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TOWNSHIP OF KING
CAD Conversion Standards

For the production of AutoCAD Drawings

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CAD Standards

For the production of AutoCAD Drawings

1. About this document

This document describes the standards and procedures used to develop a set of engineering contract drawings in AutoCAD for the Township of King. The Township of King's CAD Standard is intended as the minimum procedures when preparing contract drawing containing asset information. The objective of the Standard is to ensure that all drawings are provided to the Township in a way that is easy to understand and includes all necessary information.

Any comments or recommendations about this manual should be addressed to:

Public Works Department
The Township of King
2585 King Road, King City, ON L7B 1A1

2. Scope

This manual was developed to assist the designers responsible for the preparation of engineering contract drawings for the Public Works Department using AutoCAD software. Elements covered in this manual are drawing file folder structures, drawing set ups and layer definition.

The Township must be able to use the information supplied, not only for reproduction for internal use, but also to feed data to corporate wide systems and convert data from AutoCAD to shape file. Files supplied to the Township, must conform to the standards outlined in this manual.

This manual does not cover all possible conditions, but is meant to be used as a guide in the development of engineering contract drawings. Procedures presented in this document will produce drawings clear enough to be printed at scales 1:500 and 1:1000.

Over time the users producing drawings for the Township will become accustomed to using the CAD Standard and its practices. Until such a time that users become familiar with the practices outlined in this Standard it is expected that there will be frequent reference to the Standard.

3. Drawing Preparation

Definition

A base plan is a digital drawing (AutoCAD file), a scanned image, that shows all existing above and below ground information on plan view only (no profile information). Base plans form the base information to be used for all design-related activities. All base plans should be prepared in accordance with this manual.

Base Plan Preparation

Base plan drawings include all existing topographical data and existing assets with accurate location. Profile sections detailing the sub-surface section of underground features may also be included.

When used for design purposes base plan drawings must include all sub-surface, surface, and aerial (above ground) detail. Below ground details including but not limited to, sewers, water mains, gas mains, and other utilities should be located in their actual vertical location in the profile section of the drawing. Above ground detail including but not limited to phone lines and cable TV wires and electrical lines should also be identified. Base plans may also consist of digital aerial mapping and/or information obtained by topographic surveys carried out in the field. Common methods of obtaining base map data include total station, GPS (Global Position System) and LIDAR (Light Detection and Ranging) surveys of the project area.

Drawing Structure

There are two distinct working environments, or "spaces," in which you can create objects in a drawing. These are represented by the Model and Layout tabs. Typically, a model is composed of geometric objects that are created in a three-dimensional space called *model space*. A final layout of specific views and annotations of this model is created in a two-dimensional space called *paper space*. These spaces are accessible on two or more tabs near the bottom of the drawing area: the Model tab and one or more layout tabs.

Note: These tabs can be hidden, appearing instead as buttons on the status bar at the bottom-center of the application window.

Working on the Model tab, you draw a model of your subject at 1:1 scale. Working on a layout tab, you can create one or more *layout viewports*, dimensions, notes, and a title block to represent a drawing sheet. Each layout viewport is like a picture frame containing a "photograph" of the model in model space. Each layout viewport contains a view that displays the model at the scale and orientation specific for the project. You can also specify which layers are visible in each layout viewport.

After you finish arranging the layout, you turn off the layer that contains the layout viewport objects. The views are still visible, and you can plot the layout without displaying the viewport boundaries.

All digital drawings produced for Township of King are to be drawn in Model space using metres as the measurement unit and to a real scale (1:1).

Viewport Custom Scale Required	Custom Scale factor
1:1000	1
1:750	1.33
1:500	2
1:300	3.33
1:250	4
1:200	5
1:100	10

Table 1: Custom Scale Factors

Coordinate System

One continuous Model Space should be produced for each project. All drawings created under this standard should be drawn using the UTM (Universal Transverse Mercator) NAD 83 Zone 17N Coordinate System in Model Space. This system was chosen for its accuracy and ease of use. UTM coordinates are based on metre distances from a 0,0 origin. Typical UTM values for King Township Northings range from about 4 858 491 to 4 889 3386 and typical Eastings range from 593 852 to 622 363.

Drawing Format

All drawings shall be standard AutoCAD Release 2009 (or higher) drawing files. The Township uses AutoCAD (Civil 3D) by Autodesk for drafting and review purposes. At the time of the release of this document the earliest version supported by Autodesk is AutoCAD 2009.

All text entities to follow the styles outlined in Table 2, below. Standard text sizes have been defined to ensure conformity and legibility on all drawings for viewing and plotting. The model space size is dependent on the final plotting scale.

