

**1**

# Chapter 1 Introduction

# 1

# Manual Contents

<b>VOLUME 1</b>	<b>Chapter 1</b> Introduction
	<b>Chapter 2</b> General Standards
	<b>Chapter 3</b> Aerial Surveying
	<b>Chapter 4</b> Right of Way
	<b>Chapter 5</b> Electronic Models
	<b>Chapter 6</b> Visualisation
<b>VOLUME 2</b>	<b>Road Design and Development (Concept Planning and Design Presentation)</b>
<b>VOLUME 3</b>	<b>Bridge Design Drafting Manual</b>

## Chapter 1 Amendments – February 2008

# 1

### Revision Register

Issue/ Rev No.	Reference Section	Description of Revision	Authorised by	Date
1	-	First Issue	Steering Committee	Jan 2006
2	-	Signatures/Names on Drawings	Steering Committee	July 2006
3	-	Certifying and Approving of drawings Use of Coloured Drawings	Steering Committee	Feb 2007
4	-	Signatures on scheme drawings Legislative requirements Main Roads design requirements Signatures in the title block	Don Hicks	Feb 2008

# Table of Contents

<b>Manual Contents .....</b>	<b>iii</b>
<b>Chapter 1 Amendments – February 2008.....</b>	<b>iv</b>
<b>Revision Register .....</b>	<b>iv</b>
<b>Table of Contents .....</b>	<b>v</b>
<b>1.1 Introduction.....</b>	<b>1</b>
<b>1.2 Signatures on Scheme Drawings.....</b>	<b>1</b>
1.2.1 Signatures of an Overall Nature .....	2
1.2.2 Engineering Certification .....	3
1.2.3 Names and Signatures on Drawings .....	4
<b>1.3 Computer Software for Road Design .....</b>	<b>8</b>
<b>1.4 Functional Drafting.....</b>	<b>9</b>
1.4.1 Use of Coloured Drawings.....	9
<b>1.5 Use of Consultants LOGO.....</b>	<b>9</b>
<b>1.6 Requirements for Tendering and Construction .....</b>	<b>10</b>
1.6.1 General.....	10
1.6.2 Electronic Models and Engineering Drawings .....	10
1.6.3 Providing Construction Information .....	10
1.6.4 'Schedule of Quantities' for Tendering and Construction .....	11
<b>1.7 Risk Management of Document Quality .....</b>	<b>11</b>
<b>1.8 Drawing Documentation .....</b>	<b>12</b>
1.8.1 Engineering Surveys .....	12
1.8.2 Aerial Photography .....	12
1.8.3 Standard Drawings .....	12
1.8.4 Design Presentation Drawings .....	13
1.8.5 Urban Design.....	14
1.8.6 Environmental Design .....	14





# Chapter 1

## Introduction

1

### 1.1 Introduction

This manual provides the drafting and design presentation standards for the production of all drawings delivered as outputs of the planning and/or design activity of road infrastructure projects performed for the Department of Main Roads Queensland.

It is important to understand that drawings form only a part of the overall list of instructions to the constructors of road infrastructure projects. Generally these instructions comprise:

- Engineering drawings
- Specifications, including supplementary specifications
- Schedules of work to be performed
- Test instructions
- Intent of the design, including critical design issues
- Visualisation of the proposals

The primary purpose of these instructions is to specify “the design” of the proposed road and to convey the engineering “requirements for tendering and construction” of road infrastructure. Project visualisation is a key element in the tendering process as it helps the construction contractor to understand what is to be constructed, i.e. design intent. Visualisation is an output from the electronic model. This manual has a focus on the production of engineering

drawings for approval and construction purposes.

Where drawings are produced for community display purposes it is important for them to present the information in a way suitable for the group concerned. In this respect the drawing would have a focus on clearly showing project impacts rather than design/construction detail.

### 1.2 Signatures on Scheme Drawings

Signatures on scheme drawings play a very important role in the legitimisation of scheme documents and the authorisation for the scheme to progress through the various process steps.

