

## **PROJECTS FROM AS- BUILTS**

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# **NEW PROJECTS USING AS-BUILT PLANS**

## **Introduction and Overview**

This document can be used to help you prepare a set of plans when no CADD Microstation files are available. This is partially accomplished by using as-built plan sets.

Locating the as-built plans requires that you have enough information about your project to find other completed projects in the area needed. Roadway Design has scanned all the as-built projects plans and linked them to a database that can be accessed on Roadway Design's web server. You will have to use county names, project numbers, project descriptions, dates, etc. to locate the proper as-builts.

As-Built plans are scanned images of completed projects. The images were originally in a raster format called (TIFF). A TIFF image is usually a scanned copy of the original paper documents. Several things must be considered when using these raster images. Since these images are, in a raster format, you cannot use Microstation by itself to modify them and each sheet image does not have a coordinate system that will match up with any coordinate system.

Most AS-Built project images have been converted from TIFF to multi-page PDF files. PDF files are also consider raster files, but one significant difference between a PDF file and a TIFF file is that a PDF file cannot be edited. In cases, were you need to edit the raster images they will have to be converted back to individual TIFF images.

Your objective is to take the PDF or raster TIFF images and use them to create Microstation files that can be used in your project. The final product will be a combination of raster images and Microstation design files. This may be accomplished by creating digitized tracings of some of the raster images, Microstation vector drawing, or a combination of both. Microstation has the tools needed to reference and warp the images to a known coordinate system. Once they have been mapped (warped) to a coordinate system they can be digitized into the design file.

Warping the raster images to a coordinate system requires that you locate monument points in the raster image and match them to known coordinates in the Microstation design file. The most practical way to accomplish this is by storing and plotting the as-built projects alignments into Microstation. Then you can use stations on the raster images as monument points to match them up with the design file. Once these points have been matched, you can trace the raster image using Microstation tools.

The following information will give some general instructions on how to locate as-built plans and then use these images to create a base map for your project. I will also give some information on how to take advantage of additional raster files that you may want to use in a typical project

## **Options for Utilizing As-built Plans**

You have a few options to consider in regards to how to utilize As-built Plans in a creating a new set of plan or plan/profile sheets.

1. Reference to a stored alignment and digitize.
2. Redraw elements needed from scratch based on a stored alignment.
3. Reference to a stored alignment and use a combination of raster and graphics.
4. Do not Reference to alignments, but instead use sheet images as-is with cleanup and additions.

Which one you choose depends on a lot of factors. Including quality of As-built Plans and the type of project, you have to produce. Roadway recommends using a combination of 1 & 2 above for most projects. Drawing elements from scratch that you can locate by Station/Offset such as EP, ROW, some pipes, etc. and then digitizing other things you cannot locate. Option 3 could be used when the As-built sheets are in good condition. There will be times when you do not have to tie the sheets to an alignment (Option 4). Instead, you can place the sheet randomly in a DGN file to scale and use the sheet "As Is" except for the cleanup and additions you will need to do.

In all options, you may need to perform cleanup (delete unwanted items) from the sheet; via Microstation and Raster editing. Remember if you want to edit the raster image you must be in TIFF format

## Locating As-Built Plans

1. Use MDOT Collaboration site to access the As-Built Let Plans Query.

<http://mdotcollab/divisions/rwd/SiteAssets/Let%20Query.aspx>

2. If you do not know a Project Number for a set of plans, it is best to enter the route and county and then tag Submit Query to run the query.

**PROJ. # (CON)**  OR

As on Plans - SP-008-3(17) Formatted - 0008-03(017)

**FMS\_CON**

**COUNTY**

**ROUTE**

**TERMINI**

**DISTRICT**

Click [HERE](#) for recently LET projects.

TERMINI field is present in case you want to search for project in cities, at Rivers, etc.

3. Once you have located the project; you can either VIEW and/or LINK to the TIFF images under the DESIGN PLANS column. You can use VIEW to make sure you have located the correct information. Once located, you can use Link to copy the raster files. The CADD FILES column is a link to CADD files of the project. Obviously, if CADD files are available, you would want to download these and use them in your design process, but Microstation CADD files will not be available for many projects completed prior to the year 2000.