Text Style	Text Name	Plot Height		Model Space Size (m)			
		mm	inch	1:100	1:200	1:500	1:1000
D040	RomanS	1.0160	0.0400	0.1016	0.2032	0.5080	1.0160
D040B	RomanD	1.0160	0.0400	0.1016	0.2032	0.5080	1.0160
D050	RomanS	1.2700	0.0500	0.1270	0.2540	0.6350	1.2700
D050B	RomanD	1.2700	0.0500	0.1270	0.2540	0.6350	1.2700
D060	RomanS	1.5240	0.0600	0.1524	0.3048	0.7620	1.5240
D060B	RomanD	1.5240	0.0600	0.1524	0.3048	0.7620	1.5240
D080	RomanS	2.0320	0.0800	0.2032	0.4064	1.0160	2.0320
D080B	RomanD	2.0320	0.0800	0.2032	0.4064	1.0160	2.0320
D100	RomanS	2.5400	0.1000	0.2540	0.5080	1.2700	2.5400
D100B	RomanD	2.5400	0.1000	0.2540	0.5080	1.2700	2.5400
D120	RomanS	3.0480	0.1200	0.3048	0.6096	1.5240	3.0480
D120B	RomanD	3.0480	0.1200	0.3048	0.6096	1.5240	3.0480
D140	RomanS	3.5560	0.1400	0.3556	0.7112	1.7780	3.5560
D140B	RomanD	3.5560	0.1400	0.3556	0.7112	1.7780	3.5560
D175	RomanS	4.4450	0.1750	0.4445	0.8890	2.2225	4.4450
D175B	RomanD	4.4450	0.1750	0.4445	0.8890	2.2225	4.4450
D200	RomanS	5.0800	0.2000	0.5080	1.0160	2.5400	5.0800
D200B	RomanD	5.0800	0.2000	0.5080	1.0160	2.5400	5.0800
D240	RomanS	6.0960	0.2400	0.6096	1.2192	3.0480	6.0960
D240B	RomanD	6.0960	0.2400	0.6096	1.2192	3.0480	6.0960
D290	RomanS	7.3660	0.2900	0.7366	1.4732	3.6830	7.3660
D290B	RomanD	7.3660	0.2900	0.7366	1.4732	3.6830	7.3660
D350	RomanS	8.8900	0.3500	0.8890	1.7780	4.4450	8.8900
D350B	RomanD	8.8900	0.3500	0.8890	1.7780	4.4450	8.8900
D425	RomanS	10.7950	0.4250	1.0795	2.1590	5.3975	10.7950
D425B	RomanD	10.7950	0.4250	1.0795	2.1590	5.3975	10.7950
D500	RomanS	12.7000	0.5000	1.2700	2.5400	6.3500	12.7000
D500B	RomanD	12.7000	0.5000	1.2700	2.5400	6.3500	12.7000

Table 2: Text Styles

Colour Dependent Plot Style Tables

The Township of King will use the colour-dependent plot styles produced by the Developer to control how objects are plotted, and to ensure that all objects that share the same color are plotted the same way.

Drawing Scale

Drawing units are to be metric and set to real scale. i.e.1 unit in the drawing is equal to 1 metre in the field.

Layer Structure

Each Asset must be on its own layer. Mandatory layers.

TYPE OF ASSET
Amenity Area
Access Point
Water Valve
Park Asset (benches, bleaches, play structure, slide)

Bridge
Boundary
Building Entrance
Catchbasin
Common Element
Conduit
Contour
Casing
Catchbasin Leads
Structural Culverts
Connection Point
Curb Stop
Curb
Culvert (small culverts)
Clean water Collector
Community Mailbox
Ditch Inlet
Discharge Point
Driveway
Easement
End Treatment
Equalization
Foundation Drain Collector
Building Footprint
Facility Footprint
Fiber Line
Fence
Fitting
Flow Meter
Flow Meter Basin
Force Main
Gravity Main
Geodetic Benchmark
Gas Line
Hand Holes
Headwall
Hydrant
Light Wiring
Landscape
Meter Chamber
Manhole
Open Space
Buffer Blocks
Node
Oil Grid Separator

Open Facility (Kiosk, Gazeebo)
Other Elements
Odor Control Facility
Pedestal
Siphon Main
Sanitary Pipe (Sanitary Main, Foundation Drain Collector Sewer Storm Sewer)
Stormwater Pond
Pumping Station
Production Well
Parking Area
Parking Line
Parcel
Phase lines
Prevailing Environment
Road Base
Road Surface
Road Widening
Retaining Wall
Safety System
Subdrain
Sign
Street Lights
Septic Maintenance
Splash Pad
Sampling Station
Service (Water Service, Sanitary Service, Foundation Drain Collector Lateral (Storm Lateral))
Sidewalk
Snow Storage
Spillway
Streets
Street Centerline
Trail
Transformer
Tree
Treatment Plant
Utility Trench
Underground Enclosure
Water
Water Storage
Water Resource Recovery System
Watermain
Walkway

Table 3: Mandatory Layers

The layers have been broken down to the component (or feature) level in order to give more control to the draftsperson. This adds more layering options and functionality because similar objects can be controlled groups of smaller size. For example; the sanitary pipe is on a separate layer from the manhole it is attached to which allows for independent display.

The following layer must be able to convert using the table below.

