Digital Printing

By Dorothy Gantenbein

1. Further Reading

1. *"Fine Art Printing for Photographers"* by Uwe Steinmueller & Juergen Gulbins. ISBN 978-1-933952-00-8. See http://www.amazon.com/Fine-Art-Printing-Photographers-Exhibition/dp/1933952008/sr=8-1/qid=1163843197/ref=pd_bbs_sr_1/102-5073776-7483301?ie=UTF8&s=books.

2. *"Build Your Own Controlled Light Print Viewing System"* by Joseph Holmes. See http://www.ppmag.com/reviews/200605_rodneycm.pdf on second page.

3. *"Real World Image Sharpening with Adobe Photoshop CS2"* by Bruce Fraser. ISBN 0321449916. See http://www.amazon.com/World-Image-Sharpening-Adobe-Photoshop/dp/0321449916/sr=8-1/qid=1163884205/ref=sr_1_1/102-5073776-7483301?ie=UTF8&s=books.

2. Color Management

Simply put, you want your prints to match what you see on the screen.   Here are all the areas that must be addressed.

- Viewing lights to see your print color accurately.
- Profiled Monitor otherwise you cannot tell what you are working on.
- Print profile for your printer, paper and ink combination.
- Photoshop color management settings.

2.1. Viewing Lights

To review your prints, your viewing light is essential. For color proofing, you have several choices.

- Inspect in bright sunlight around noon (otherwise color temperature changes). This is not a reliable method.
- Indoors, look for a light source of 5000K (give or take 500k).
- Look for a D50 light source about $100-$150.
    - o Solux TrueColor Task Lamp
    - o Ott-Lite True Color Lamp
    - o Sol-Source by Gretag MacBeth
- Buy a D50-compliant bulb or tub. Use it in a lamp with a neutral gray or white reflector shade about $15-$25.
    - o You can buy these bulbs from SoLux and Ott-Lite.
    - o Do not buy a daylight fluorescent bulb because these have color spikes.
    - o Philips TL-969 5000K fluorescent bulb or Philips Colortone F40-T12/C50.

2.2. Monitor Profile

Your monitor must be profiled for color and brightness to show you accurate colors. Based on first hand experience, this can cause all sorts of problems when not properly profiled. Your monitor should be profiled regularly about once a month.

You can use the Adobe Gamma tool for profiling your monitor manually. However, this is can be very inaccurate and is not recommended.

There are inexpensive hardware-based profiling products.

- Gretag-MacBeth Eye-One Display 2: $230
  http://www.gretagmacbeth.com/index/products/products_color-mgmt-spec/products_cm-for-creatives/products_eye-one-display.htm.

- Colorvision Spyder2Express: $70
  http://www.colorvision.com/profis/profis_view.jsp?id=581

For Mac and Windows, here are your calibration settings.

White point:	6500K (D65)
Gamma:	2.2
Luminance:	100-150 cd/m^2

2.3. Printer Profile

A printer profile is specific to the printer, paper and ink combination.

- If you are using Epson's paper and ink, their profiles are very good and can be used.
- For the Epson 2200 profiles, download at http://www.epson.com/cgi-bin/Store/EditorialAnnouncement.jsp?oid=42114986. Only use the more recent 2200 profiles because earlier profiles were not very good.
- For the Epson 2400 profiles, download at http://www.epson.com/cgi-bin/Store/support/supDetail.jsp?BV_UseBVCookie=yes&oid=54861&prodoid=53540920&infoType=Downloads&platform=All.
- If you use a non-vendor paper or inks, you need a custom profile. You can buy a custom profile from http://www.inkjetart.com/custom_profiles/ for $25. When creating a custom profile, make sure that you write down all your settings. If supported, save your settings with a name in your printer driver.

