



# **BRC WATER SERVICES ELECTRICAL DRAWING STANDARD**

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## **Revision History**

<b>Rev.</b>	<b>Date</b>	<b>Reviewer</b>	<b>Checked</b>	<b>Description</b>
0.1	22/07/2014	Allan Quach		First draft for review.
0.2	29/07/2014	Allan Quach		Drawing specification amendments
1.0	08/09/2014	Allan Quach	Richard Collins, Tawfik Shehata	Initial Issue
1.1	17/09/2014	Allan Quach		The layer 'Symbol' is now 'Symbols'
1.2	23/09/2014	Allan Quach		Updated document template for IMS
1.3	17/06/2020	T. Stenner		Minor Changes
1.4	18/06/2024	T.Stenner	C.Niehoff	Review and update to industry standards.
1.5	7/05/2025	T.Stenner	A.Johnston	Minor format changes

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## **1. Introduction**

BRC Water Services is responsible for operation and maintenance of an extensive amount of engineering infrastructure.

This standard has been developed to assist in the design, maintenance, construction, and management of this infrastructure.

## **2. Purpose**

The purpose of this standard is to detail minimum requirements to ensure that assets are constructed and maintained to consistent standards and attain their economic asset life.

## **3. Scope**

This Technical Standard details the requirements for production and submission of Engineering drawings, created or modified for BRC Water Services. This document applies to the Computer Aided Design (CAD) drawings and the drawings outputted from them.

This Standard Technical Specification details the requirements for the production or modification of electrical drawings for the Bundaberg Regional Council (BRC).

All electrical drawings supplied to the BRC are to conform to the requirements of this document.

## **4. Compliance with Standards**

All drawings shall comply where applicable with BRC Water Services discipline specific standards, this standard and relevant Australian Standards.

- AS 1000 - The International System of Units (SI) and its application
- AS 1100 - Technical Drawing
- AS 1101 - Graphical Symbols for General Engineering
- AS 1102 - Graphical Symbols for Electrotechnology Documentation
- AS 3702 - Item Designation in Electrotechnology
- AS 4383 - Preparation of Documentation used in Electrotechnology.
- AS 60417 - Graphical Symbols for use on Equipment

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## **4.1 RPEQ**

All drawings provided by external consultants; contractors shall be certified by RPEQ prior to submission.

## **4.2 Typical and Standard Drawings**

BRC Water Services has created Typical and Standard drawings, which encompass some commonly installed infrastructure. Some of these drawings' pre-date this technical standard, however if these drawings are used as a base for project specific drawings, then the new drawings shall comply with this standard. Typical drawings can be provided upon request.

It is the responsibility of whoever is creating / modifying a drawing to ensure that the latest versions of these documents are used.

## **4.3 Existing Non-Compliant Drawings**

In some instances, there may be a requirement to work on or modify existing or legacy drawings that do not conform to the current standard. Drafting protocol is to maintain the standards that were applied at the time of drawing creation, unless major modifications to the content are required or a conflict with symbology (e.g. P&ID, Electrical, and Process Flow) is introduced.

BRC Water Services does not require that an existing drawing is migrated onto the current title block when being modified unless more than 50% of the drawing content is being modified.

# **5. General CAD Requirements**

All new 2D drawings for BRC shall be prepared and submitted in AutoCAD® release 2018 .dwg format or earlier unless approval is given prior to commencement of any drafting work.

If another package is to be used for the preparation of 2D drawings, the native CAD file along with an AutoCAD® conversion (where available) shall be provided.

## **5.1 Plot Style**

Drawings shall be printed in monochrome unless there is a specific requirement to show coloured line work. If a drawing is printed in colour, lighter colours such as yellow and cyan shall be avoided.

## **5.2 Sheet Size**

All new drawings produced for BRC Water Services shall be presented on the current BRC title block. All drawings shall be A3 landscape unless prior arrangements are made. The title block shall

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not be modified or exploded, and the latest version can be provided upon request. All drawings shall be legible when plotted / printed at A3 size.