PROJECT NUMBER	SORT	FMS CON	COUNTY	ROUTE	LETTINGDAY	TERMINI	TYPEPROJ	DESIGNER	DISTRICT	PLANS	CADD Files
PE:STP-NH-055-02(185) ROW:ACNH-9204-00(001) CON:ACNH-9204-00(007)	9204-00(007)	100486/301000	Madison	55	3/27/2012	I-55 FROM OLD AGENCY ROAD TO SR 463 W/HIGHLAND COLONY CONNECTION PHASE II (Add 2 Lanes, Split Interchange, Frontage Roads)	INTERCHANGE	MICHAEL BAKER	5	Final Plans <a href="#">View Link</a>	<a href="#">Link</a>
PE:NH-0055-02(200) ROW: CON:NH-0055-02(200)N	0055-02(200)N	104819/301000	Madison	55	11/27/2007	I-55 FROM COUNTY LINE ROAD THROUGH THE I-220 INTERCHANGE - ADD ONE LANE	ADD 1 LANE	HARTER	5	Final Plans <a href="#">View Link</a>	<a href="#">Link</a>
PE:STP-NH-055-02(185) ROW:SP-0055-02(035) CON:SP-0055-02(035)	0055-02(035)	104831/301000	Madison	55	1/23/2007	I-55 WEST FRONTAGE ROAD FROM OLD AGENCY ROAD TO STEED ROAD	GRADE PAVE 2 LANE	MICHAEL BAKER	5	AsBuilt Plans <a href="#">Link</a>	
PE:STP-NH-055-02(185) ROW:ACNH-9204-00(001) CON:NH-SP-0055-02(190)N	SP-0055-02(190)N	100486/302000	Madison	55	9/12/2006	I-55 FROM OLD AGENCY ROAD TO SR 463 - PHASE 1 - ADD 2 LANES	ADD 2 LANES	HARTER	5	Final Plans <a href="#">View Link</a>	<a href="#">Link</a>

4. Tag LINK.

5. You will be taken to a directory that contains the PDF or TIFF Images. Select the files as you would in any other window and copy them to your project directory.

## Storing the As-Built Alignments

- Now that you have the raster images, you will want to locate monument points on the images that can be used to match to known coordinates in a design file. A good way to do this is to use the alignment information as shown on the images use Geopak to store the alignment and plot them into Microstation. Then you will have station points along the raster image alignment that you can match to your design file.
- To store the alignment, use Geopak's Coordinate Geometry application and then draw it into a Microstation design file. Ensure that the alignments you store are identical to that which is shown on the as-built plans. Otherwise, all other work done from this point on would be wasted.

## Referencing and Warping the Images

If you have some alignments stored that match the raster images you can then reference and warp them to the alignment in the design file. Using the RASTER MANAGER utility, you can perform the referencing and warping required. Warping means you will move and rotate the image so that the alignment on the images matches the alignment you placed in the design file. The first step is to take the raster images (in this example, we will be using TIFF raster files) and use the Raster tools to match them up to the design file alignment.

1. Open the design file you want to attach the image (ali.dgn).
2. Activate RASTER MANAGER.
3. Use FILE > ATTACH and locate the first raster image. Note: raster image should be in the same directory as the design file.
4. Recommend: Place Interactively (ON). Open Read-Only (OFF)
5. Place image into the design file. You should place it close to the area of interest to make the matching process easier in future steps. Scale does not matter at this point, because we will be warping it into place later.
6. Now we need to match the raster image to the drawing. This is done using the warping tools. This tool can be found on the Raster Manager dialog under EDIT WARP.

### Warp Tools

There are three methods of warping; ALIGN, SIMILITUDE, and AFFINE. The ALIGN method will only move and or scale the raster file. The SIMILITUDE method will move, scale, and rotate the raster file. AFFINE will move, scale, rotate, and skew the raster image. Since we will need to rotate the raster image we must use either the SIMILITUDE or AFFINE methods.

Usually a skewing factor need to be applied when trying to warp photographs to a match a drawing. This will remove some of the error in the matching process due to the 3 dimensional aspect of the photo. For engineering type drawings you could use SIMILITUDE, but many factors cause original paper drawings to get off-scale. Including the original being drawn by-hand or the image was not square when scanned. For these reason, we recommend using the AFFINE method.

The AFFINE method will remove many of the scaling errors, especially if you use include a lot of points when doing the warping process.

- Use the AFFINE command to start matching (image) points to drawing (monument) points. Before you begin you should locate matching points on your drawing with points you can locate on the image.

## Points for Warping Process

One tool that is very useful for this is the Geopak DP/STATION OFFSET tool. Place a cell such as (DP), which are easy to snap to.

Locate points on the image that can be found using stations and offsets. Such as; row markers, benchmarks, etc.