CONDO

Source_Text_Layer	Target_Layer	Description
If there is a text layer that can be associated by proximity, add it here.	**DO NOT EDIT. Only to be edited by the Municipality.**	**For reference in understanding how to map the layers.**
	Boundary	Boundary Layer
	Units_P	Condo units, Lines or polygons showing the limits of each condo unit
	Units_txt_P	Condo units numbers
	Building_footprint_E	Building footprints (lines or polygons)
	Building_footprint_P	
	Curb_E	Curb lines or polygons
	Curb_P	
	Sidewalk_E	Sidewalk delimitation
	Sidewalk_P	
	Walkways_E	Walkway delimitation
	Walkways_P	
	Parking_area_E	Parking lot outline
	Parking_area_P	
	Parking_line_E	Parking spot lines
	Parking_line_P	
	Parking_Label_txt_P	Labels for commercial, visitor, handicap parking etc.
	Parcel_E	Parcel lines or polygons
	Parcel_P	
	Common_Elements_P	Several polygons with text to identify the common elements, e.g. gym, meeting room etc.
	Common_Elements_txt_P	
	Open_spaces	
	Amenity_area_P	Lines or polygons showing amenity area limits
	Amenity_area_txt_P	
	Streets_E	Street outline (polygon or closed polyline)
	Streets_P	
	Street_Centreline_E	Street centerline
	Street_Centreline_P	
	Driveway_E	Driveway delimitation (lines, polygons or hatch)
	Driveway_P	
	Driveway_access_P	Line drawn to the width of the driveway access
	Landscape_area_E	Lines or polygons showing landscaping features limits
	Landscape_area_P	
	Other_elements_P	Lines or polygons showing limits for loading area, electrical, garbage/ recycling, storage, mechanical room etc.
	Other_elements_txt_P	labels for loading area, electrical, garbage/recycling, storage, mechanical room, etc.
	Phase_line_boundaries_P	If the project is divided into phases each phase should have a boundary and be labeled
	Phase_line_boundaries_txt_P	
	Stairs_txt_P	Text

Table 4: Condo Conversion Table for Digital Data Upload

SUBDIVSION

Source_Layer	Source_Text_Layer	Target_Layer	Description
Add your CAD layer name for the appropriate Target_Layer.	**If there is a text layer that can be associated by proximity, add it here.**	**DO NOT EDIT. Only to be edited by the Municipality.**	**For reference in understanding how to map the layers.**
		Boundary	One closed polyline defining the boundary of the subdivision.
		Street_E	Street outline
		Street_P	
		Street_Centreline_E	
		Street_Centreline_P	Street centerline
		Street_Name_txt_E	Street names (Text)
		Street_Name_txt_P	
		Lot_Number_txt_P	Lot numbers (Text)
		Blocks_E	Lines delimiting street blocks (open space, uitility corridors, landscape area, part blocks, buffer blocks, walkways)
		Blocks_txt_E	Street block information (Text)
		Blocks_P	
		Blocks_txt_P	
		Parcels_E	Parcel lines or polygons
		Parcels_P	Parcel lines or polygons
		Lot_Frontage_txt_P	Lot frontage measurement (text)
		Lot_Depth_txt_P	Lot depth measurement (text)
		Building_Footprint_E	Building footprints (lines or polygons)
		Building_Footprint_P	
		Driveway_E	
		Driveway_P	Driveway delimitation (lines, polygons or hatch)
		Countour_Lines_E	
		Countour_lines_P	Elevation contour lines
		Sidewalk_E	Sidewalk delimitation
		Sidewalk_P	
		Walkways_E	Walkways delimitation
		Walkways_P	
		Road_widening_P	Road windening lines
		30cm_reserve_P	
		Phase_boundaries_P	If the project is divided into phases each phase should have a boundary and be labeled
		Phase_line_boundaries_txt_P	
		Water_E	Water delimitation
		Prevailing_Env_Feat_E	Prevailing environmental feature - woodlot, floodline, top of bank, wetland etc.
		Prevailing_Env_Feat_txt_E	
		Prevailing_Env_Feat_P	
		Prevailing_Env_Feat_txt_P	

Table 5: Subdivision Conversion Table for Digital Data Upload

SITE

Source_Layer	Source_Text_Layer	Target_Layer	Description
Add your CAD layer name for the appropriate Target_Layer.	**If there is a text layer that can be associated by proximity, add it here.**	**DO NOT EDIT. Only to be edited by the Municipality.**	**For reference in understanding how to map the layers.**
		Boundary	Boundary layer
		Lot_number_txt_P	Lot numbers (Text)
		Blocks_P	Lines delimiting street blocks (open space, uitility corridors, landscape area, part blocks, buffer blocks, walkways)
		Blocks_txt_P	Street block information (Text)
		Parcel_E	
		Parcel_P	Parcel lines or polygons
		Units_P	Unit divisions inside of individual parcels
		Building_footprint_E	Building footprints (lines or polygons)
		Building_footprint_P	
		Street_Centerline_E	Street centerline
		Street_Centerline_P	
		Street_P	Proposed road delimitation
		Street_E	
		Driveway_P	Driveway delimitation (lines, polygons or hatch)
		Curb_E	Curb lines
		Curb_P	
		Sidewalk_E	Sidewalk delimitation
		Sidewalk_P	
		Walkway_E	Walkways delimitation
		Walkway_P	
		Parking_area_E	Parking lot outline
		Parking_area_P	
		Parking_Lines_E	
		Parking_lines_P	Parking spot lines
		Parking_Label_txt_P	Labels for commercial, visitor, handicap parking.
		Pilon_sign_P	Pilon Sign
		Ramps_to_underground_txt_P	Ramps to underground delimitation
		Other_elements_P	Lines or polygons showing limits for loading area, electrical, garbage/recycling, storage, mechanical room etc.
		Other_elements_text_P	Labels for loading area, electrical, garbage/ recycling, storage, mechanical room, bike racks etc.
		Driveway_access_E	Line drawn to the width of the driveway access
		Driveway_access_P	
		Building_entrances_P	Lines showing the main building entrances
		Road_widenings_P	Road windening lines
		Light_post_E	Light post point locations

