

## **5. Plotting at Caltrans**

### **5.1 Purpose of Plotting**

Plotting is the process of transferring the graphic information in a CADD file to paper. Each CADD file represents a single plan sheet that will be plotted as part of a set of project plans. Caltrans uses specific software to plot these plan sheets so as to standardize scale, line thickness, lettering and other features of the plan sheet (hard copy), thus instilling integrity of information to the contractor when a project is finally ready for advertisement. Plotting is also used when documenting particular phases of a project and producing maps for public display.

### **5.2 Plotting Solution**

#### **A. Overview**

Interplot is a Bentley Corporation software officially used as the plotting solution for all Final Contract Plans at Caltrans. Interplot works within the MicroSoft Windows environment. It requires software and printers to be installed on a plot server and client software to be installed on each workstation that utilizes Interplot. Interplot Professional (another Bentley product) is a total plotting solution that may be installed on a stand-alone workstation.

#### **B. Why a Single Plotting Solution**

Interplot offers a convenient user interface both inside and outside of MicroStation for creating plots and saving plot sets for later processing. It also allows for easy creation and management of batch plotting.

A single plotting solution minimizes technical support and ensures uniform quality plotting statewide. It also allows for centralizing of resource files and settings files to produce the same quality results for all users.

Division of Engineering Services - Office Engineer (DES-OE) issues Final Contract Plans to the public. For each design file (.dgn) submitted to DES-OE, an Interplot parameter file (.i) **must** accompany it in order for the plan sheet to plot exactly as intended. One plotting solution allows for statewide consistency and accuracy.

### C. Using Interplot at Caltrans

Each workstation needs to be on a domain network, which allows the user to create network attachments to printers that reside on the Interplot server within the district. District computer support is responsible for configuring and maintaining Interplot for their district, which also includes the settings and resource files for plotting.

## 5.3 Terms and Definitions

### ProjectWise Interplot Organizer

Is a Windows application that runs outside of MicroStation. It allows batch plotting for a variety of different types of files, such as MicroStation (dgn), AutoCad (dwg) and raster image file formats such as TIFF and JPEG. It also supports the plotting and creating of PDF files. Plot requests are added by selecting the CADD files, Image files or Plot parameter files (such as iparms) via the supplied browser.

### Iparm (\*.i)

Stands for “Interplot parameter file.” It contains instructions on how to process a single plot request for a single MicroStation design file (dgn). It contains information such as; which design file region, levels and display attributes will be plotted. It also lists which design script (formerly called a pen table) is to be used in order to further control the look of the plot. These files are usually created while in the design file using the “save” command from the “Iplot-Main” dialog. Organizer can then be use to read in these iparms for batch plotting at a later time.

Note: Creating Iparms for PS&E is covered under section 5.5 in this manual.

### Interplot Plot Set file (\*.ips)

Contains a set of individual plot requests packaged into a single file, including all parameter settings for each plot request.

Note: DES-OE does NOT accept PS&E submittals with “ips” files. DES-OE only accepts Iparm “i” files because it makes file management easier at the time of submittal in that each design file will have a matching iparm with the same name.

### Settings files (\*.set)

Settings files contain default plotting parameters such as specifying a design script, paper size and display attribute settings.

They can be categorized as follows:

1. Automatic settings – The settings file named “lplot.set” found in the “auto” subdirectory is always read when opening Interplot Organizer and applied when adding plot requests involving MicroStation design files. “lplot.set” is also applied upon initiating the “lplot-Main” dialog within MicroStation. This file is meant to contain default settings that would be desirable no matter which plotter is to be used.

Note: Caltrans utilizes this file to turn off undesired display attributes like construction elements and ‘fast’ displays (such as ‘fast cell’ and ‘fast text’).

2. Printer settings – Settings files can be set up with names that correspond with existing printer queues so that when a particular printer queue is selected, its corresponding settings file will be applied. These settings files reside in the “auto” subdirectory and are mainly used for setting up the most commonly used paper size, plot size and design script for each particular plotter/printer.
3. Manual settings – These settings files are manually selected by a user and are normally used for additional functions such as defining plot regions via a pre-defined shape.