Signatures are used for the following purposes:

- Scheme Approval authorises the scheme release for tendering purposes,
- Scheme Submission indicates the service providers formal submission of the scheme in response to a brief/functional specification, and
- Engineering certification of the design, including its presentation on drawings for each area of engineering concerned. It also verifies all names and signatures on the drawings relating to engineering matters. This certification also includes relevant Main Roads standards specifications and supplementary specifications.

### 1.2.1 Signatures of an Overall Nature

Signatures of an overall nature are required for:

- Scheme Approved, and
- Scheme Submitted

These signatures are required to cover the entire scheme drawings and are

included on the first sheet of the drawing set under a listing of all the drawings appropriately identified (including document version and date).

Where the scheme drawings listing require more than one sheet, the statement will appear only on the first sheet of the drawing listing.

1

<b><u>SCHEME SUBMITTED</u></b> <i>(External Consultants or Internal Business Unit):</i>		
This scheme has been prepared in accordance with the requirements of the brief/functional specification.		
SIGNED:	TITLE:	
ORGANISATION:		DATE:
<b><u>SCHEME APPROVED:</u></b> <i>(District Director or Delegate):</i>		
I hereby certify that the scheme complies with the intent of the relevant project on the Roads Implementation Program and the scheme is approved for release in accordance with that program.		
SIGNED:	TITLE:	DATE:

#### 1.2.1.1 Scheme Approved

The District Director (or delegate) shall approve a scheme for tendering purposes. Approved means the relevant District Director (or delegate) is satisfied that:

- The scheme satisfies the Road Network Strategy in relation to:
  - o Investment Strategies
  - o Functional Road Hierarchy
  - o Traffic Operation Function
  - o Corridor Development Plans
  - o The need to be satisfied by the project
- The scheme satisfies the requirements of the Roads Implementation Program (RIP) in terms of:
  - o Prioritisation
  - o Scope, and

o Cost

- The appropriate level and extent of external communication has been undertaken

Also, approval applies to design variations during construction that require extra funds.

The District Director (or delegate) shall sign under the word 'Scheme Approved' to formally authorise the submission of the scheme for tendering.

Scheme approval is by a single signature under a listing of all scheme drawings on the first drawing of the drawing set.

NB: Approval for construction is given separately on Form 1B – "Estimate of Authorised Expenditure".

#### 1.2.1.2 Scheme Submitted

The person duly authorised by the service provider (engineering consultant

or internal business unit) shall formally (under a covering letter) submit the contract materials (scheme documents) to the client.

The meaning of Scheme Submitted is:

- The scheme satisfies the requirements of the client's brief/functional specification.
- The client has been progressively involved in the evolution of the design, including Peer Review.
- The engineering design has been certified by the relevant RPEQ(s), and that all signatures in the drawing title block are bona fide.

Scheme submission is a commercial response to a brief. The submission is by a single signature under a listing of all scheme drawings on the first drawing of the drawing set. The organization or internal business units approving officer must sign under the words 'Scheme Submitted' and indicate their organisation.

In addition, the submission covering letter shall state that the scheme has been prepared in accordance with the (*name of organisation*) fully certified quality system and other relevant organisational standard process and practices, and Main Roads technical requirements published in various departmental documents, including manuals.

### 1.2.2 Engineering Certification

Road design is becoming an increasingly complex process with significant Legislative and Main Roads, requirements to be satisfied.

The overall responsibility for quality of the project design and documentation lies with the organisation carrying out the work. However, the individual design responsibility for each area of engineering concerned is identified by the various engineering certification signatures on each project design drawing, as relevant.

#### 1.2.2.1 Legislation requirements

The legal requirements emanate from:

- The *Registered Professional Act 2002* together with the Code of Practice
- The *Workplace Health and Safety Act 1995* together with amendments

#### Registered Professional Act 2002

The responsibilities of Registered Engineers are set out in the Code of Practice (The Code) produced through the *Registered Professional Engineers Act 2002* (The Act).