		Light_post_P	
		Landscape_areas_E	Areas delimiting landscaping features
		Landscape_areas_P	
		Fence_E	Fence lines
		Fence_P	
		Retaining_walls_E	Retaining wall lines
		Retaining_walls_P	
		Snow_storage_areas_P	Snow storage area delimitation
		Stairs_txt_P	TBD (Questioning whether this has a place here)
		Phase_line_boundaries_P	If the project is divided into phases each phase should have a boundary and be labeled
		Phase_line_boundaries_txt_P	Labels for each project phase

Table 6: Site Conversion Table for Digital Data Upload

ENG

Source_Layer	Source_Text_Layer	Target_Layer	Description
Add your CAD layer name for the appropriate Target_Layer.	**If there is a text layer that can be associated by proximity, add it here**	**DO NOT EDIT. Only to be edited by the Municipality**	**For reference in understanding how to map the layer**
		utcWAccessPoint	Water
		utcWCasing	Water
		utcWConnectionPoint	Water
		utcWEasement	Water
		utcFacilityFootprint	Water
		utcWFitting	Water
		utcWFlowMeter	Water
		utcWHydrant	Water
		utcWMain	Water
		utcWProductionWell	Water
		utcWPumpingStation	Water
		utcWStorage	Water
		utcWTreatmentPlant	Water
		utcWUndergroundEnclosure	Water
		utcWValve	Water
		utcWWAccessPoint	wastewater
		utcWWCasing	wastewater
		utcWWConnectionPoint	wastewater
		utcWWDischargePoint	wastewater
		utcWWEasement	wastewater
		utcWWEqualization	wastewater
		utcWWFacilityFootprint	wastewater

		utcWWFitting	wastewater
		utcWWFlowMeter	wastewater
		utcWWFlowMeterBasin	wastewater
		utcWWForceMain	wastewater
		utcWWGravityMain	wastewater
		utcWWManhole	wastewater
		utcWWOdourControlFacility	wastewater
		utcWWPumpingStation	wastewater
		utcWWSiphonMain	wastewater
		utcWWUndergroundEnclosure	wastewater
		utcWWValve	wastewater
		utcWWWaterResourceRecoveryFacility	wastewater

Table 7: ENG Conversion Table for Digital Data Upload

Additional Information

Sometimes it is necessary to identify features within the project area because some characteristics may not be identifiable from aerial photographs or previous projects. It is strongly recommended to carry out a field verification of:

- Driveway types (paved, gravel, etc.),
- Road Pavement Types,
- House numbers,
- Utility poles height and type (Electricity, Phone, etc),
- Manholes
- Valve chambers and valve boxes

In addition to the topographic data, a survey crew is requested to obtain precise field information relative to the location of all –above and below-ground- utilities and services (storm, sanitary and water mains). Information obtained by the survey crew must:

- Be acquired using '**Survey Grade**' GPS equipment to achieve the optimum accuracy possible.
- Be represented in an AutoCAD drawing file that follows the standards and procedures explained in this document. This drawing shall use a UTM NAD 83 Zone 17N coordinate system, using metres as the measure unit.
- Provide a coordinate list for all control points found or used for the project.
- Provide a list for all control points elevations.
- Provide a list of Water main valves and sanitary manholes numbers with invert elevations.

The majority of wastewater system assets (maintenance hole covers, chamber lids, valve box covers) and water system assets (chamber lids and valve box covers) have GPS coordinates with centimetre accuracy.

All GPS X, Y, Z coordinates will be obtained with respect to the following:

- GPS points must be provided in UTM Zone 17 NAD83 coordinates.
- GPS points must have a horizontal accuracy of 100mm or less.
- GPS points must have a vertical accuracy of 30mm or less.

Grids and Coordinate Systems

Coordinate System grids shall use real UTM NAD 83 Zone 17N coordinates, expressed in metres. In NO case shall the user coordinate system be modified in Model Space. Use of the commands "Rotate", "Align", "UCS", or any other command that changes the coordinate base will not be accepted. Grids shall conform to the following criteria:

- No local coordinate system should be used. Drawing coordinates shall be within the coordinate ranges previously presented.

All topographical information in plan view shall be registered to AutoCAD's World coordinate system and to the UTM NAD 83 Zone 17N coordinate system.

- Coordinate grid shall consist of a series of cross hairs drawn to the nearest 25-100 metres intervals.
- The northing and easting coordinates shall be shown at the intersection of the coordinate lines at
  - 25-100 metres intervals.
- All information related to the grid system (crosshairs, Northing and Easting) shall be on the specified layer.
- The cross hairs for the grid system shall be indicated outside of the road allowance. Locate cross hairs in an open area of the drawing and avoid overlapping other drawing data or line work.

Cover Sheet

King has developed standard cover sheets that must be used for all projects. Cover sheets contain a location map as well as various details about the project. An example of the cover to be used for all Township of King Water and Wastewater projects has been provided in Figure 1 below; items identified in Figure 1 can be found in Table 8, immediately following Figure 1.