### **5.3 Referencing**

External electronic referencing is not permitted in drawings. An example of this would be an image in the drawing which depends on the image file being in the same directory as the drawing file. In this case the image must be directly inserted into the drawing.

Any Xref linked drawings shall be bound into the drawing/s in which they are used before provision to BRC, such that the provided files are stand alone.

### **5.4 Model Space and Paper Space**

All electrical drawings are to be drawn in model space with a scale of 1:1, in millimetres.

The title block or drawing frame shall always remain in paper space, using viewports to show model space. Viewports are to be scaled appropriately so that the drawing can fill the viewport and the scale shall be displayed in the title block.

Model space and Paper space backgrounds are to be black. Electrical schematics must be drawn to the grid.

## **6. Drawing Borders**

Contractors have the option to use their own boarder with the company logo and contact details. If the contractor chooses to utilise the BRC border, the most current version is to be used and they must still insert their company logo and contact details.

Borders must remain as a block and not exploded and are to be inserted in paper space at location 0,0,0.

### **6.1 Drawing number**

A request shall be made to the BRC design department, for allocation of a unique internal drawing number for each drawing provided.

Each drawing supplied to BRC can have a unique drawing number allocated by the contractor, however the BRC number shall be used for file naming and transmittals.

### 6.1.1 BRC Plans Register

Drawings and Documents which have received a BRC number must be sent to **Infrastructure Assets** via [engineering@bundaberg.qld.gov.au](mailto:engineering@bundaberg.qld.gov.au) in both native formats, e.g. DWG and printable PDF formats, for upload onto the BRC Plans Register. An template document register can be provided upon request to facilitate this.

## 6.2 Drawing Title

The drawing title determines the indexing of the drawing in the BRC Plans Register. It is vital to allocate accurate descriptions for the drawing title so that the drawing can be easily found on the BRC Plans Register when required. Table 1 gives an example of a drawing title for a Pump Station and Table 1 gives an example of a drawing title of a Treatment Plant.

**Table 1: Treatment Plant drawing title example**

Format	Example
Locality - Facility	Millbank - Sewer System
Title Line 1	Millbank Wastewater Treatment Plant
Title Line 2	Chlorine & Dosing Building
Title Line 3	Electrical Schematic

## 6.3 Drawing Revision

See Modification to Drawings.

## 6.4 Drawing Signatories

Only the abbreviated names (initials) are to be used as required on drawings. Table 2 shows signatories found on BRC drawings.

**Table 2: Signatories found on BRC drawings**

Signatory	Description
Designed By	The initials of the designer. The date which the designer has given certification.
Drawn By	The initials of the drafter. The date which the drafter has completed the drawing.
Design Checked By	The initials of the checker. The date which the checker has verified the drawing. The

	checker is typically not the same person as the designer.
Approved	The initials of the approver. The date which the approver has confirmed that the drawing is ready to be issued for use. The approver is typically not the same person as the designer and checker.

## 7. Modification to Drawings

During the design/review stage (pre-construction), drawings are to be given a sequential letter starting with A.

When the drawing reaches the construction stage it must be given the number 0. Further revisions to the drawing after the construction stage are to be given a sequential number after 0. Table 3 shows an example of a drawing revision history.

**Table 3: Example of a drawing revision history:**

Revision	Description
A	Preliminary Issue
B	For Review
0	For Construction
1	Added Wire Numbers
2	As Built

When a revision involves a drawing change, it must have the change highlighted with a cloud. Clouds from previous drawing revisions must be removed.

## 8. Drawing Specifications

All objects existing on drawings must be assigned to layers. Layers must globally control the object colour in AutoCAD and plot style of the objects.

## 8.1 Text Styles

All text must be horizontal and uppercase except for abbreviations for engineering units.

Engineering units must be SI standard. DText and MText are acceptable. Table 4 defines the acceptable text styles.