2.3.1.   Installing Profiles

Profiles are a file ending in '.icc'. Sometimes on Windows, a profile ends with '.icm'

Mac OSX Installation

If you have administrative access and want the profile for all users, place the profile in the following directory:

```
System/Library/ColorSync/Profiles/
```

If only need the profile accessed by yourself, place the profile in the following directory:

```
~user/Library/ColorSync/Profiles/
```

Mac OS 9 Installation

Place the profile in the following directory:

```
System Folder/ColorSync Profile/
```

<u>Windows Installation</u>

Right click on the profile file and select *Install Profile*. This will install the profile in the following location.

```
XP:    c:\windows\system32\spool\driver\color\
2K:    c:\winnt\system32\spool\driver\color\
NT:    c:\c:\windows\system32\color\
```

2.4. Color Space

When working digitally, your digital image files should have an embedded color profile. Always work with an embedded profile because the RGB color numbers without a profile are just meaningless percentages. These embedded color profiles determine the number of colors that can be represented (nope, not infinite). The set of all possible colors defined in a color space is called it gamut.
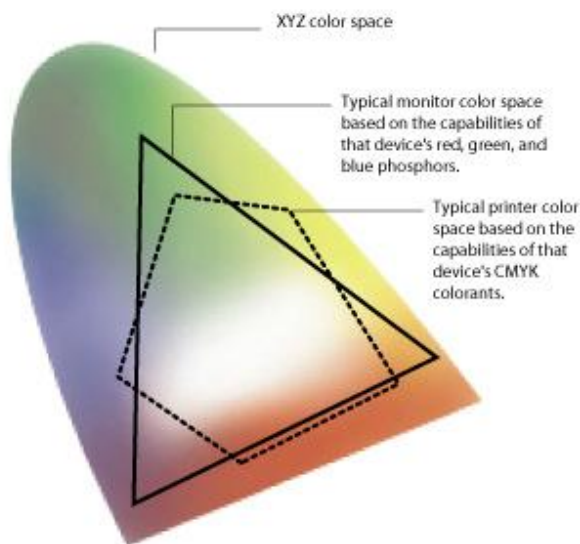
As you can see from the previous picture, not all color spaces are the same size. Here are the popular color spaces.

- sRGB: very small color space. Originally used to represent a monitor color space. Good for images posted on the web or email. Do not use for image processing.

- Adobe RGB (1998): large space and very popular with Photoshop users. If you are using a digital camera and shooting JPGs, use this space.

- Pro Photo RGB: a very large color space. Growing in popularity for images because when you adjust your image in Photoshop, it is very unlikely that you will clip your colors and lose information. See http://www.outbackphoto.com/color_management/cm_06/essay.html.

You can view your color spaces and compare their sizes. Actually, colors spaces are 3-dimensional (red, green, and blue axes). There are utilities to view your color spaces and compare then against each. This is useful to compare different printer profiles to your image's color space.

- On Mac OSX, you can use the Color Sync utility.

- On Windows, you can download the MS Color Control Panel. The visualization is very limited but also handy for managing profiles. See http://www.microsoft.com/downloads/details.aspx?FamilyID=1e33dca0-7721-43ca-9174-7f8d429fbb9e&DisplayLang=en.

- There is a great commercial tool for viewing color spaces. See http://www.chromix.com/ for $150.