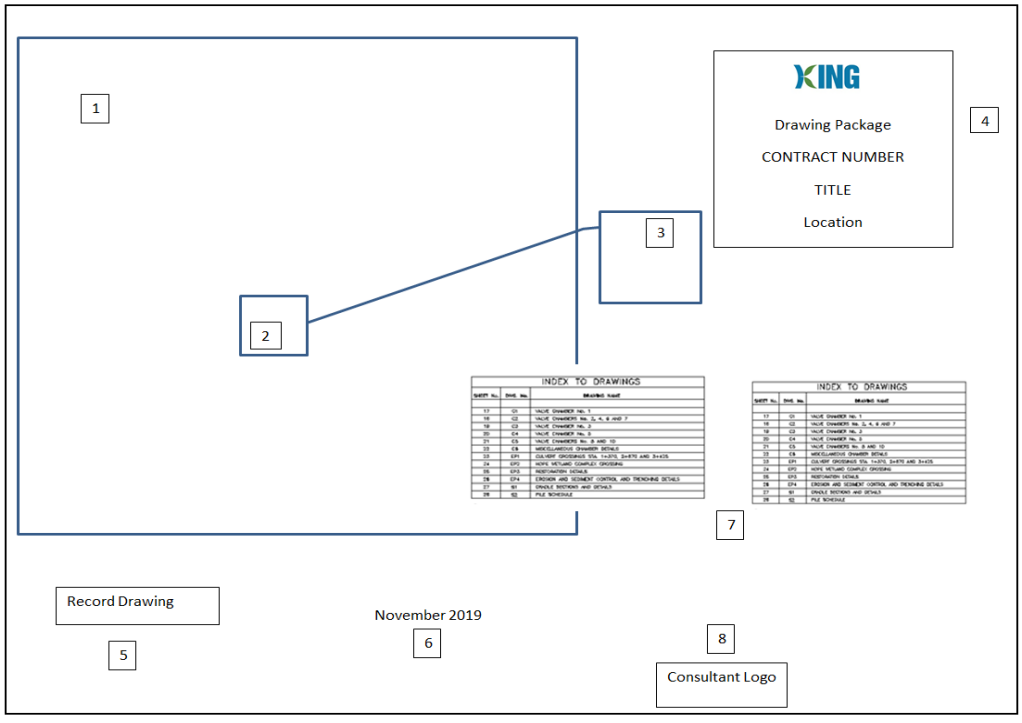


Figure 1: Township of King Cover Sheet

Cover Item Number	Cover Item Description
1	General Location (Township) Map
2	Project Extents
3	Project Extents Viewport
4	Project Identification Area
5	Drawing Status
6	Drawing Creation Date
7	Index to Drawings
8	Consultant Logo

Table 8: Coversheet Item Description

Working with Xreferences

You can attach an entire drawing to the current drawing as a referenced drawing (Xref). With Xrefs, changes made in the referenced drawing are reflected in the current drawing. Attached Xrefs are linked to, but not actually inserted in, another drawing. Therefore, with Xrefs you can build drawings without significantly increasing the drawing file size.

By using referenced drawings, you can

- Coordinate your work with the work of others by referencing other drawings in your drawing to keep up with the changes being made by other designers. You can also assemble a master drawing from component drawings that may undergo changes as a project develops.
    - All component drawings referenced within the project drawing must conform to the Township of King's CAD Standard.
- Ensure that the most recent version of the referenced drawing is displayed. When you open your drawing, each referenced drawing is automatically reloaded, so it reflects the latest state of the referenced drawing file.
- Keep the names of layers, dimensioning styles, text styles, and other named elements in your drawing separate from those in referenced drawings.
- Merge (bind) attached referenced drawings permanently with your current drawing when the project is complete and ready to be archived.

Note: Like a block reference, an Xref appears in the current drawing as a single object. However, you cannot explode an Xref without binding it first.

Use of referenced drawings (Xref) is allowed where drawing size affects computer performance. Follow

the recommendations below when using Xrefs:

- Provide information about all Xref drawings used in your project.
- Do not use a full path when attaching Xrefs. Always use Relative Path. It is recommended to keep the attached drawings in the same directory as the current drawing.
- Set to layer 0 (zero) and attach the referenced drawing to that layer using 0,0,0 as the insertion point, 1,1,1 for the scales, and 0 for the rotation.
- Do not edit the layer visibility by changing the referenced drawing. The preferred method for this is to change visibility at the current drawing.

Requirements

Pre Consultation Meeting Township of King Project Manager or Project Tech to inform Developer and Consulting Engineer of Geo reference Coordinate system for Auto CAD files, Unique identifier; King AutoCAD Standards, Conversion Tables, AutoCAD files review (at each appropriate milestone – 30%, 60%, Form 1, 90%, IFC and As Built)

Consulting Engineer AutoCAD files review (at each appropriate milestone – 30%, 60%, Form 1, 90%, IFC and As Built)

Township of King Project Manager or Project Tech review of AutoCAD

File Name Convention for Drawings

The naming convention for digital files should follow the following format:

"Designation" - "Contract Number" - "Sheet Number" - "Type of Drawing" - "Drawing Stage Abbreviation"

Designation: Can be either "W" for Water, "WW" for Wastewater, or "WWW" for Water and Wastewater (combined).