The more points you can locate on the image the more accurate the warping process.

When running the AFFINE command it is best to identify the points in a counter-clockwise circular direction.

All the warping commands are a bit tricky. You have to match raster image points with known points. Using two or more views will help. Put drawing points in one view and raster image points in the other. View control is needed to zoom to points were you can see them. This means you have to zoom, window area, fit, etc. while doing the warp process. You press the reset after doing a view manipulation to return to the warp command, but DO NOT press the reset button again when have returned to the warp process. If a reset is pressed during a warp command the warp process will be processed. For this reason you have to be very careful which buttons you press. If you press reset at the wrong time the warp is processed and you will have to UNDO and start over.

- Repeat the procedure above for each image that needs to be referenced and warped.

The steps above show the basic process of referencing raster images to a drawing. In that example you still need to do additional work to make it usable in your project. You can't use them to make plan/profile sheets unless you either digitize (trace) the raster images or edit the raster data to make it useable for setting up plan profile sheets.

## Single Plan Sheets

An alternate scenario is when you want to use the actual raster image as part of the sheet in your plans. This may occur when you are creating certain sheets, such as; typical sections or detail sheets. When this occurs you will need to reference the raster image in at a specific scale and then do some raster editing to make it usable.

1. Create or open the design file you want to attach the image. (Create typ.dgn)
2. Activate RASTER MANAGER.
3. Use FILE > ATTACH and locate the first raster image. Note: raster image should be in the same directory as the design file.
4. Recommend: Place Interactively (OFF). Open Read-Only (OFF)
5. Place image into the design file by selecting OK.
6. Fit the image to a view with the DISPLAY > FIT RASTER TO VIEW

## Checking the Scale and Rotation

If the raster image was created at its original scale the image will come into the design file at the correct scale. If the image was scanned properly it should be square with the view. If either condition is not true, you will have to warp the image to a known element.

7. If warping is required, draw linear elements into the design file that match a known dimension on the raster image.
8. Then use the EDIT > WARP > SIMILITUDE command to warp the image to the drawing. This warping scenario usually only requires that you scale and rotate. The affine method usually does not work in these situations where you are only trying to line up a single linear element.
9. Now that you have the image in the design file at a scale and also rotated to be square with the view you can use it in your plans after doing some raster editing or clipping.

## Raster Clean-Up and Editing

The next objective is to clean-up or edit the raster image to make it more usable in your project. The extent of the edit depends on how it's to be used in the project.

If you're using it for digitizing purpose, you may only want to do some minor changes to the raster images where they overlap. First, convert them to TIFF format (if needed) and if you're using a complete raster sheet image, you may need to do more extensive editing. Such as; removing the sheet border, adding annotation, and making some changes to the drawing details on the sheet.

## Raster Editing – Preparing to Digitize

1. If you have TIFF raster references attached to an alignment file for digitizing. It may be helpful to modify the raster images. One item that you may want remove are were the images overlap. This will help in the digitizing process.

Image Editors:

**Axiom RasterDGN.** MDOT has a state-wide license to use this editor. RasterDGN works inside of Microstation to edit raster images. Roadway Design has installed this product for our division only. It can be installed by using the MDOT internal link below.

<\\rwdcadd\support\software\axiom>

Locate the "RasterDgn" folder and "exe" file and run it. The license is located in the same folder structure under a license folder. This is the only Raster Editor we currently have licensed to use state-wide.

A instructional video is available at the following link:

<http://sp.gomdot.com/Roadway%20Design/CADD/Microstation/Videos/Axiom%20RasterDGN.swf>

If you wish to use more sophisticated editing tools, you can pursue them yourselves. Here are some suggested tools. MDOT and Roadway Design do not endorse or support these products. Availability may be limited and change without notice.

DECARTES is a raster editing product available from Bentley, and it works inside of Microstation. This product may be available for download by MDOT users from Bentley's web site. This program has a steep learning curve, so it may not be the best choice for casual editing.

PAINT.NET is an easy to use third party software raster editor provided free by its creators.

GIMP is GNU Image manipulation program that is freely distributed. This program has a slightly higher learning curve, but has a lot of features.

