	100	100	100	100	100
Oxycodone	**Regional**	100	-	100	-	100	-	100	-	100	-	100	-	100
Fentanyl	**Capital**	100	97	100	99	100	100	100	100	100	100	96	100	100
Fentanyl	**Regional**	96	-	94	-	99	-	100	-	100	-	100	-	100
Heroin	**Capital**							83	92	84	85	76	83	72
Heroin	**Regional**							37	-	59	-	22	-	24
Alcohol	**Capital**	100	100	100	100	100	100	100	100	100	100	100	100	100
Alcohol	**Regional**	100	-	100	-	100	-	100	-	100	-	100	-	100
Nicotine	**Capital**	100	100	100	100	100	97	100	100	100	100	100	100	100
Nicotine	**Regional**	100	-	100	-	100	-	100	-	100	-	100	-	100
Mephedrone	**Capital**	2	-	-	-	-	1	-	1	24	3	4	5	8
Mephedrone	**Regional**	-	-	3	-	3	-	1	-	12	-	3	-	3
Methylone	**Capital**	45	19	47	28	79	7	28	46	59	10	2	4	12
Methylone	**Regional**	41	-	14	-	9	-	22	-	22	-	3	-	1
Cannabis	**Capital**													100
Cannabis	**Regional**													100



CONCLUSIONS

CONCLUSIONS

For the sixth report of the National Wastewater Drug Monitoring Program, wastewater analysis was conducted in June and August 2018. The program has identified variations in patterns of drug consumption both within and between jurisdictions and over time. Consistent with previous reports, of the drugs measured by the program with available dose data, nicotine and alcohol are the most consumed drugs.

As the program continues to build longitudinal drug consumption data, fluctuations in consumption are evident. Understanding these patterns, and variation within and between time periods, will assist the development of refined supply, demand and harm reduction strategies.

METHYLAMPHETAMINE

The population-weighted average consumption of methylamphetamine for capital city and regional sites increased from April 2018 to August 2018. Regional average methylamphetamine consumption exceeded capital city average consumption. Western Australia had the highest estimated average capital city and regional consumption of methylamphetamine in August 2018.

When comparing data for August 2016 and August 2017, the population-weighted average consumption of methylamphetamine for capital city sites increased, while consumption decreased in regional sites.

When comparing data for August 2017 and August 2018, the population-weighted average consumption of methylamphetamine for both capital city and regional sites increased.

When comparing data from the start of the program (August 2016) to August 2018, the population-weighted average consumption of methylamphetamine has increased in capital city and regional sites.

Since the commencement of the program, the highest population-weighted average capital city consumption of methylamphetamine was reported in October 2017, with the highest regional consumption reported in August 2018. The lowest population-weighted average capital city consumption of methylamphetamine was reported in June2017, with the lowest regional consumption reported in April 2017.

AMPHETAMINE

Amphetamine is a metabolite of methylamphetamine consumption. While the program measured amphetamine consumption, measured consumption was not reported separately as levels measured were consistent with observed levels related to methylamphetamine consumption.

COCAINE

The population-weighted average consumption of cocaine for both capital city and regional sites increased from April 2018 to August 2018. Capital city average cocaine consumption continues to exceed regional consumption and is around double the regional average. New South Wales had the highest estimated average capital city and regional consumption of cocaine in August 2018.

When comparing data for August 2016 and August 2017, the population-weighted average consumption of cocaine for both capital city and regional sites increased.

When comparing data for August 2017 and August 2018, the population-weighted average consumption of cocaine for both capital city and regional sites increased.

When comparing data from the start of the program (August 2016) to August 2018, the population-weighted average consumption of cocaine has markedly increased in both capital city and regional sites.

Since the commencement of the program, the highest population-weighted average consumption of cocaine for both capital city and regional sites was reported in December 2017. The lowest population-weighted average consumption of cocaine for both capital city and regional sites was reported in August 2016.