### Meta files

A Meta file (.m) is temporarily created when submitting a plot request from within MicroStation or the DOS command line. This Meta file contains information from the active design file, any reference files, and design script information controlling the plot when sent to the plot server.

### Print Driver

In basic terms, a print driver is a translator between the plotting software’s output to commands understood by a specific plotting device. Interplot supports various plotters with their own enhanced print drivers. Other vendor supplied print drivers can also be used since Interplot uses Windows print services. An administrator sets up print drivers at the time of creating the printer queues on the plot server.

## Integrate

Integrate is a feature of the Interplot client application which allows the user to select the CADD product that will process the plot request. It also allows the user to specify which CADD products will have the IPLOT tool available. Integrate is accessed via the “Integrate” button on the “Interplot Client Configure” dialog.

## Translucent plotting

Translucent plotting allows the user to tint or colorize an area without obscuring the underlying image or element. For a detailed look at translucent plotting, see Section 5.10 in this chapter.

## Paper Size

Defines the size of the paper that is selected, which then determines the maximum size that is available for plotting.

## Export to PDF

Export to PDF is used to create PDF files which can be shared without the need of printing to paper media. For further information about creating PDF at Caltrans, see Section 5.7 in this chapter.

## Dropout

At Caltrans, dropout is a dotted linear pattern that is applied to elements on certain levels, giving the effect of subduing (fading into the background) existing information. Dropout is used for all PS&E submittals. For a detailed look at how dropout is achieved at Caltrans, see Section 5.10 in this chapter.

## Grayscale

Gray scale is a range of “shades of gray” that can be used to give the effect of subduing certain information on a plan sheet. Caltrans DOES NOT use gray scale for PS&E submittals.

## Masking

Masking is the effect of covering over elements by placing a shape with a fill color in front.

## 5.4 Accessing Interplot

There are 3 ways that Interplot can be accessed.

A. Within MicroStation via “Iplot-Main” dialog:

This is best used for creating Iplot parameter files (iparms) or creating single preliminary “review” plots. Interplot is accessed by selecting “Iplot” under the MicroStation File pull-down, typing “Iplot” at the MicroStation command line or by selecting the “Iplot” tool icon.

B. From Windows via “ProjectWise Interplot Organizer”:

Organizer can read in “iparm files” to create plot request for batch plotting MicroStation design files. It allows one to quickly organize and send batches of plots. Besides MicroStation design files, it supports various other file types such as AutoCad files, TIFF, PDF and JPEG. Organizer is accessed via the Window’s start bar under “**Start >Programs** >....then navigate to the appropriate location where Organizer is located.

C. From the DOS command line:

This requires that you have knowledge of the Interplot command line syntax. A user can create, modify and submit Iparms from the window’s DOS command line. Caltrans has mainly made use of this functionality to enable scripts that modify “Iparms” in batch mode.

## 5.5 **Creating Interplot Parameter Files (iparms) for PS&E**

### A. Creating Iparms

One Interplot parameter file (Iparm) needs to be submitted for each Final Contract Plan sheet (1 design file “dgn”) submitted at PS&E. Iparms should be created after the design file naming convention has been applied to the contract plan sheets. This will avoid the need to modify or create new Iparms. Changing the name of a design file after creating the Iparm requires the user to modify the Iparm to specify the renamed DGN file.

The following procedure is recommended:

1. Open the design file and fit the border sheet with the proper view parameters; (one view window, all levels on, and the view is to be rotated so that the border sheet is visually at “exactly” zero degrees rotation). See Section 4.1 of the Plans Preparation Manual for additional “General Plotting Requirements.”
2. Place a fence by snapping exactly around the cut lines of the border sheet (place the fence by snapping from the lower left corner to the upper right corner).
3. Open the “Iplot-Main” dialog box.
4. Select the plotter that will accommodate a full-sized 22” x 34” plot. This is the official size of all contract plan sheets at PS&E.
5. Select a paper size that will accommodate a 22” x 34” plot size. Typically this would be “Arch D” which is 24” x 36”.
6. Check that the correct plot size (22” x 34”) is displayed in the Plot Size field and the appropriate Plot Scale is shown.
7. Under the “Select Plotting Files” option, make sure the correct design script is selected for PS&E submittal (CT\_FinalPSE.pen).
8. Use the “File >Save” pull-down command in the “Iplot-Main” dialog to save an “Iparm”. The new Iparm will either appear in the same directory as the design file or in a default directory depending on how Interplot is configured. If the “Iparms” are in a default directory, the user should copy the Iparms to the same directory where the design files are located. This will allow the user to utilize the correct Iparm throughout the design stage.