The Act requires design to be carried out by a Registered Professional Engineer or under the direct (one on one) supervision of a Registered Professional Engineer (RPEQ).

The Code has many similarities to other Codes of Ethics but it has the force of Law in this State and includes the following definition of engineering:

"Engineering is a creative process of synthesising and implementing the knowledge and experience of humanity to enhance the welfare, health, and safety of all members of the community, with due regard to the environment in which they live and the sustainability of the resources employed. Engineering professionals must display detailed technical and

professional understanding and the wise application of that understanding"

### Workplace Health and Safety Act 1995

Legal obligations for designers of road infrastructure were introduced in Queensland on 1 July 2007 under amendments to the *Workplace Health and Safety Act 1995 (WH&S Act)*. Since 2003, designers have had an obligation to design a structure that is intended to be used as a workplace that is without risk to the persons when it is being used for the purpose for which it was designed (s34B).

The *WH&S Act* includes designers as one of the several duty holders for health and safety in the workplace.

Complying with these requirements are part of the RPEQ's designer obligations under law.

#### 1.2.2.2 Main Roads Design Requirements

Organisations have internal processes and procedures that seek to deliver consistency and predictability of deliverables and outcomes.

Technical governance requires compliance with the intent of Main Roads Policies, References, Standards, Planners and Designers Instructions, Codes of Practice, Guidelines and Brief/Functional Specification(s).

#### Specifying the Design

The drawings must precisely detail those parameters that specify "**the design**":

- Locating the project job site
- The precise location of the project on the ground

- The road shapes
- The road structure (materials)
- Full details of accesses, turnouts, intersections, interchanges etc.
- The size, shape and full detail of structures (bridges, retaining walls, culverts, noise barriers)
- Portray a clear visual understanding of the project and its environs to unambiguously portray the design intent.

#### Critical aspects of Design

It is very important for any critical aspects of the design to be highlighted on the drawings and also explained to the contractor to avoid compromising the integrity of the design during construction. This may be included in supplementary specifications. It must also be addressed at the pre-start conference.

#### Drawing Responsibility

The key person responsible for preparing the various drawings and their presentation is required to include their name in 'text' in the relevant part of the drawing title block.

This ensures the legibility of the persons name allowing ready identification where there is a need for further information, additional design, or to correct an error or omission. This information together with the claims history and the consultant performance reports may be used in consultants prequalification assessment processes.

#### 1.2.3 Names and Signatures on Drawings

Names and signatures on engineering drawings play a very important role in

the legitimisation of scheme documents. In this context each engineering drawing must include the names and signatures, as relevant of the person responsible for:

- Producing the engineering drawings,
- Checking the engineering drawings,
- Carrying out the design,
- Verifying the design,
- Reviewing the design, and
- Certifying the design for all areas of engineering, as relevant.

### 1.2.3.1 Signatures in the Title Block

Every drawing must have a standard Main Roads Title Block that requires a range of names and signatures to be applied in order to complete the drawing. These signatures are required to identify the key person responsible for the relevant production functions, e.g. 'Drawing', drawing 'Checked', 'Design', design 'Verified', 'Design Review' and 'Engineering Certification' for each area of engineering, as relevant.

Names in text are required for Drawing, Design, Checked, Verified and Review.

Drawing	Design	Design Review	Engineering Certification
<i>Name in Text</i>	<i>Name in Text</i>	<i>Name in Text</i> <i>Actual Signature</i>	<i>Actual Signature</i> / /
Checked	Verified	Date: / /	RPEQ No.
<i>Name in Text</i>	<i>Name in Text</i>	<i>Name in Text</i>	

Actual signatures for Design Review and Engineering Certification are to be completed in blue to facilitate identification of original drawings.