2.5. Photoshop Color Management Settings

In Photoshop, set your color management settings. In Photoshop CS2, open *Edit | Color Settings* dialog.
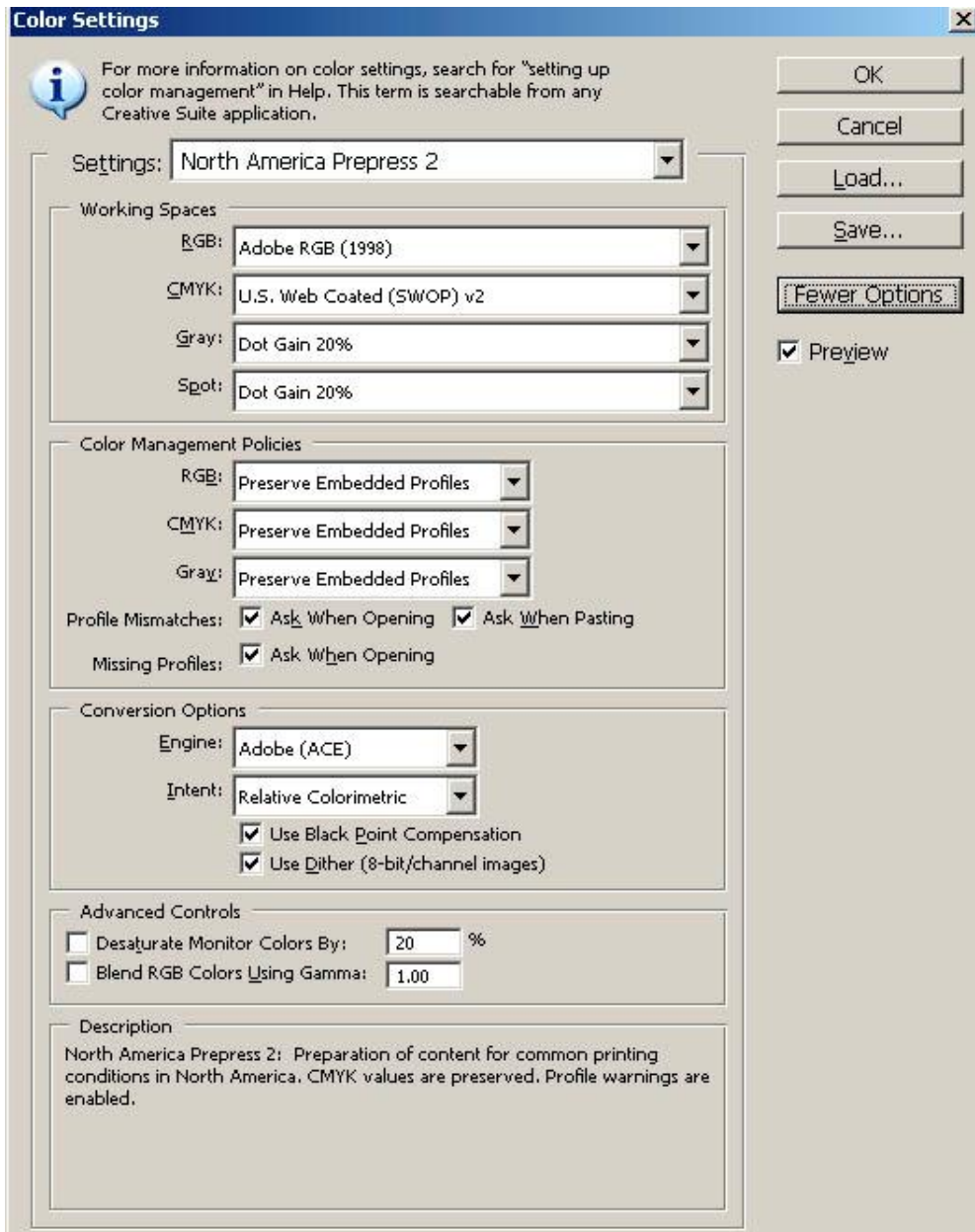
- In the Settings drop down list, you can choose *North America Prepress 2* for these settings.
- The *Adobe RGB (1998)* color space is a good choice or *Pro Photo RGB* depending on your workflow.
- The *Preserve Embedded Profiles* is a good choice so that you do not override an image's embedded color profile by opening it in Photoshop.

2.6. Sanity Check

After doing all your color management work, run a sanity check. You can download a reference image from Bill Atkinson's website. Look at the image in Photoshop and print it. See http://www.jirvana.com/resources/printing/.

3. Printing Workflow

3.1. Image Optimization

Optimizing an image in Photoshop is the subject of many books.

1. When working with an image, start with global problems and finish with local adjustments.
2. Start with cropping and straightening your image.
3. If necessary, remove noise. I recommend Noise Ninja plugin. See http://www.picturecode.com/.
4. Begin with optimizing your tonal range. Here are a few good online resources.
   - Histograms and Tones
     See http://www.cambridgeincolour.com/tutorials/histograms1.htm.
     See http://www.cambridgeincolour.com/tutorials/histograms2.htm.
   - Levels & Curves
     See http://www.cambridgeincolour.com/tutorials/levels.htm.
     See http://www.cambridgeincolour.com/tutorials/photoshop-curves.htm.
   - Local Contrast Enhancement
     See http://www.cambridgeincolour.com/tutorials/local-contrast-enhancement.htm.
5. Next, work with your color adjustment. It is a good idea to temporarily add a *Hue/Saturation* adjustment layer and radically increase saturation. This will show you what colors you actually have.
6. Set Black and White points in your image using Levels or Curves. See http://www.siberart.com/teaching%20pages/downloads/instruction/setting_points.pdf.
7. Address local color problems from here.
8. Begin local adjustments. Here is one technique that I learned from Vincent Versace. See http://www.dorothyphoto.com/dorothy_photo/2004/11/photoshop_tip_e.html

3.1.1. Variations

The Variations command lets you adjust the color balance, contrast, and saturation of an image by showing you thumbnails of alternatives. This command is most useful for average-key images that don't require precise color adjustments. It does not work on indexed-color images or 16 bit per channel images.