There are many editing applications available that have advanced tools for editing images. If you do decide to use a different product, we suggest that you make sure it has the ability to load, save, and print "Tiled Group 4 (compressed), two color (black/white or color) tiff files. This the ONLY format we can currently accept as a final format. If the editor can't produce this format, then use another product that has the ability to convert other formats to the one that is currently required. (i.e. FastStone Image viewer)

2. You should now be ready to digitize the elements into the design file, which we will also cover in more detail.

### **Raster Editing – Using a raster sheet in your plans (not just for digitizing)**

1. Before you use a raster sheet in your plans you should consider several things.
  - a. Is the quality of raster image good enough to convey your details? When you plot it, will all the details show up properly?
  - b. Will you need to do minor or major raster editing? If you think that you will have to do some major work, it may save time to digitize the drawing or draw it from scratch.
  - c. Does the drawing have accurate details?
  - d. Is the drawing to scale? If the drawing is not to scale it can be difficult to find a scale that you can use to make your modifications.

2. If the drawing can be used, you can use your image editor to make your edits. Common edits are to remove the old sheet border, change project numbers, or erase data that is no longer applicable to your new project.
3. Even after doing all the raster edits you will most likely have to use Raster Referencing to bring the image into Microstation to add additional vector drawing data. In addition you will likely have to warp the image. Warping will of course bring in to a correct scale and rotation (most of the time, scans are not straight).

### **Raster Clipping**

Another tool that is available to you is Raster Clipping. The EDIT > CLIP command. This command will clip the reference so that anything outside the area will not show. The area can be defined by placing a block during the clipping process, or by identifying an element in the design file, or a fence that was previously placed. Note: The image cannot be set to "Read-Only" in order to clip the image.

This command probably would only be useful for quickly getting rid of items like sheet borders around the main drawings. It is an alternative to having to actually removing things from the original images. This process would therefore maintain items that could be brought back for display at a later time.

4. After referencing the image, warping it and adding your new details you should be able to use it as a sheet in your project. Depending on how you're plotting, you may have to make the raster image "white" to plot it in black and white.

## **Digitizing (Tracing)**

The objective of digitizing is to trace the raster images. With the images referenced, cleaned up, and warped to their proper scale and rotation, you can begin tracing the drawing. You should plan to keep the original copies of the images so you can refer back to them during the digitizing process.

The Roadway Design tools that are part Microstation play an important part in digitizing. You will be tracing over the raster elements with the command that is associated with that image element. When you begin drawing, you should try to find the Microstation commands best suited for drawing that element.

1. Use Microstation and the Roadway Dzine menus to help trace the elements into the design file.
2. Listed below are some tips for digitizing:
  - a. By following the order of the Dzine menu items, draw each type of element in order. This will help ensure that you don't miss anything.
  - b. If you think you have completed digitizing over a particular raster image you may want to turn it off. This would indicate to you or someone else that you have finished with that image. I don't recommend that you detach the images, because if you need to turn them back on, you would have to go through the

entire attach and warp process again. A raster images reference display cannot be turned off like a design file. Instead, you have to turn the raster display off in the view(s). Go to RASTER MANAGER and use the View numbers on the dialog to quickly turn on/off the display.

- c. You can use Geopak's "Station/Offset" utility to help you more accurately place elements in the design file. For example, If the raster image indicates that a right-of-way marker is 60 feet right of station 10+00, you can use the utility in Geopak to place the cell at this exact location, instead of just visually placing the cell by looking at the raster image.
- d. Whenever dimensions are given on the raster image, you should try to use those exact distances instead of just tracing. For example if the existing edge of pavement lines are exactly 12 feet parallel to the alignment. You should copy the alignment parallel 12 feet instead of just tracing the lines from the raster image.

## Digitizing Steps

1. You should have the alignment stored and drawn into Microstation. The raster images should be attached as references and the images warped to the alignment. The raster images are now ready for digitizing.
2. Select the proper commands from the Roadway Menus and Microstation for each image element and begin drawing. Continue tracing each element in turn.  
One of the problems with digitizing is making sure that you have traced everything. You should look over the drawing carefully to make sure you haven't missed anything. A good way to do this is to step through each item on the RWD Dzine Menu one at a time. You should not just trace by sight only, especially when you know the dimensions. For example, if you know the edge of pavements are 12 feet parallel to the alignment, you should copy the alignment parallel instead of just tracing by sight.
3. When completed, you will have replaced all the raster elements with vector elements and you can turn off each raster image. You shouldn't de-attach the images because you may want to use them later.

## Title Sheets

The objective of this session is to learn how to combine some drawings and put together a title sheet. The most difficult process is getting the base map for your project location.

### The Base Map

1. The first thing you need to do is locate the base maps that match the location of your project. We can take Planning Division county maps and crop out the areas from them to use for the base map.