### 1.2.3.2 Drawing & Checked

The meaning of the word 'Drawing' and 'Checked' in the title block is that reasonable skill, care and diligence has been exercised by the external consultant or internal business unit in preparing the engineering drawings in accordance with the ethics of the engineering profession, main roads drafting and design presentation standards manual and includes:

- The process of structuring the layout of the drawing (drafting and readability),
- The intent of the design is absolutely clear,
- The accuracy of the design detail included in the drawing, and
- The appropriateness of the drawing to the users performing the next step in the process, e.g. approval, tendering, and construction.

The key persons responsible for this function must insert their name in text under the word 'Drawing' and 'Checked' in the title block.

### 1.2.3.3 Design & Verified

The meaning of the word 'Design' in the title block is that reasonable skill, care and diligence has been exercised by the external consultant or internal business unit in carrying out the design in accordance with the ethics of the engineering profession, main roads Drafting and Design Presentation Standards Manual and includes:

- The appropriateness of the designed components for their intended function,
- The design complies with the relevant legalisation, codes, standards and references,

# 1

- The design has been carried out in accordance with the consultant's fully certified Quality System that complies with AS/NZS ISO 9001-2000.
- The appropriateness of design inputs, including assumptions,
- The appropriateness and accuracy of the design calculations,
- A road safety audit has confirmed that the safety aspects of the design satisfy Main Roads standards,
- The relevant environmental issues have been appropriately considered in the design, including the long term impact of the constructed works on the environment,
- The design is an economical solution,
- The design details have been reviewed for constructability appropriate to the relevant construction site,
- The overall design solution is appropriate for the problem being solved, and
- The constructed infrastructure will achieve the required operational performance outcomes.

The key person responsible for the design must insert their name in text under the word 'Design' in the title block.

The meaning of 'Verified' is the checking of the results at the end of the design process meets the customer's requirements.

There are many acceptable verification methods, such as:

- Independent calculations by another person(s),
- Performing alternative calculations;

- Comparing the new design with a similar proven design (if available),
- Undertaking tests and validation by computer simulations, and
- Reviewing the design stage documents before release.

The person responsible for verifying the 'Design' must insert their name in text under the word 'Verified'.

#### 1.2.3.4 Design Review

Design review is the formal checking of the design to confirm its adequacy to meet the customer's needs i.e. Project Proposal (the need or problem articulated) and Functional Specification, and other design inputs (Design Considerations and Technical requirements – Form M4211 or M4212), to identify problems and to develop solutions.

Design Review process must include other people that represent the full spectrum of the development and implementation process.

In the above context the meaning of the words 'Design Review' is to confirm:

- The design conforms to the customer's needs (confirmed through regular project meetings between the principal and consultant),
- The overall design solution is appropriate for the problem being solved,
- The information supplied (engineering drawing and electronic project model) is appropriate for project tendering purposes,
- The information supplied (engineering drawing and electronic project model)

is appropriate for project construction purposes,

- The constructability of the project has been assessed and confirmed as being appropriate for the site concerned,
- Design interfaces between different design disciplines have been checked for functionality and technical interfacing matching,
- Any unusual features of the design have been duly considered and/or referred for specialist advice/determination as appropriate,
- The design has been verified, and
- The quality of design and documentation is appropriate for its intended purpose.

The key person responsible for the design review must sign their name and insert their name in text under the words 'Design Review' in the title block.

#### 1.2.3.5 Engineering Certification

Key requirements of the *Registered Professional Engineers Act 2002* (The Act), is to require:

- All professional engineering services under the (The Act) to practice only in their area of qualification and competencies.
- The relevant code(s) of practice under the (The Act) to be complied with in the carrying out of the professional engineering services.
- Compliance with government legislation such as the *Workplace Health and Safety Act, 1995*.
- The work to be designed by or under the supervision of a registered professional engineer Qld. in accordance with Australian Standards,

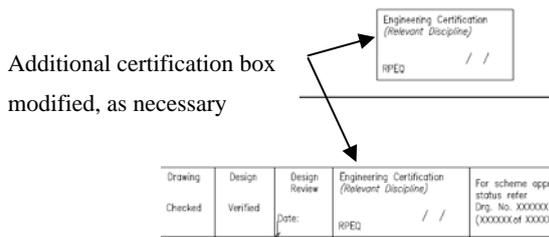
Main Roads standards and good building practice.