In Photoshop, open an image. Make sure that your color depth is 8 bit. Run *Image | Adjustments | Variations*.

3.1.2. Ring Around

In the wet color darkroom, the "Ring Around" technique is common to evaluate images. In Photoshop, you can use this technique to make sure that you have picked the best processing choices or if you are unsure about your color choices.

Note this action only work on Windows unless you want to modify the 9 save commands in the action.

- Download the Ring Around Photoshop action from http://www.outbackphoto.com/DigitalCameraExperiments/dce_003/essay.html and install into Photohshop.
- Create a directory named c:\tmp\ring_around\.
- Open an image that you want to evaluate into Photoshop.
- Run the *Ring Around* in Photoshop.
- In Photoshop, run the *File | Automate | Contact Sheet II.* In the contact tool dialog, setup a 3x3 thumbnail grid and check *Use Filename as Caption.* Use the *Arial 9* font.
- Print your contact sheet.
- Clean out your c:\tmp\ring_around\ directory.

3.2. Sizing & Sharpening

Once you are ready to print an image, make sure to work on a duplicate to avoid overwriting your original image. In Photoshop use the *Image | Duplicate* to avoid changing your original.

Now working with a duplicate image, you should resize your image. This resizing can become very complicated if you are radically increasing the size. If not, you can use Photoshop's *Image | Image Size* command. Make sure that *Resample* and *Constrain Proportions* are checked. Verify that your *Resolution* is somewhere between 240 and 360 pixels per inch. Enter your new print size.
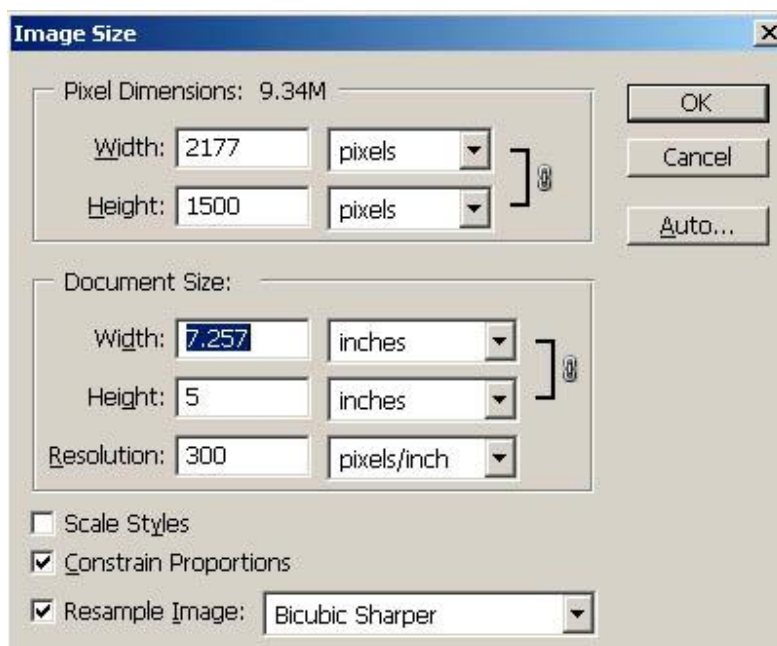
- If you are make the image bigger, then choose *Bicubic Smoother.*
- If you are making the image smaller, then choose *Bicubic Sharper.*
- If you do not want to remember like me, stick with *Bicubic* for all cases unless you are changing the size more than 200%.

Sharpening is another complex topic. There is an excellent reference book that covers all the cases in exhaustive detail. See "*Real World Image Sharpening in Photoshop CS2*" by Bruce Fraser.

For me that is too complicated, Bruce works for PixelGenius and their Photokit Sharpener plugin has all that logic done automatically. You can download the Photokit sharpener at http://www.pixelgenius.com/photokit/index.html. It is about $100.

3.3.   Soft Proofing

The color space (or gamut) of your image, your printer and your monitor are not the same. In general, the printer color space is much smaller than your monitor's color space. To help you visualize what you will print, Photoshop offers soft-proofing. Using soft-proofing, you can simulate viewing your printed output using the printer's profile.