It is permissible to use smaller fonts to enable good drawing presentation. In these cases, the minimum size is 2.5 mm, providing that the drawing is legible when plotted / printed at A3 size. 1.8mm (A3) is permissible in Electrical Drawings.

**Table 4: Acceptable text styles**

Text Height	Layer	Colour	Font	Width
1.75mm – Wire Colour, Wire Sizes	TextWire	By Layer	Iso3098b	0.85
2.5mm	Text25	By Layer	Iso3098b	0.85
2.5mm – Wire References	WireRef	By Layer	Iso3098b	0.85
3.5mm	Text35	By Layer	Iso3098b	0.85
5mm	Text50	By Layer	Iso3098b	0.85
7mm	Text70	By Layer	Iso3098b	0.85

## 8.2 Line Types

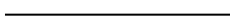
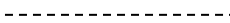
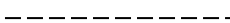
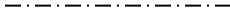
Line styles applied to drawings shall conform to Australian Standard AS 1100 and industry standards. Where possible all line work should use standard AutoCAD® line styles. If a custom line style is to be used, then a copy of the line type file (\*.lin) shall be provided. Globally LTSCALE should be set to 1.

All line properties – Colour, Line weight and Line Type shall be set to ByLayer.

Lines must belong to defined layers. Lines are not to be broken to simulate other line types.

Different line types must be achieved through line properties. Table 5, defines the acceptable applications for each line type.

**Table 5: Acceptable applications for line types**

Line Type	Application
Continuous 	Solid Lines Visible outlines of objects and components General details and symbols Dimension lines, projection lines and leaders Intersection and bend lines General purpose electrical circuits Hatching line work
Hidden  (Dashed Line Type Scale 10)	Hidden outlines and edges of objects To group several devices in one area Cable runs on electrical arrangements and site plans Objects or material to be removed
Dashed  (Dashed Line Type Scale 20)	Field wiring lines
Centre  (Dashed Line Type Scale 10)	Centre lines and axis of components, solids, holes, hole groups and services Cutting planes

### 8.3 Layers

Utilise only the following layers as defined in Table 6 for electrical drawings.

**Table 6: Acceptable layers**

Layer Name	Colour	Line Type	Line Weight	Description
0	White	Continuous	Default	Not used
Defpoints	White	Continuous	Default	Not used
Dim	White	Continuous	Default	Dimensioning
Pen25	Yellow	Continuous	0.25mm	Control Circuit
Pen35	Red	Continuous	0.35mm	Construction outlines, Relay outlines
Pen50	Blue	Continuous	0.50mm	Power Circuit
TextWire	White	Continuous	0.25mm	Wire Numbers
TextReference	Yellow	Continuous	0.25mm	Component Reference
Text25	Yellow	Continuous	0.25mm	Text only
Text35	Red	Continuous	0.25mm	Text only
Text50	Blue	Continuous	0.25mm	Text only
Text70	White	Continuous	0.25mm	Text only

Symbols	White	Continuous	0.25mm	Symbols and Associated Text
Viewports	Magenta	Continuous	Default	Viewport (Disable Plot)

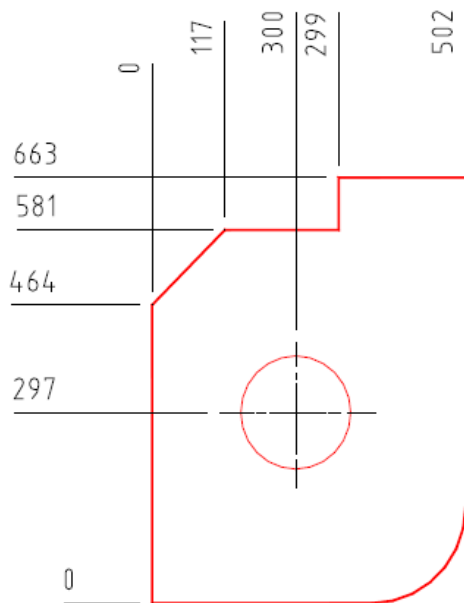
## 8.4 Dimensioning

Dimensions shall be in accordance with Australian Standard AS 1100.