The board of Professional Engineers accepts an RPEQ may delegate the inspection of work to a non-RPEQ but under the direct (one on one with no intermediary) supervision of the RPEQ. However, ultimately RPEQ's must exercise their judgment to determine if the delegate is competent to undertake the work (includes design and inspection), as the RPEQ will retain liability for the consequence arising out of the certification they provide based on that certification.

It is the responsibility of the engineering organisation concerned to ensure the requirements of (The Act) are satisfied. In addition, Main Roads require engineering drawings to be certified by the relevant Registered Professional Engineer Queensland (RPEQ).

Disciplines of civil, structural, electrical and other specialist areas of engineering will provide RPEQ certification appropriate for that part of the design on each relevant drawing i.e. the relevant RPEQ must sign and place their registration number under 'Engineering Certification' in each drawing Title Block. The RPEQ number must be clearly shown and can be hand written or typed.

Where more than one discipline occurs on a single drawing then an additional certification block is provided and modified to show each relevant discipline.



### 1.2.3.7 Non-Compliance with Design Standards

Aspects of design that do not comply with the requirements of Main Road Standards must be submitted to the Director (Road Planning and Design) for specialist approval before being incorporated into the design.

## 1.3 Computer Software for Road Design

Computer programs should be used as tools to assist in the road design development process. They must not be considered in the context of automated design systems. The great strength of computers is in their ability to accurately and quickly perform many numbers of calculations. This in turn allows alternative design options to be quickly examined and evaluated at a relatively low cost with full designer control of outcomes.

Most road authorities in Australia restrict the software packages that can be used to produce planning and design projects. This is because of interoperability issues, software purchasing cost, macro development cost and the on-going training cost. Main Roads has adopted the 12d Model software as its standard for the delivery of all Main Roads projects from survey through planning, design, tendering, construction, as constructed and archival activities.

The primary function of road design software is to support the design development process, including the production of:

- Geometrics
- Quantities

1

As constructed drawings must record any significant changes to the design detail/intent/functionality made during the construction period. These changes together with any resulting changes to the design intent/functionality of the original design must be certified by relevant RPEQ(s) in the revision area of the drawing sheets title block by initials and RPEQ number.

Revisions		Certified	Date	Microfiled	At
B	Description of revision	Initials			
A	Original Issue A1/A3	RPEQ No.			

CAD FILES: \\MR10150733\Drawing1.dwg; Layout: Layout1

### 1.2.3.6 Design Standards/ Requirements

Designs must fulfill the stated and implied requirements of the project proposal and the functional specification or brief and comply with the requirements of relevant Codes of Practice and Australian Standards.

The long-term maintenance of structures (e.g. Bridges) and civil works (e.g. Drainage) are serious issues for the department. The design must incorporate good design practices that minimise future:

- environmental damage, and
- maintenance requirements of the completed works.

- Drawings
- Project Electronic Model

Production of an electronic project model that assists in:

- checking all aspects of the design in a three dimensional model viewing
- validation of the design through traffic simulation activities to confirm the required traffic performance outcomes are being achieved.
- visualising the proposal in the community engagement process
- verification to confirm design aspects on a progressive basis
- supplying accurate construction information, including electronic information for GPS guided road plant
- production of contract drawings
- production of cross sections at any scale, frequency or skew
- integration of design variations during construction, and
- production of as constructed drawings from the electronic model

For straight forward restoration projects with minimal survey input it may not be appropriate to try and create an electronic model.

## 1.4 Functional Drafting

Functional drafting refers to a technique that eliminates all unnecessary detail while maintaining the full clarity, completeness and accuracy of the finished drawing without being subject to variable interpretation. The use of rectified aerial photography as the backdrop for engineering survey used in

the planning and/or design process is one method of achieving this approach. This is because the impacts of the design process (either immediate or surrounding) are immediately recognisable without the need for further detailing. This manual exploits the functional drafting approach in the text and example figures/drawings throughout this manual.