## B. Modifying Iparms

Changes or modifications to the MicroStation Design file may or may not require modifications to the Iparm.

Iparms will need to be modified or re-created for the following situations:

1. Levels are turned **on** or **off** in the view to be plotted for either the active or referenced files.
2. Level Symbology is turned **on** or **off**.
3. Added, deleted or renamed reference file attachments.

Iparms will **NOT** need to be changed for the following situations:

4. Any changes to element properties such as weight, style or color.
5. Any changes to element positions or geometry.
6. Changes to reference attachments (scale or position).
7. Changes to Level Symbology if it was already turned **on**.

## 5.6 Plotting to TIFF image files

### A. How to plot to a TIFF image file

Caltrans has established a printer queue on most of the Interplot servers named "Tiff Output". Instead of printing an actual plot on paper, this printer queue will create a TIFF image file at a pre-designated directory on the plot server, (usually "\\plot server name\TiffOut").

### B. Standard Properties of TIFF Images generated by "Tiff Output"

TIFF image files at Caltrans should have the following properties:

File format:	400 dpi Monochrome Tiff
Compression:	CCITT group 4
Size:	22" x 34"

### C. Use of TIFF files

TIFF files are used for design cross sections (which are part of the contract documents).

## 5.7 Creating and Plotting PDF files

### A. Creating PDF files

PDF files can be created from Organizer or the Iplot-Main dialog while in MicroStation using the “Export PDF” from the “file” pull-down.

### B. Plotting PDF files

Organizer supports plotting PDF files but its functionality is very limited. Therefore, it is recommended that users print from Adobe Reader or Adobe Acrobat Professional which provides a better interface for better control of rotation, size and scale of the output. For batch plotting PDF files, it is recommended that you obtain software that has the ability to combine single paged PDF files, making it much easier to plot all the pages at once.

### C. PDF Standards

The standards that are set at the “PDF Format Configuration” dialog are:

Resolution	600 DPI
Rotation	270 degrees

The standards that are set at the “Main Properties” dialog are:

Use full paper size	yes
Paper Size	ANSI D
Size	22” x 34”
Design Script	CT_FinalPSE.pen

Note: It is recommended that the above PDF standards be used even if printing PDF files to 11” x 17” printers to ensure better quality and consistency. It is easy to “fit to the paper size” from the Adobe Print dialog.

### D. Use of PDF files

PDF is currently the standard file format for final submittal of AADD projects. PDF files are created by HQ-Project Plans and sent to reprographics for all jobs. Reprographics uses these PDF files for generating the final plans for advertising.

## 5.8 Things to watch out for when using Interplot

1. Do NOT create “Iparms” that utilize UNC protocol “\\” for navigating to a directory containing the design files. This may cause major slow downs with the computer when another district or HQ uses these “Iparms”. You should open your design files by browsing to a drive letter. You may need to “map a network drive” if you cannot browse to your files using a drive letter.
2. It is recommended to always use Organizer’s browser when handling files.

Note: Do not use the “drag and drop” method to add files to Organizer.

This enables Interplot to find corresponding design files that reside in the same directory as the Iparms when a different directory was originally listed in the Iparm. This might happen when moving files to another directory during PS&E submittals.

3. When sending a request to an “offline” raster output queue, via Organizer, to create TIFF image files, you should select “separate print jobs” under the “submit plots as” section. “Separate print Jobs” creates one TIFF image file per sheet. “One print job” (which is the default) will result in creating one TIFF image file with all the sheets in it.
4. Interplot has an auto align function that can be configured to behave in one of two ways (parallel or coincident). Both of these methods will determine how the “align\_x” or “align\_y” commands work. Caltrans defaults to the parallel method and the “align\_x” command.
  - “I PLOT\_ALIGN\_METHOD = parallel” – When set to “parallel”, IPlot finds the longest side of the plot fence polygon (usually the top or bottom of the border) and rotates the border to the X or negative X axis (depending on the rotation angle).
  - “I PLOT\_ALIGN\_METHOD = coincident” – This method is used when a user wants to generate a plot request from InterPlot Organizer using a plot shape. Caltrans has embedded a plot shape in each of the Caltrans border sheets. If the embedded shape is used, the border sheet will plot normal to the view (zero degrees).
5. When creating PDF files, “Use full paper size” is recommended (margins will be added later when printing to paper).