To setup for soft-proofing, use the *View | Proof Setup | Custom*. This lets you choose your printer profile and rendering intent.
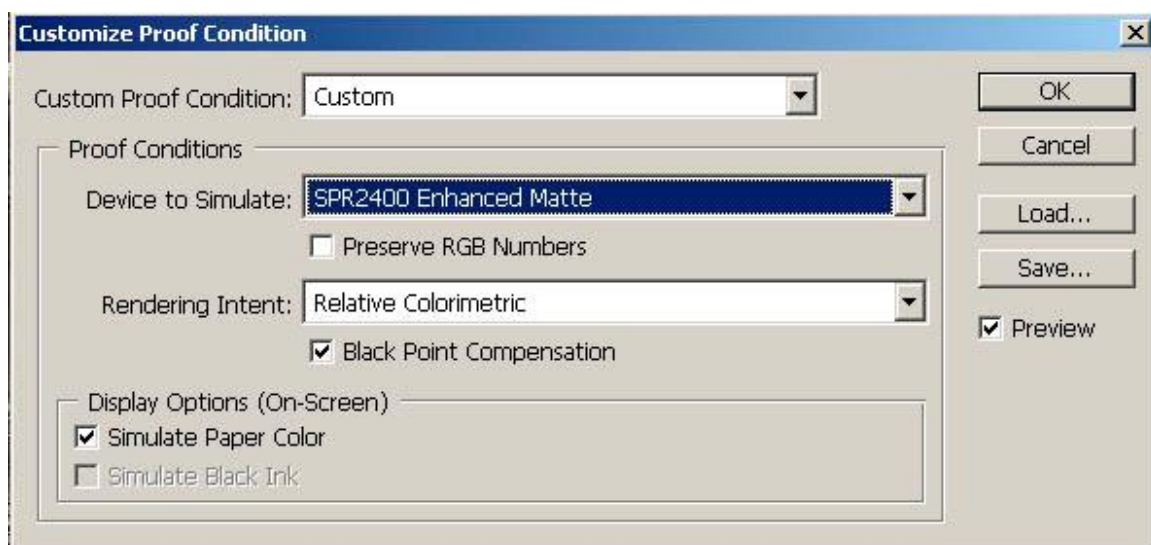
- When choosing the Epson profiles, make sure to choose the profile with just the paper name rather than something like "SPR2400 Ehhanced Matte BstPhoto".
- Use *Relative Colormetric* rendering intent as a starting point. If you have a lot of out-of-gamut, then you can switch to proofing *Perceptual* rendering.
- Check *Black-Point Compensation*. This improves the simulation because it compensates for the fact that you cannot print pure black.
- Check *Simulate Paper Color*. This improves the simulation because it compensates for the fact that your paper is not pure white.

Now that you have the color-proofing setup, go ahead and turn on *View | Proof Colors*. This command toggles the soft-proofing on and off.

Also take a look at the out-of-gamut warning. Use the *View | Gamut Warning* command. When gamut warning is on, it shows you all colors that cannot be printed by coloring them with a middle gray color. Gamut warning can be toggle on and off.

Well, what to do if you have a lot of colors out of gamut? One option is to try *Perceptual* rendering intent instead of relative colormetric. The perceptual rendering intent maps all in-gamut colors and out-of-gamut colors proportionally into something printable. Perceptual rendering shifts all colors in your entire image. Another option is to fine-tune your image yourself. Generally, the out-of-gamut colors are too saturated. So, try to desaturate the out-of-gamut colors.

3.4. Print with Preview

In Photoshop when you are ready to print an image, use the *File | Print with Preview* command. The preview dialog is very handy to make sure that you have everything correctly setup. The settings in the Print Preview dialog are different if you are using a vendor's printer profile versus a custom profile.