Functional drafting should be an output from electronic models

### 1.4.1 Use of Coloured Drawings

Colour drawings may be used where it is necessary to provide improved readability of the drawings. The use of standard line styles and features will in most cases avoid the need for colour drawings. However, where additional information is required to be added such as traffic management and stage construction scenarios, or in cases of very complex detail then the use of colour drawings should be seriously considered as colour significantly enhances quality and readability.

Most benefit achieved from using colour is the additional means of separating types of functional detail or objects. Colour does help to distinguish material from dimensions from elements/shapes also supported by different line weight.

In addition, drawing quality is improved together with improved project communication due to the removal of uncertainty in the understanding of the drawings.

### 1.5 Use of Consultants LOGO

The consultant responsible for preparing the drawings may include their Logo on

the drawings, provided the Logo does not occupy an area on the drawing greater than that occupied by the Main Roads Logo. In addition, where the consultant decides to include its logo on the drawing then it must be inserted in the top right hand corner of the drawing sheet.

disciplines, e.g. bridges, traffic signals, etc. Once the design has been checked via the electronic project model, the projects engineering drawings can then be produced directly from this model. This process is designed to achieve a good engineering input and to avoid errors in engineering drawings.

Visualisation drawings can also be produced to assist tendering and constructors to identify what they have to build.

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## 1.6 Requirements for Tendering and Construction

### 1.6.1 General

A set of project drawings must contain the engineering information that supports the key functions of:

- Setting out the works
- Ordering material
- Identify available work areas
- Support tendering processes for constructors
- Planning construction methods and to seek opportunities to optimise construction activities and processes
- Working of materials
- Inspect and control construction quality and reliability
- How to Construct (e.g. traffic management during construction)
- Determine costs
- Facilitate construction material quantity calculations

### 1.6.2 Electronic Models and Engineering Drawings

The attributed electronic model is becoming a standard method to check the design together with its interfaces with the site and various design interfaces, and between design

### 1.6.3 Providing Construction Information

Construction personnel invariably have their own discrete methods for setting out and constructing the works. Attempting to preempt the method that will actually be used and then providing aligned detail in the drawings is quite futile. History has demonstrated this fact by the rework that has been required to suit another method when someone else ends up performing the work. The electronic model allows construction personnel to produce the requirements they actually need to do their work.

Individual constructors can produce a range of information to suit their particular requirements e.g. cross sections from the electronic model at any chainage, interval, scale (including distorted scales), or at any skew angle, all on command.

There is no requirement to produce cross section drawings for inclusion in scheme documents on the basis it is what construction crews actually require. Because construction contractors have their own computers and plotters they can produce the cross

sections or any other information they actual require to suit their own operational processes whether it be for tendering or construction purposes.

#### 1.6.4 'Schedule of Quantities' for Tendering and Construction

The practice of the Main Roads providing a 'Schedule of Quantities' (Schedule) introduces contractual risks as it may cause a "blurring" of the contractor's responsibility for construction in the event of the quantities not agreeing with the details shown in the drawings. A high level of claim and disputation occurs in relation to the (Schedule) as a result of errors and omissions in the (Schedule) when compared to the drawings and specifications. Designers must recognise the contractual importance of the (Schedule) as it could lead to a shift in the contractor's responsibility which opens up the potential for claims and disputes.

When preparing a (Schedule), adequate time and appropriate resources must be made available to carry out the task. The preparation of the (Schedule) should provide the following benefits:

- The method of measurement should be specified or agreed,
- Detailed measurement should reveal and result in rectification of ambiguities and discrepancies in drawings and specifications, which in turn will reduce claims and disputes,
- The provision of a (Schedule) is a requirement of tendering,

- A (Schedule) provided to tenderers provides a common basis for tenderers and could eliminate errors which tenderers might make in preparing their own quantities (it also reduces risks to the contractor).
- Preparation of quantities by individual tenderers could result in increased overheads and thus in increased tender prices to the client,
- A (Schedule) assists in valuing progress claims and in pricing variations,
- A (Schedule) provided to tenderers assists tenderers in obtaining prices from subcontractors, and
- In construction management situations, a (Schedule) can assist in finalising trade packages let on a provisional basis to sub-contractors.