## 5.9 **MicroStation Print**

MicroStation “Print” refers to the printing solution that is packaged within MicroStation and is accessed by selecting “Print” via the MicroStation File pull-down. MicroStation “Print” is primarily used to plot raster images (especially long display maps). MicroStation “Print” is not to be used for PS&E submittals.

## 5.10 **Caltrans Design Scripts**

### A. What is a Design Script

Design scripts are files that contain instructions that are supplied to the plotting application to control how certain elements are to be plotted. The plotting application allows the user to choose which design script is appropriate when creating a plot request.

### B. The History of the Caltrans Design Scripts

Caltrans established certain plotting standards for roadway drawings back when CADD was first introduced in 1987. The most noticeable feature of the Caltrans roadway design scripts is the changing of all elements on levels 2 through 9 and 11 to a fine dotted pattern (\*). These levels are commonly referred to as “dropout levels”, which contain existing design information. This simulates the “screened out” affect that was used by the reprographics department on non-CADD drawings. Another feature is the adjustment of line weights. Weighted lines are reduced if they are on a dropout level. This allows the proposed design information to stand out more boldly against the existing design information.

(\*) – This level range has been extended since the introduction of MSV8.

See Section E for the list of dropout levels.

### C. Standard Caltrans Roadway Design Scripts

Caltrans has several design scripts depending on the product being plotted. The various design scripts are based on the same plotting logic and process files in the same way. Full-Size plotting is 22” x 34”, which is the standard size for all Final Contract Plans at PS&E. Half-Size printing is used for preliminary design review and check prints at various milestones. Design scripts for Right of Way Engineering have additional logic for color plotting.

For Final PS&E

**"CT\_FinalPSE.pen"** Full-sized monochrome plotters

For full-size black and white plotting (22" x 34"). This design script is always to be used for final PS&E submittals.

For Preliminary Design & Check Prints

**"fullbw.pen"** Full-sized monochrome plotters

**"fullbw-600.pen"** Full-sized monochrome plotters

**"halfbw.pen"** Monochrome printers

**"halfbw-75.pen"** Monochrome printers

**"fullclr.pen"** Full-sized color plotters

**"halfclr.pen"** Color printers

**"halfclr-75.pen"** Color printers

Fullbw.pen For full-size black and white plotting (22" x 34"). Can be used for full-size check prints. This is optimized for 400 dpi.

Fullbw-600.pen For full-size black and white plotting (22" x 34"). Can be used for full-size check prints. This is optimized for 600 dpi.

Halfbw.pen For half-size black and white printing (11" x 17"). Line weights and patterns are reduced to simulate a half-size reduction for check prints.

Halfbw-PCL.pen For half-size black and white printing (11" x 17"). To be used with the "HP Generic PCL/5 Mono by Bentley" driver.

Halfbw-75.pen For half-size black and white printing (11" x 17"). Dropout pattern is reduced by 75% from full-size.

FullClr.pen For full-size color plotting. (A gray scale affect will result when submitting to a black and white printer/plotter).

HalfClr.pen For half-size color printing. (A gray scale affect will result when submitting to a black and white printer/plotter). Line weights and patterns are reduced to simulate a half-size reduction.

HalfClr-75.pen      For half-size color printing. (A gray scale affect will result when submitting to a black and white printer/plotter). Dropout pattern is reduced by 75% from full-size.

### For 11 x 17 Printers

With the coming of Windows 7 (64 bit), drivers that were used with 11 x 17 legacy printers on the XP platform are no longer available. But Bentley Systems has two new drivers that can be used for both XP (32 bit) and Windows 7 (64 bit). These drivers are the “HP Generic PCL/5 Mono by Bentley” and the “HP Generic PCL/5 Color by Bentley” drivers.

When printing black and white to an 11 x 17 printer, use the “HP Generic PCL/5 Mono by Bentley” driver along with the Caltrans design script “halfbw-PCL.pen.”