Current location of Planning Division maps: <\\mdotpdssrv005\maps>

Current location of modified versions of planning maps that will be under constant updating and are modified to Roadway Design drawing standards, there are located here: [\\rwdquads\title\\_graphics\county\](#)

2. Copy the county map from that corresponds to your project.
3. Enter the county map design file and check or change the attached GIS coordinate system. Use the MSTM coordinate system in these county map files.
4. Create a new design file for your Title Sheet (title.dgn).
4. Reference in the following files:
  - a. County Base Map (Attach using the Geocorridinate method of alignment.)
  - b. Your Border file
  - c. Your Alignment file
6. Next you should crop-out any area of the county base map you do not need. Use the Reference Clip Boundary commands.

Recommendations:

  - a. When clipping be sure to leave plenty of extra data around the project limits. This varies with every project.
  - b. Look at the text descriptions around the area. Some of the text may normally get clipped. You may want make your clipping area much bigger to make sure you get the text gets included. You need the text for future reference.
7. You now need to edit the county base map data. Copy the reference data into you design file. Make sure you only copy the Base Map and not any other reference data. You must copy the data into the file to allow editing.
  - a. Turn display off for all references except county base map.
  - b. Place a fence around data can use a fence copy to copy it into the design file. Make sure your copy from and to points are the same.
  - c. Make sure the FENCE LOCK > CLIP is on, otherwise not all data will be copied.

Why this data may needed editing\*\*\*:  
The text sizes are not the proper scale and also may need to be moved and scaled.  
Line symbology may need to be changed or re-scaled.  
Filled elements may be present and need to be removed.  
\*\*\*If you use Roadway Design's version of County dgn files you will have to do less editing.
8. You can de-attach the county map reference file and turn on the display of the other references.
9. You can now begin your final editing on the base map. First you need to determine what section will remain. You can do this by placing a title sheet cell into the design file at a scale that will cover the area you need.
  - a. Place a TITLE SHEET cell. Change the active scale to fit. The active scale you use will also be your working/plotting scale.
  - b. A rectangular shaped placed in the design file around the area you need to keep may help when placing the title sheet.
  - c. LOCK the title sheet cell so you can't delete it.
10. Begin editing the map graphics:
  - a. Remove any graphics you don't need.

- b. Scale, move, and fix the text to work for your drawing. Watch out for “view independent” text. This text will rotate based on the view rotation. You can modify it with the “Analyze” or Element Information command.
- c. Remove or modify “filled” shapes. Most of the highway marker shields are filled shapes. You will have to drop the cell to edit them. They may be other filled shapes that may need modifying. It may be easier to delete and replace.
- d. A check plot is a good way to see what things need to be modified.
- e. Use the referenced border as a guide to place the plan sheet coverage blocks and placement of alignment stationing work. You should then de-attach the alignment and border files.

Note: Roadway Design versions of the county dgn files will require less edits.

11. Once you have the graphic ready, you will need to add the items that are required for title sheets. Before you begin that you need to know a few things about a title sheet cell.
  - a. The cell contains “data fields” that you can use to fill in. You should probably turn on data fields in the view while you are filling them out. The fields just below the project number area are for FMS numbers.
  - b. The Project Number text area contains pre-placed text for either State or Federal numbers. Since the sheet is a cell you will either have to turn off a level or drop the cell to remove one of them.
  - c. If you’re having trouble editing the title sheet cell, it may be locked.
12. The items that are needed for a title sheet can be found by looking at the Quality Control Check List. This check list is an Excel Spread Sheet that can be found at the following Intranet Link. Use this link to view or save the spreadsheet. A copy of this file is already located on your computer in  
`...rwwdata\apps\standardforms&letters\qualitycontrol.xls`

## **Additional Sheets from Raster Images**

You may want to use other raster files located in the as-built set. A good example would be a typical section drawing. These details can be time consuming when done from scratch. By using what is already on the raster images, you can remove any items on the image that is not applicable and then add in Microstation elements to make a final detail for your particular project.

In the end you always need to be able to plot. Most plots are done in black and white. This may require you to make the color of the raster elements that are referenced into Microstation to be “white” on the black background.

Try to pull-out any raster detail or drawing that may save you some drawing time. Think ahead and try to balance the time it takes to edit the raster image compared to how long it would take to draw everything from scratch. You don’t want to use the raster images if it requires tremendous editing time. In the end, it’s always better to have Microstation vector type

elements, for they are much easier to maintain and update. Remember the objective of using the raster files is to save drawing time.