3.4.1.   Print with Preview using Epson Profile

This is the Print with Preview dialog when you are using an Epson profile. Use the *Page Setup* button to setup your printer driver settings.
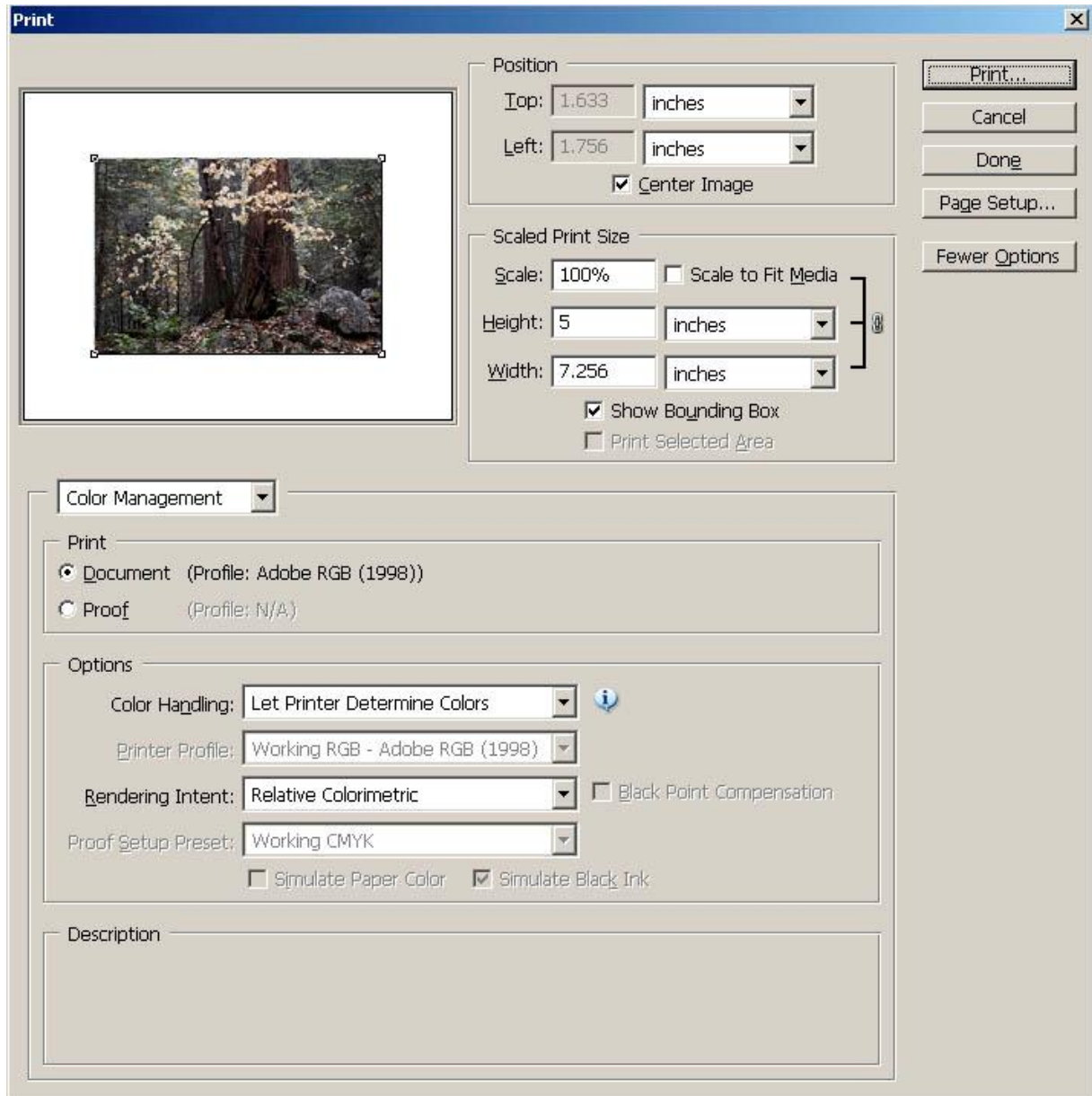
Thumbnail
- Look at the print mockup in the upper-left hand corner. Make sure your paper is correctly oriented and your image fits on the paper.