When printing color to an 11 x 17 printer, use the “HP Generic PCL/5 Color by Bentley” driver along with the Caltrans design script “halfclr.pen.”

### For Right of Way Maps

The following four design scripts are similar to the preliminary design and check print design scripts.

**“rwe\_fullbw.pen”**  
**“rwe\_fullclr.pen”**  
**“rwe\_halfbw.pen”**  
**“rwe\_halfclr.pen”**

The following four design scripts are the same as the four above, but have been optimized for 600dpi.

**“rwe\_fullbw-600dpi.pen”**  
**“rwe\_fullclr-600dpi.pen”**  
**“rwe\_halfbw-600dpi.pen”**  
**“rwe\_halfclr-600dpi.pen”**

The following Right of Way design scripts are all designed to color-fill Parcel Boundaries. The selection of a design script will affect whether line work is colored or black and whether line weights and patterns are reduced.

The eight design scripts with “SetPriorities” in the name are used to set “display priorities of elements prior to plotting”. The eight design scripts with “NoPriorities” in the name are used when display priorities are accounted for by means such as “Reference File Update Sequence” or “Move To Front/Back routine”. The design scripts with “-600dpi” in the name have been optimized for 600 dpi.

**“RW\_full\_Parcel-color\_Line-bw\_NoPriorities.pen”**  
**“RW\_full\_Parcel-color\_Line-bw\_NoPriorities-600dpi.pen”**  
**“RW\_full\_Parcel-color\_Line-bw\_SetPriorities.pen”**  
**“RW\_full\_Parcel-color\_Line-bw\_SetPriorities-600dpi.pen”**  
**“RW\_full\_Parcel-color\_Line-color\_NoPriorities.pen”**  
**“RW\_full\_Parcel-color\_Line-color\_NoPriorities-600dpi.pen”**  
**“RW\_full\_Parcel-color\_Line-color\_SetPriorities.pen”**  
**“RW\_full\_Parcel-color\_Line-color\_SetPriorities-600dpi.pen”**  
**“RW\_half\_Parcel-color\_Line-bw\_NoPriorities.pen”**  
**“RW\_half\_Parcel-color\_Line-bw\_NoPriorities-600dpi.pen”**  
**“RW\_half\_Parcel-color\_Line-bw\_SetPriorities.pen”**  
**“RW\_half\_Parcel-color\_Line-bw\_SetPriorities-600dpi.pen”**  
**“RW\_half\_Parcel-color\_Line-color\_NoPriorities.pen”**  
**“RW\_half\_Parcel-color\_Line-color\_NoPriorities-600dpi.pen”**  
**“RW\_half\_Parcel-color\_Line-color\_SetPriorities.pen”**  
**“RW\_half\_Parcel-color\_Line-color\_SetPriorities-600dpi.pen”**

## D. Functions and Features of Caltrans Design Scripts

### DROPOUT

1. Converts all elements on Levels 2-9, & 11 (and all specified dropout levels for a MicroStation V8 format file) to the specified 'dropout' pattern, as long as the color of an element is not 101 through 116. For additional dropout levels in a MicroStation V8 format file (see Appendix A9 of this manual for a list naming and describing each level).

Note: Colors 101 through 116 are used when one wishes not to dropout an element that resides on a dropout level.

2. Converts all elements with color 85-100 to the specified 'dropout' pattern.

Note: Colors 85 through 100 are used when one wishes to dropout an element that does not reside on a dropout level but maintain the RGB value while viewing the element on the monitor.

### WEIGHTS

3. Reduced weight (WT =) assignments for elements on dropout levels 2-8, & 11 (and all specified dropout levels for a MicroStation V8 format file) except with colors 101 through 116.
4. Reduced weight (WT =) assignments for elements with dropout colors (85-100).
5. The reduced weight assignments for dropout features are as follows:
  - a. Weight 1 is converted to weight 0.
  - b. Weight 2 & 3 are converted to weight 1.
  - c. Weight 4 & 5 are converted to weight 2.
  - d. Weight 6 & 7 are converted to weight 3.
  - e. Weights 8-31 are converted to weight 4.