3,4-METHYLENEDIOXYMETHYLAMPHETAMINE (MDMA)

The population-weighted average consumption of MDMA for both capital city and regional sites increased from April 2018 to August 2018. Regional average MDMA consumption exceeded capital city average consumption. The Northern Territory had the highest estimated average capital city consumption of MDMA in August 2018, while New South Wales had the highest average regional consumption.

When comparing data for August 2016 and August 2017, the population-weighted average consumption of MDMA for both capital city and regional sites decreased considerably.

When comparing data for August 2017 and August 2018, the population-weighted average consumption of MDMA increased in both capital city and regional sites.

When comparing data from the start of the program (August 2016) to August 2018, the population-weighted average consumption of MDMA has decreased in both capital city and regional sites.

Since the commencement of the program, the highest population-weighted average consumption of MDMA for both capital city and regional sites was reported in August 2016. The lowest population-weighted average capital city consumption of MDMA was reported in April 2018, with the lowest regional consumption reported in April 2017.

3,4-METHYLENEDIOXYAMPHETAMINE (MDA)

MDA is a metabolite of MDMA. As the proportion of MDA derived from MDMA is known, it has been possible from Report 3 (April 2017) to estimate MDA consumption rather that its presence solely as a metabolite of MDMA use. While it is not possible to provide a breakdown of MDA consumption by the number of average doses, general consumption patterns can be identified from the data. The regional average consumption of MDA exceeded capital city consumption in August 2018. Tasmania had the highest estimated average capital city and regional consumption of MDA in August 2018.

HEROIN

The population-weighted average consumption of heroin for both capital city and regional sites increased from April 2018 to August 2018. Capital city average heroin consumption continues to exceed regional average consumption. Victoria had the highest estimated average capital city consumption of heroin in August 2018, while New South Wales had the highest average regional consumption.

The program began measuring heroin in August 2017. When comparing data for August 2017 and August 2018, the population-weighted average consumption of heroin has decreased in both capital city and regional sites.

Since the program commenced monitoring heroin in August 2017, the highest population-weighted average capital city consumption of heroin was reported in June 2018, with the highest regional consumption reported in August 2017. The lowest population-weighted average consumption of heroin for both capital city and regional sites was reported in April 2018.

CANNABIS

The program began measuring cannabis consumption in August 2018. In August 2018, the estimated average regional consumption of cannabis was almost double the capital city average consumption. Tasmania had the highest estimated average capital city consumption of cannabis in August 2018, while the Northern Territory had the highest average regional consumption.

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 tripled, from 10 in April 2018 to 30 in August 2018. Mephedrone was detected at eight sites in August 2018, an increase from the six sites in April 2018. While mephedrone was detected in New South Wales, Queensland and Western Australia in August 2018, use appears to be concentrated in Queensland.

When comparing data for August 2016 and August 2017, the number of national mephedrone detections increased, from 9 detections to 11.

When comparing data for August 2017 and August 2018, the number of national mephedrone detections increased, from 11 detections to 30.

When comparing data from the start of the program (August 2016) to August 2018, the number of national mephedrone detections has increased.

Since the commencement of the program, the highest number of mephedrone detections was reported in August 2018, with the lowest number of detections reported in August 2016.

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 increased, from 8 in April 2018 to 21 in August 2018. Methylone was detected at six sites in August 2018, a decrease from the seven sites in April 2018. While methylone was detected in New South Wales, Queensland, South Australia and the Northern Territory in August 2018, use appears to be largely confined to Queensland.

When comparing data for August 2016 and August 2017, the number of national methylone detections increased, from 58 detections to 90.

When comparing data for August 2017 and August 2018, the number of national methylone detections decreased, from 90 detections to 21.

When comparing data from the start of the program (August 2016) to August 2018, the number of national methylone detections has decreased.

Since the commencement of the program, the highest number of methylone detections was reported in August 2017, with the lowest number of detections reported in April 2018.