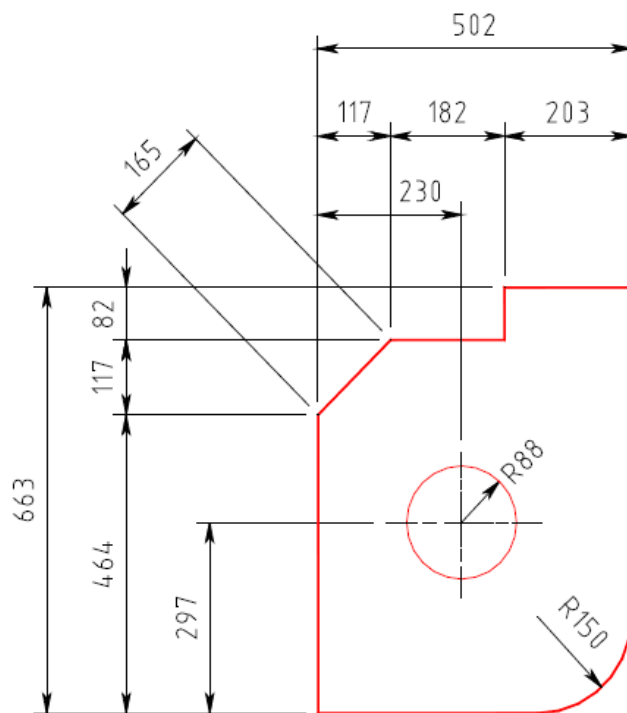
Linear dimensions should be in millimetres and angular dimensions in decimal degrees unless industry standards for that drawing type differ, in which case the industry standard shall take preference.

Dimensions shall not be exploded.

Solid arrowheads are to be used to terminate a dimension or leader line. Align dimension text parallel to the dimension line as shown in the Figure 1 and Figure 2 below.



**Figure 1: Incorrect dimensioning**



**Figure 2: Correct dimensioning**

## 8.5 Blocks and Symbols

The standard BRC symbol set must be utilised and can be obtained from the BRC design department. Where a symbol required is not available from the standard BRC symbol set, obtain approval from the BRC design department before the use of the symbol. If new symbols are required to be drawn, they must be created on the layer "Symbols" with their attributed tag name and reference. Approved new symbols can be sent to the BRC design department for addition to the standard BRC symbol set.

External drawings must use symbols which conform to AS 1102.101 – AS1102.113.

Do not create blocks on any other standard layer. Do not insert blocks with different X & Y scales.

Blocks must be inserted at the same scale every time they are used (i.e. x=1, y=1).

## **8.6 Hatching**

Use standard AutoCAD defined hatch patterns for all shading requirements. Do not explode hatching patterns.

## **8.7 Grids and Grid Snap**

Grid must be turned on for electrical drawings. All wires must snap to the grid. A grid of 5.0mm and a snap of 1.25mm shall be used to ensure all sectors align correctly.

## **8.8 Scaling**

All electrical engineering drawings are to be drawn at a typical scale of 1:1. Construction and layout drawings of electrical panels will also be 1:1 scale but may be scaled using viewports in paper space.

The scaling factor must be mentioned in paper space in the view port or the boarder.

# **9. Technical Presentation**

Electrical circuits are to be drawn with the circuit ladder rungs horizontal. Vertical ladders must not be used without prior BRC approval.

## **9.1 Wire Numbering**

All wires on the drawings must be numbered. BRC utilises two separate wire numbering systems based on the size of the electrical installation. Wire numbers are to be placed on the associated layer using the standard text style 'Wire'.

### **9.1.1 Small to Medium Installations (e.g. pumping stations)**

Wire numbers will contain two fields as per the example below.