Contract Number: The contract number provided for the project.

Sheet Number: The sheet number of the drawing.

Type of Drawing: Identifies if the drawing is a:

P## - Plan and Profile Drawing

A## - Architectural Drawing

S## - Structural Drawing

M## - Mechanical Drawing

G## - General Plan Drawing

E## - Electrical Drawing

Drawing Stage Abbreviation: Identifies the drawing as one of the following drawings:

AT - As Tendered

AR - As Recorded

C - Construction

AC - As Constructed

CR - Construction Record

D - Draft

AB - As Built

A - Approval

S - Shop Drawing

File naming convention example:

W-T1096-001-G00-C.dwg

Drawing Submittals

During all phases of submittals, all electronic deliverables must be identical to the hard copy. If the CAD drawing files use references (Xref's), then the referenced file must be provided along with the CAD drawing. All files and their attached Xref's must be located in the same directory.

Colour Table file used to generate the plot file must be submitted during all phases of submittals. All drawing files shall be set so all that is necessary to plot a hard copy is to open the drawing and execute the plot command.

All digital submittals must include:

- Drawing file in .dwg format using the lowest supported version supported by Autodesk.
- CTB or STB file.
- Shape files.
- Font files.
- Line definition files.
- Metadata file.
- Conversion Tables for Digital Data Upload.
- Unique Identifiers form.

Metadata

Metadata refers to descriptive information regarding data (or drawings containing data). Metadata allows users to understand the data they are working with as well as its limitations (e.g. currency, accuracy, projection, etc.). Metadata must accompany all drawings submitted to the Township. Project metadata is stored within the METADATA attribute definition block and must be located on the METADATA layer at coordinates 0,0,0 in the model space. The mandatory metadata fields (where applicable) are as follows:

- Title – The project or drawing title
- Drawing file name – The name of the drawing file.
- Project number – The project number for the project.
- Units – The units that the drawing was created in.
- Author – The consultant/contractor responsible for the drawing.
- Coordinate system – Projection and Datum used to create the drawing. By default should be UTM NAD 83 Zone 17N.
- The drawing status – As built/tendered, etc

Quality Assurance/Quality Control

Review Milestone

30% AutoCAD review
60% AutoCAD review
Form 1 AutoCAD review
90% AutoCAD review
Issued for Construction AutoCAD review
As Built AutoCAD review

Detailed AutoCAD Review Process

Consulting Engineers check AutoCAD file for completion of mandatory layers, correct conversion tables, Geo reference coordinate system, Unique identifiers, completion of .ctb file, completion of Metadata and a complete set of drawings (electrical, landscape, plan and profile, quantity sheets)

Form 1 Submission mandatory check is for water and wastewater assets.

4. Topology Rules

A topology is a set of integrity rules that define the behaviour of geographic features. A topology enables you to have one common set of lines to represent the geometry of many feature classes that share geometry. Topologies have rules about how the features share geometry. Topology can be built for any vector spatial data type and certain data conditions will prevent topology from being built without corrective editing. Topology allows GIS professionals to answer questions about adjacency, connectivity, proximity, and coincidence. Therefore topology is necessary for all polygonal and linear data sets submitted to the Corporate GIS.

To create and maintain coverage topology, the following must be met:

- Correct arc directionality must be maintained on streets, facility data, and any dataset with flow.
- All features must be connected or snapped to its connecting feature using the precision editing commands in AutoCAD.
- Pseudo nodes must only exist where 1) a line closes on itself 2) only two lines intersect 3) there is a change in attribution along a line 4) to maintain the shape and measurements of an arc.
- Lines, polygons, points and annotation must not be duplicated.
- Streets and facility data do not break at overpasses and underpasses.
- Polygons must have only one label per feature.
- Polygons must edge match without slivers.

Figure 2 outlines some of the typical problems drawings can contain and followed by solutions to these problems.

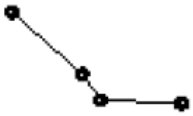
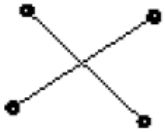
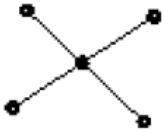
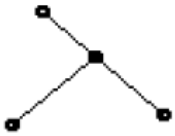
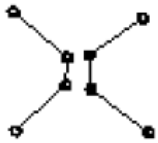
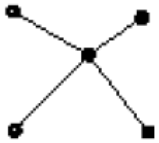
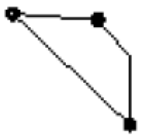
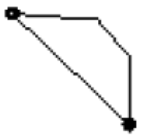
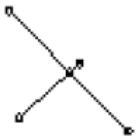
Incorrect	Correct	Description of Problem
		Duplicate objects
		Short objects
		Crossing objects
		Undershoots
		Node cluster
		Pseudo-nodes
		Dangles or over-shoots
		Zero-length objects

Figure 2: Examples of Drawing Problems

Duplicate Objects

The duplication of objects cannot occur; lines which are a duplication of another line should be removed in order to accurately reflect the features in reality. Refer to Figure 2 for a graphic example of the discussed problem.

Short Objects

A short object is one that has a plotted length of less than 0.5mm; lines shorter than 0.25m at a scale of 1:500 or 0.5m at a scale of 1:1000 should be removed from the drawing. Refer to Figure 2 for a graphic example of the discussed problem.