#### 1.7 Risk Management of Document Quality

Design is an intuitive and interactive process making the best use of available information at any point in time. Many decisions have to be revisited as a result of subsequent stakeholder involvement, additional studies, and changing circumstances. This invariably results in rework of the actual design and its documentation. Risk occurs in a range of circumstances with the common sources being:

- The depth of particular information/knowledge,
- Changing community views, and
- The impacts from emerging developments.

Because project drawings are invariably progressively produced, changes in the

design need to be reflected in the drawings to avoid future claims and disputes during construction. It is therefore extremely important for the designer to appropriately manage these risks during the design process by ensuring the final design is appropriately detailed in the drawings.

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Where these risks cannot be fully mitigated, provision must be made for them in the contract documents as either a provisional item or covered by a contingency amount should they actually eventuate? To include instructions in the contract documents (drawings and/or supplementary specifications) to transfer these risks to the construction contractor is not acceptable.

The emerging development and use of electronic project models has the potential to produce engineering drawings. This requires a design change to be included in the model with drawings being an output available on demand.

## 1.8 Drawing Documentation

Drawing documentation provides the basic elements for tenderers and construction personnel to carry out their respective activities.

### 1.8.1 Engineering Surveys

Engineering surveys supply the feature and terrain information used as the basis for design development. This information may be acquired by:

- Field surveys
- Photogrammetry from varying scales of aerial photography
- Airborne Laser Scanning

Each method will have different accuracy and content characteristics and the designer needs to read any accompanying Meta data to determine the suitability of the survey information for the purpose.

As design development progresses it is a common place for additional surveys to be required to meet specific circumstances required by the advancing development of the planning/design.

### 1.8.2 Aerial Photography

Aerial photography provides a number of products that can be used in the design process. These products range from the prints at the capture scale, enlargements, rough hardcopy and digital mosaics to digital orthorectified imagery. Orthorectified imagery provides a true to scale image that can be used as a background for the design. The imagery shows the existing state (features) within and surrounding the design project area.

### 1.8.3 Standard Drawings

Standard Drawings have been developed to reduce the number of details that have to be shown in the project drawings.

These standard drawings are provided in the departments Standard Drawings (Roads) manual and are updated on a regular basis.

The manual contains a number of drawings which provide standardised construction details for selected road related structures including Drainage, Retaining Structures and Protective Treatments, General Earthworks, Road

Furniture, Noise Barriers, Road Lighting, Traffic Signals and Bridges.

#### 1.8.4 Design Presentation Drawings

- Road Infrastructure Design

Road infrastructure design drawings diagrammatically show the actual extent and types of treatment necessary to provide for both horizontal and vertical alignments of specific infrastructure profiles.

- Bridges

Bridge design drawings show the general layout of the bridge, profiles and structural details. Bridges are typically built over streams, railways or other roads.

The structural details include reinforcement size, spacing and location as well as stressing and welding symbols. These drawings also specify the exposure classifications for durability. In complex structures, there may also be construction sequence drawings to ensure that the imposed design loads are the same as the designer assumed.

- Retaining Walls

There is a large range of types of retaining wall. The choice of retaining wall may depend on appearance, environment, construction restraints and structural action. Care should be made in the correct choice of system for the project. In urban situation, the job restraints may impact severely on the choice of system

The road designer should consider the maximum depth of excavation for road

construction and the impact of this excavation on the retaining wall.

- Noise Barriers

Noise barrier walls and earth mounds are a very effective means of reducing road traffic noise if designed and constructed to the requirements of the Noise Code of Practice.

Noise barrier drawings are to depict, construction detail and consider all design elements of the proposed noise barrier including, location, height and length as determined from an approved noise assessment report

These drawings are to refer to other relevant Standard Drawings and Standard Specifications as they relate to the project specific requirements.