OXYCODONE

The population-weighted average consumption of oxycodone for capital city and regional sites increased from April 2018 to August 2018. The regional average consumption of oxycodone continues to be around double capital city average consumption. Tasmania had the highest estimated average capital city and regional consumption of oxycodone in August 2018.

When comparing data for August 2016 and August 2017, the population-weighted average consumption of oxycodone for both capital city and regional sites decreased.

When comparing data for August 2017 and August 2018, the population-weighted average consumption of oxycodone for both capital city and regional sites increased.

When comparing data from the start of the program (August 2016) to August 2018, the population-weighted average consumption of oxycodone has decreased in capital city and regional sites.

Since the commencement of the program, the highest population-weighted average consumption of oxycodone for both capital city and regional sites was reported in August 2016. The lowest population-weighted average consumption of oxycodone for both capital city and regional sites was reported in April 2017.

FENTANYL

The population-weighted average consumption of fentanyl for capital city sites increased from April 2018 to August 2018, while consumption in regional sites decreased. The regional average consumption of fentanyl continues to exceed capital city average consumption. Tasmania had the highest estimated average capital city consumption in August 2018, while South Australia had the highest average regional consumption.

When comparing data for August 2016 and August 2017, the population-weighted average consumption of fentanyl decreased in capital city sites and increased in regional sites.

When comparing data for August 2017 and August 2018, the population-weighted average consumption of fentanyl increased in both capital city and regional sites.

When comparing data from the start of the program (August 2016) to August 2018, the population-weighted average consumption of fentanyl has increased in capital city and regional sites.

Since the commencement of the program, the highest population-weighted average capital city consumption of fentanyl was reported in August 2018, with the highest regional consumption reported in April 2018. The lowest population-weighted average capital city consumption of fentanyl was reported in December 2016, with the lowest regional consumption reported in April 2017.

NICOTINE[8]

The population-weighted average consumption of nicotine remained relatively stable in capital city sites and increased in regional sites from April 2018 to August 2018. Regional average nicotine consumption continues to exceed capital city average consumption. The Northern Territory had the highest estimated average capital city and regional consumption of nicotine in August 2018.

When comparing data for August 2016 and August 2017, the population-weighted average consumption of nicotine for both capital city and regional sites increased.

When comparing data for August 2017 and August 2018, the population-weighted average consumption of nicotine in capital city sites increased, while consumption in regional sites remained relatively stable.

When comparing data from the start of the program (August 2016) to August 2018, the population-weighted average consumption of nicotine has increased in capital city and regional sites.

Since the commencement of the program, the highest population-weighted average capital city consumption of nicotine was reported in April 2017, with the highest regional consumption reported in December 2016. The lowest population-weighted average consumption of nicotine for both capital city and regional sites was reported in August 2016.

8 For accuracy, estimates have been changed from tobacco in Report 1 and 2 to nicotine in this report due to the inability to distinguish between nicotine intake from tobacco or electric cigarettes and nicotine replacement therapies such as patches and gum.

ALCOHOL

The population-weighted average consumption of alcohol increased in capital city sites from April 2018 to August 2018 and remained relatively stable in regional sites. Regional average alcohol consumption exceeded capital city average consumption. The Northern Territory had the highest estimated average capital city and regional consumption of alcohol in August 2018.

When comparing data for August 2016 and August 2017, the population-weighted average consumption of alcohol for both capital city and regional sites decreased.

When comparing data for August 2017 and August 2018, the population-weighted average consumption of alcohol for both capital city and regional sites increased.

When comparing data from the start of the program (August 2016) to August 2018, the population-weighted average consumption of alcohol has increased in capital city and regional sites.

Since the commencement of the program, the highest population-weighted average capital city consumption of alcohol was reported in February 2018, with the highest regional consumption reported in April 2018. The lowest population-weighted average capital city consumption of alcohol was reported in June 2017, with the lowest regional consumption reported in April 2017.

NEXT REPORT

The seventh report of the National Wastewater Drug Monitoring Program is scheduled to be publicly released in March 2019.