Crossing Objects

Whenever features within the same network (water, wastewater, etc.) a node must be present at the crossing point. Crossing features from different networks (i.e. a watermain crossing a sewer main) do not require a node to be present. Refer to Figure 2 for a graphic example of the discussed problem.

Undershoots

Undershoots are often caused by inaccurate digitizing or when converting scanned data. They are composed of objects that come within the specified tolerance radius of each other, but do not meet.

If one object can be extended to cross the other, it will be extended (while maintaining the same direction) and snapped to a point on the object. If no node exists, one shall be created at the intersection.

If two objects pass within the specified tolerance and can be snapped without changing their direction, they shall be snapped together. If no node exists at that point, one will be created.

Refer to Figure 2 for a graphic example of the discussed problem.

Node Cluster

Node clusters should be avoided; features which share a common end point should be snapped together using the precision editing commands available in AutoCAD. Refer to Figure 2 for a graphic example of the discussed problem.

Pseudo-nodes

Pseudo-nodes are those which occur on a linear or polygonal feature which do not represent the case in reality. For example a single piece of flex pipe in a sanitary sewer network should be digitized as one polyline with multiple vertices instead of multiple lines or polylines broken by one or more nodes. Refer to Figure 2 for a graphic example of the discussed problem.

Dangling Objects

A dangling object is often caused by inaccurate digitizing where an object extends beyond its intended intersection with a target object. Object intersections should be created using the precision editing commands within AutoCAD. Refer to Figure 2 for a graphic example of the discussed problem.

Zero Length Objects

Zero length objects are those lines which have been created (usually through improper digitizing) that have no length. These lines serve no purpose and should not be present in drawings presented to the Region. Refer to Figure 2 for a graphic example of the discussed problem.

Overlapping

Overlapping polygons are usually created by improper digitization; polygons in the same layer should never overlap one another. Overlapping polygons in the same layer creates sliver (or spurious) polygons

when polygon topology is created. Figure 3 shows an example of improperly digitized polygons within the same layer. If two polygons share the same boundary edge, only one line should be digitized.

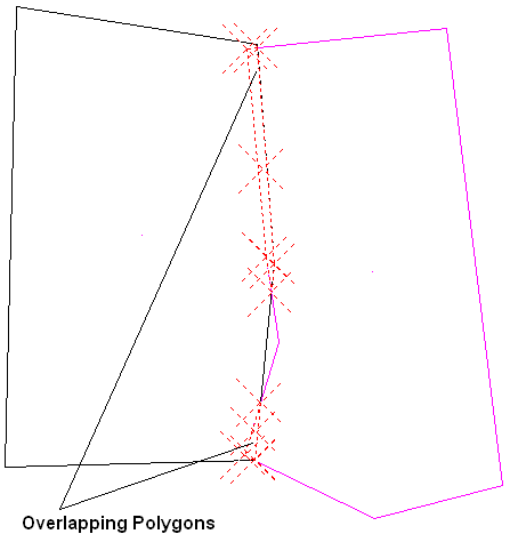


Figure 3: Overlapping Polygons

Break Lines

Do not break lines to include labels, instead use the linetypes provided within the seed file. Text for sanitary sewers and watermains is placed within the linetype definition for those lines. This allows the line to automatically generate text as part of the line and eliminates the need to break the line to insert labelling text within it. Linetypes were designed to use LTSCALE values of 1 if the plot scale is 1:500 and 2 if the plot scale is 1:1000. Remember to set the PLINEGEN system variable equal to 1 for linear assets. Examples of existing sanitary and water mains using the linetype definition created for the Township's seed
file are shown below in Figure 4.

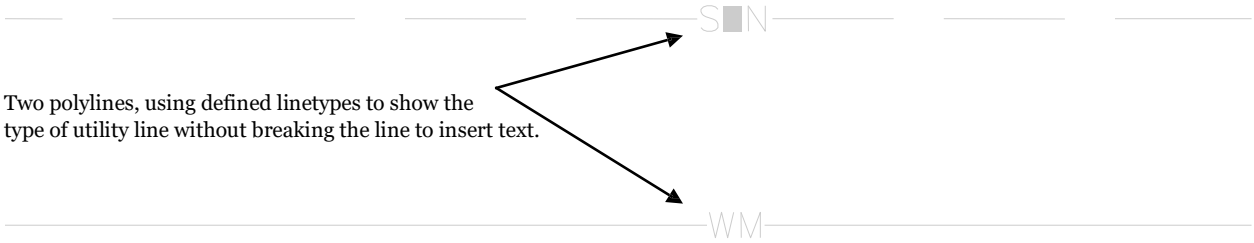


Figure 4: Linetype Definition Showing Text on the Line.

Inserting Blocks

In order to ensure connectivity with network features all blocks should be connected to linear features at the insertion point. Figure 5 shows the incorrect means for digitizing features within a linear network, the linear features appear to connect to the block (an existing valve chamber), but are only attached to the edge of the symbol.