- Drainage Devices

'Drainage Devices' are components of a project that are designed and constructed for the purpose of controlling runoff and form part of a 'Drainage System'. A 'Drainage System' is a system of natural and constructed pathways that are used to convey runoff through a project site to its receiving waters.

Examples of drainage devices are: culverts, gully inlets, pipes, drainage system, overland flow paths, open channels, energy dissipaters, kerb & channel, sedimentation traps and retention & detention basins.

Water flows as a result of fall in the ground i.e. a negative level difference between two points. Therefore with regard to drainage devices, the most important details that have to be shown in design drawings are the heights to which the devices are to be constructed.

Other details that are required are:

- Plan views to clearly show location and orientation of devices and the linkage between them, e.g. the outlet of a culvert linking to a diversion channel then to a retention basin.
- Drainage Cross Sections to clearly show the position and design details of cross drainage (culverts).
- Longitudinal Sections to clearly show the position and design details of underground piped systems, in conjunction with gully inlets and pits.
- Construction details (dimensions etc) for drainage devices which cannot be simply purchased and have to be built, e.g. open channels, scour protection and drop inlets.
- A complete project electronic model will provide all of the details necessary to tender and construct the drainage structure concerned.

### 1.8.5 Urban Design

Urban design, promotes an integrated relationship between the road user, roads and the environment (location, function and character), through which they pass. The functional, architectural and aesthetic forms and treatments for selected road related structures and elements demonstrate this integration.

Urban design documentation is typically associated with structures, including bridges, retaining walls, and noise barriers, but may be delivered by various design disciplines including landscape architects, engineers and architects.

### 1.8.6 Environmental Design

The environmental design drawings are divided into two phases

- the planning phase and
- the development phase

The drawings in each phase contain the information relevant for that stage of the project.

- Environmental Features and Management Drawings

Environmental features and management drawings show the existing environmental features and the recommended management of these features to ensure compliance with legislation.

These drawings are on large-scale and/or complex projects.

These drawings are a diagrammatic representation of the environmental assessment taken from such documents as an Environmental Impact Statement (EIS), Environmental Approval Report (EAR) and/or an Environmental Management Plan (EMP).

- Soil Suitability Drawings

Soil suitability drawings show the suitability of a site soil for use as planting media and for the construction of drainage devices.

The drawings diagrammatically show the extent and types of soil along a road alignment and relate to the Planting Media Management Plan.

- Erosion and Sediment Control Plan Drawings

A Sediment and Erosion Control Plan Drawing shows a possible approach for Sediment and Erosion Management.

The drawing is included in contract documentation so that tenderers can use it as a basis for pricing. After the contract has been awarded the contractors can choose to adopt the drawing/s or develop their own.

- Environmental Management Plan (Construction) Drawings

Environmental Management Plan (Construction) Drawing shows the environmental risks associated with the construction of a project.

The standard sets out what must be contained on the drawings but allows the option that information is shown on drawings and diagrams as opposed to just text. EMP(C) drawings are not intended to replace a text-based document but to provide an efficient means of conveying information.

- Landscape and Revegetation Drawings

Landscape and revegetation drawings show the scope and extent of landscape and revegetation works.

The scope may be as simple as the grassing and turfing of batters and table drains or as complex as the revegetation of environmentally sensitive areas or the more horticultural based landscape projects that are typical of the major urban roadways.

- Compensatory Revegetation Drawings

Compensatory revegetation drawings show the scope and extent of landscape and revegetation works specifically intended as compensatory plantings beyond the limit of clearing. They are separate, but complementary to the landscape and revegetation works that

typically include the vegetations of areas within the limit of clearing.

The planting areas typically fall within the road reserve but may, in some instances where local landowners and/or the community are involved, extend into adjoining properties. The works may be contracted separately to the associated road contract and start during the pre-construction phase of a project and continue after final inspection into the maintenance activities.



# 1