An example of a wire number from a pump station schematic

- 075a The second wire on line 075.
- 075 “Field 1” denotes the line number the wire resides on.
- a “Field 2” is utilised when there are multiple wires on the same line.
- “075” for the first wire
  - “075a” for the second wire
  - “075b” for the third wire
  - Note: that **i** and **o** are not used.

### 9.1.2 Large Installations (e.g. treatment stations)

Wire numbers will contain three fields as per the example below.

An example of a wire number from a treatment plant schematic

- 002075a The second wire on line 075 on drawing 002 of the drawing set.
- 002 “Field 1” denotes the drawing sequence number of the drawing set.
- 075 “Field 2” denotes the line number the wire resides on.
- a “Field 3” is utilised when there are multiple wires with the same line reference.
- “075” for the first wire
  - “075a” for the second wire
  - “075b” for the third wire
  - Note: that **i** and **o** are not used.

## 9.2 Wiring Colour Code

**Table 7: All wiring shall be colour coded as follows.**

<b>AC Power</b>	<i>As per AS 3000</i>	<i>Red, White, Blue, Black.</i>
<b>AC</b>		
240VAC control	<i>Active</i>	<i>Red</i>
	<i>Neutral</i>	<i>Black</i>
24VAC control	<i>Positive</i>	<i>Brown</i>
	<i>Negative</i>	<i>Black</i>
<b>DC</b>		
24VDC Control	<i>Positive</i>	<i>Brown</i>
	<i>Negative</i>	<i>Black</i>
12VDC Power	<i>Positive</i>	<i>Red</i>

	<i>Negative</i>	<i>Black</i>
<b>Control Analogue Signals</b>	<i>White</i>	
<b>Control Digital Signals</b>	<i>Orange</i>	
<b>CT Secondary</b>	<i>Grey</i>	
<b>Earth</b>	<i>Green/Yellow</i>	
<b>Insulated Screen and Functional Earth</b>	<i>Clear or Black</i>	

### 9.3 Component Identification

Refer to AS 3702 for the item type designation of electrical components. Commonly used item type designations can be seen in table 8.

A prefix of ‘-’ is to be used in front of the item type designator.

**Table 8: Commonly used item type designations**

<b>Letter Code</b>	<b>Kind of item</b>	<b>Examples</b>
<b>A</b>	Assemblies, subassemblies	Amplifier, Assembly, Laser
<b>B</b>	Transducers	Pressure Transducers, Level Transducers, Current Transducers, Voltage Transducers, Power Transducers
<b>C</b>	Capacitors	
<b>D</b>	Binary Element, Storage Devices	
<b>E</b>	Miscellaneous	Heater, Lighting Element
<b>F</b>	Protection Devices	Fuse, Thermal Overload, Surge Arrestor
<b>G</b>	Generators, Power Supplies	Battery, Generator
<b>H</b>	Signalling Devices	Indicator, Siren, Hooter, Strobe Light
<b>K</b>	Relays, Contactors	Relays, Contactor, Timer, Multi-Function Protection Relay
<b>L</b>	Inductors, Reactors	Induction Coil, Line Trap, Reactors
<b>M</b>	Motors	AC Motor, DC Motor
<b>N</b>	Analogue Elements	
<b>P</b>	Measuring Equipment, Testing Equipment	Ammeters, Voltmeters, Power Factor Meters, kWh Meters, Integrated Metering Packages, Time Clock