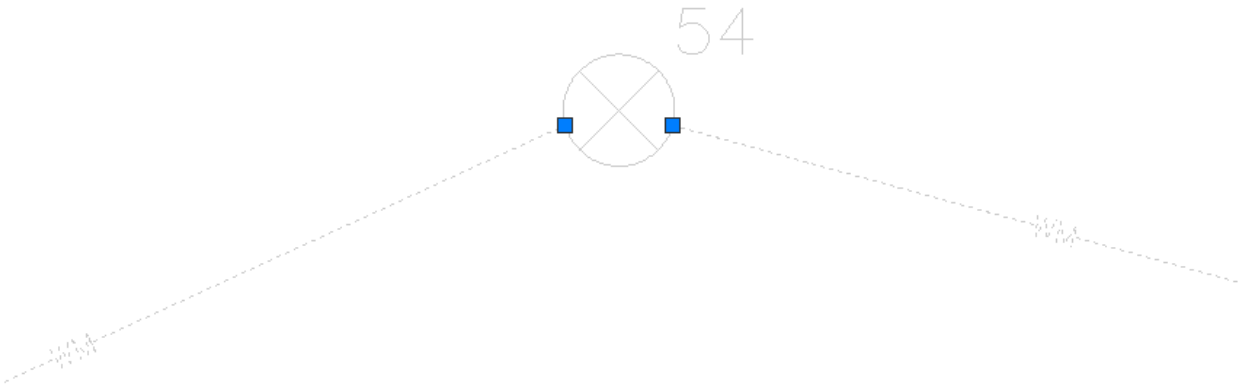


Figure 5: Incorrect Insertion of Block Connected to Linear Features

Make sure all blocks are connected to linear assets at the block insertion point. Using the precision editing commands in AutoCAD allows for the proper connection of blocks to linear features; Figure6 shows the correct method for connecting blocks to linear features.

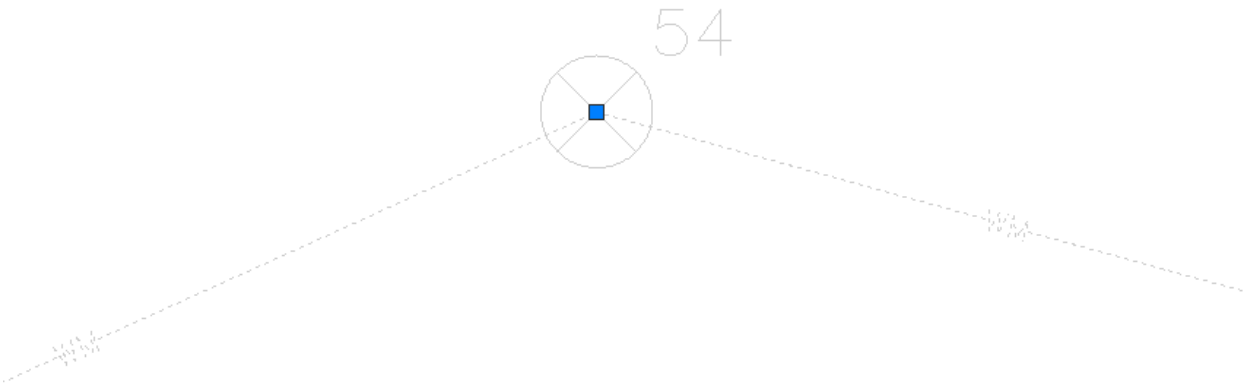


Figure 6: Correct Insertion of Block Connected to Linear Features

Insert Blocks with attributes for linear entities

Include the block with attributes that belongs to the linear object. Make sure to include one block with attributes for each line segment. The block included with each line segment should be inserted at the mid point of every line segment. Figure 7, below, shows the proper method for insertion of a linear asset attribute block.

Figure 7: Proper Insertion of Attribute Data Block on Linear Features

Insert Blocks with attributes for polygon entities

In order to ensure that polygon information can be attributed to the proper polygon, each polygon must be closed and include the block with attributes that belongs to that object. An example of including polygon attribute blocks is shown in Figure 8, below.

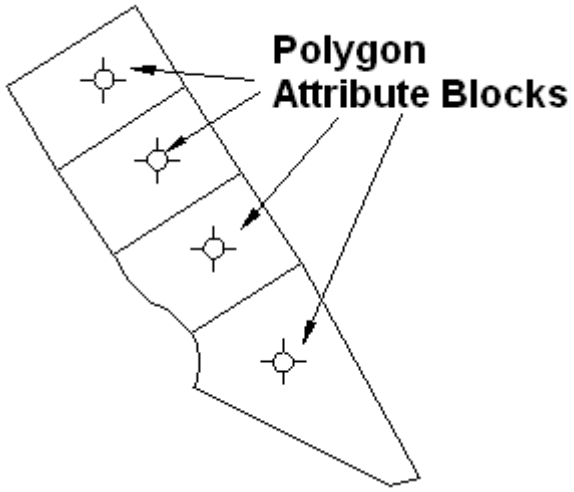


Figure 8: Polygons Including Attribute Block

Appendix A: List of Acronyms

Acronym	Description
CAD	Computer Aided Drawing
CTB	Colour Dependant Plot Style Table
ENG	Engineering
GIS	Geographic Information System
GPS	Global Positioning System
LIDAR	Light Detection and Ranging
NA	Not Applicable
NAD	North American Datum
STB	Style Table
UTM	Universal Transverse Mercator
XREFS	X Reference