### LINE THICKNESS (Full Size Plot – 22" x 34")

6. Weight 0 is set to .005 inches.
7. Weight 1 is set to .0125 inches.

8. Weight 2 is set to .02 inches with subsequent weights graduating at a .005 inch increment.

### TIME / DATE STAMP

9. Certain characters or text strings are substituted to print specific information at the time of a plot. These characters are included in the standard border sheet. The substitutions are listed below:

<b>Characters to be substituted</b>	<b>Information plotted</b>
\$TIME	Time of plot
\$DATE	Date of plot
\$USER	Person who sent plot request
\$REQUEST	Design file name
<b>Characters not part of border sheet</b>	
\$FREQUEST	Directory path with design name
\$QUE	Name of the printer queue used

Note: There are additional characters or text strings included in the Caltrans design scripts that are not actively used.

### USING COLORS TO PLOT

10. In the design script "CT\_FinalPSE.pen", all elements are set to black (0,0,0) in order to ensure black and white plotting/printing for final PS&E submittals.
11. In the design scripts for preliminary design and check prints and the Right of Way Engineering design scripts, colors 0-127 are set to black to prevent grayscale occurring. Elements can be placed with colors 128-249 if needed for a color or a grayscale effect.
12. R/W monument cells, landscape cells and some drainage cells use color 250 for area masking. Masking allows a shape to have a black fill color (on the workstation monitor) to match the preferred monitor background and then be plotted with a white fill to match the white paper. Color 251 is used as a boundary for masked areas when the boundary needs to be seen when printed.

13. Translucent plotting is usually done over a raster image (aerial photo) to distinguish specific areas or parcels from one another. Translucent plotting can be accomplished with MicroStation V8i or pre-MicroStation V8i.

Pre MicroStation V8i:

Translucent plotting can be accomplished by placing shapes using the Caltrans line style “zz-fillshape1” (Note: using “zz-fillshape1” does not work in MicroStation V8i). The shape does not need to be filled with a color. This helps those using MicroStation V8-2004 since this version does not support translucent elements like V8i does.

When the line style “zz-fillshape1” is used to create a shape, the tinting (translucency) will take on the same color as the boundary of the shape. In addition to the tinting, the boundary will be converted to the color white in order to separate different tinted areas.

Translucent plotting, using the line style “zz-fillshape1” with MicroStation V8-2004, is only supported by color plotters/printers that use Interplot drivers. This also includes Raster Offline cues and Export PDF functionality.

Note: Interplot only supplies drivers for full-size plotters (not half-size printers), which include the HP-1055 color plotter and the HP-4500 color plotter.

MicroStation V8i:

MicroStation V8i supports elements with translucent properties. Files with translucent elements can be sent to any color plotter/printer to achieve the tinting effect.

## MISCELLANEOUS

14. Corners are set to curve (not mitered) for text, shapes, line strings and line styles to prevent the problem of a ‘spiked’ affect that occurs with some printers.

E. Dropout logic and weight and patterning values

Dropout Levels and Colors

Dropout Levels	Dropout Colors	NO Dropout Colors
2-9,11 202-208 302-309,311 402-409,411 502-509,511 602-609,611 702-709,711 802-809 871-900	85-100	101-116

Pattern for Dropout (dash/gap in inches)

(These random patterns give a better look than a straight dotted pattern)

Table	Dash	Gap	Dash	Gap	Dash	Gap	Dash	Gap
Full	.0075	.020	.010	.0225	.0125	.025	.010	.0225
Half	.00375	.01	.005	.011	.006	.012	.005	.01125
Half 75	.005625	.015	.0075	.0165	.009	.018	.0075	.016875

Reduced Weight for Dropout

Non Dropout Weight	Dropout Weight
0	0
1	0
2-3	1
4-5	2
6-7	3
8-31	4

Weight Thickness assignments

Weight	Full Pen Tables (inches)	Half Pen Tables (inches)	Half-PCL Pen Table (inches)
0	0.005	0.0025	0.005
1	0.0125	0.00625	0.007
2	0.020	0.010	0.010
3	0.025	0.0125	0.0125
4	0.030	0.015	0.015
5	0.035	0.0175	0.0175
6	0.040	0.020	0.020

Note: Weight 2 and above increment by 0.005” for Full, 0.0025” for Half.