<b>Q</b>	Switching Devices for Power Circuits	Circuit Breakers, Isolating Switch
<b>T</b>	Transformers, Voltage Regulators (power)	Current Transformer, Voltage Transformer, Earth Leakage Toroid, Control Transformer, Power Transformer
<b>U</b>	Modulators, Changers	AC to DC Power Supply, DC to DC Converter, Variable Speed Drive, Invertor, Converter, Uninterruptible Power Supply, Modem
<b>V</b>	Tubes, Semiconductors	Diode, Semi-Conductor
<b>W</b>	Transmission Paths, Waveguides, Antennas	Busbar, Cable, Aerial
<b>X</b>	Terminals, Plugs, Sockets	Disconnecting Plug, Test Jack, Plug, Socket
<b>Y</b>	Electrically Operated Mechanical Devices	Brakes, Clutches, Solenoid Valve
<b>Z</b>	Networks, Hybrid Transformers, Filters, Equalizers, Limiters	Hybrid Transformer, Limiter

### 9.3.1 Small to Medium Installations (e.g. pumping stations)

Electrical components will have labels consisting of three fields as per the example below.

An example of a component label from a pump station schematic

-Q006a      The second circuit breaker on line 006.

-      Identification of item (designation block).

Q      “Field 1” item type designator (see table 8).

006      “Field 2” denotes the line number the component resides on.

a      “Field 3” is utilised when there are multiple components of the same type with the same line reference.

- “006” for the first component
- “006a” for the second component
- “006b” for the third component
- Note: that **i** and **o** are not used.

### 9.3.2 Large Installations (e.g. treatment stations)

P&ID components will be labelled as per the BRC Wastewater Treatment Plant Piping & Instrumentation Diagram standard.

Other electrical components will have labels consisting of four fields as per the example below.

An example of a component label from a treatment plant schematic

-Q001006a The second circuit breaker on line 006 on drawing 001 of the drawing set.

- Identification of item (designation block).

Q “Field 1” item type designator (see table 8).

01 “Field 2” denotes the drawing sequence number of the drawing set.

006 “Field 3” denotes the line number the component resides on.

a “Field 4” is utilised when there are multiple components of the same type with the same line reference.

- “006” for the first component
- “006a” for the second component
- “006b” for the third component
- Note: that **i** and **o** are not used.

## 9.4 Line Number Designator

#### 9.4.1 Small to Medium Installations (e.g. pumping stations)

The following line numbers are to be used.

**Table 9: Sheet number – Line number relationship**

Sheet Number	Line Numbers to be Used
001	001 to 033 inclusive
002	034 to 066 inclusive
003	067 to 099 inclusive
004	100 to 133 inclusive
005	134 to 166 inclusive
006	167 to 199 inclusive
007	201 to 233 inclusive
008	234 to 266 inclusive
009	267 to 299 inclusive
010	301 to 333 inclusive
011	334 to 366 inclusive
012	367 to 399 inclusive
013	401 to 433 inclusive
014	434 to 466 inclusive
015	467 to 499 inclusive

#### 9.4.2 Large Installations (e.g. treatment stations)

Each drawing in the drawing set will utilise line numbers 001 to 033 inclusive. The same line numbers can be used on every drawing in the drawing set as referencing for large installations incorporates the drawing number sequence field.

## 9.5 Terminal Strips

### 9.5.1 Small to Medium Installations (e.g. pumping stations)

Terminals will be labelled as per the example below.

An example of a terminal label

- X2:1            Terminal 1 of terminal group 2.
- Identification of item (designation block).
- X                “Field 1” item type designator.
- 2                “Field 2” denotes the terminal group.
- :
- 1                “Field 3” denotes the terminal number.

**Table 10: Terminal Group Preferences**

Terminal Group	Reserved For
1	CT/VT Wiring
2	External Wiring
3	PLC Wiring
4 onwards	Other

### 9.5.2 Large Installations (e.g. treatment stations)

Due to the large volume of terminals, the labelling convention will vary throughout the drawing set and must be reviewed by BRC.

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## **10. Completed Drawings**

### **10.1 Final Drawing Settings**

The following must be fulfilled at completion of a drawing.

1. Set Layer to '0'
2. Purge Drawing.
3. Insert electronic file name obtained from the BRC design department.
4. If drawing is external, the company logo must be inserted into the title block.
5. Save drawing at the first paper space tab at "ZOOM EXTENTS".