Position
- Check *Center Image* if you are placing a single image on the paper.
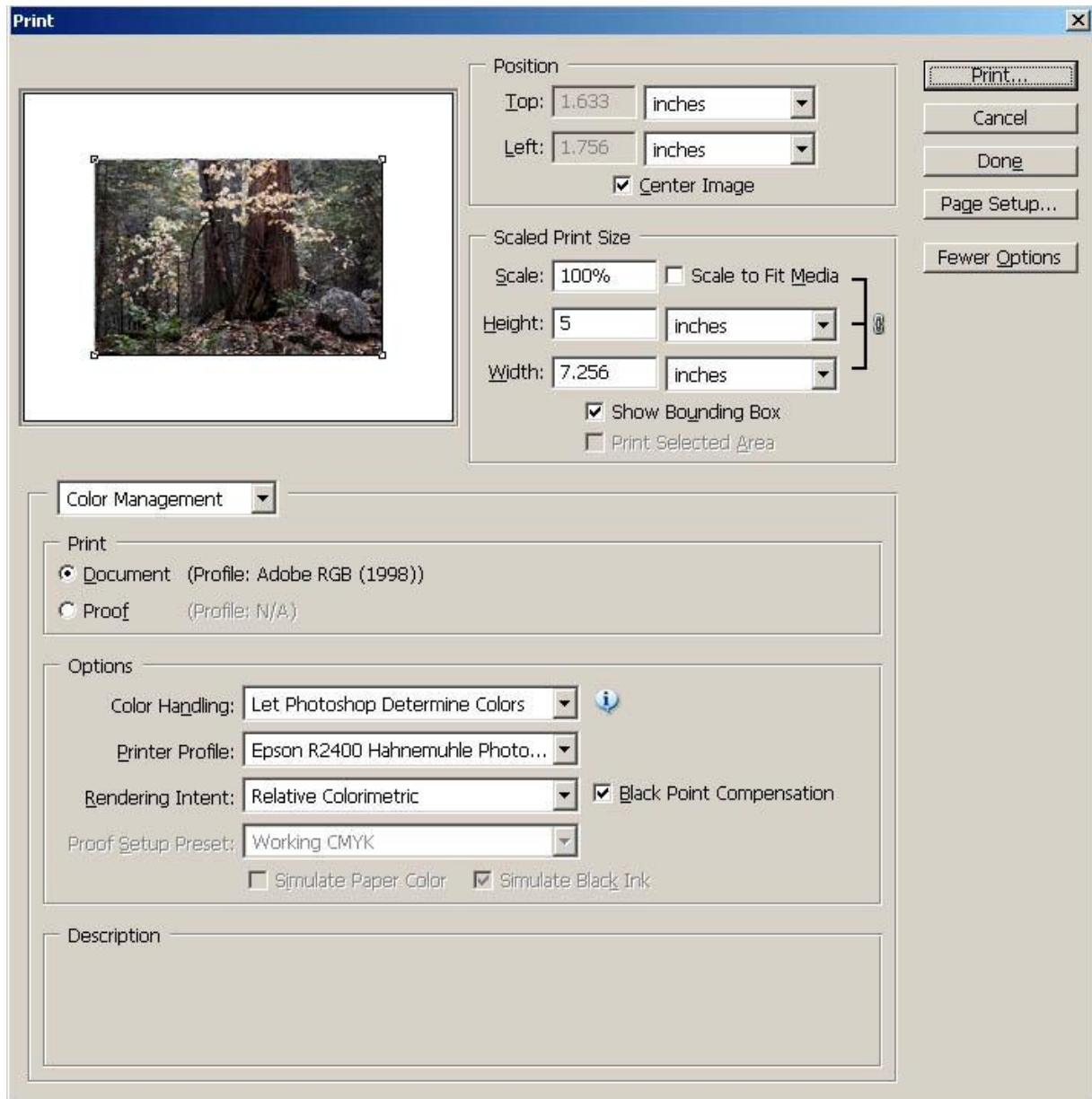
Scaled Print Size

- Do not check *Scale to Fit Media* and leave *Scale* at 100%. You should do all image sizing before entering this dialog where you can control the quality.

Options

- Because we are using an Epson (vendor) profile, select *Let Printer Determine Colors*. Do not try to select the vendor profile here or you will end up with double-profiling and very funky colors.

- Select *Relative Colormetric* for rendering intent unless you have a significant out-of-gamut color warning.

3.4.2. Print with Preview using Custom Profile

This is the Print with Preview dialog when you are using a custom profile. Use the *Page Setup* button to setup your printer driver settings.

Thumbnail
- Look at the print mockup in the upper-left hand corner. Make sure your paper is correctly oriented and your image fits on the paper.

Position
- Check *Center Image* if you are placing a single image on the paper.

Scaled Print Size

- Do not check *Scale to Fit Media* and leave *Scale* at 100%. You should do all image sizing before entering this dialog where you can control the quality.
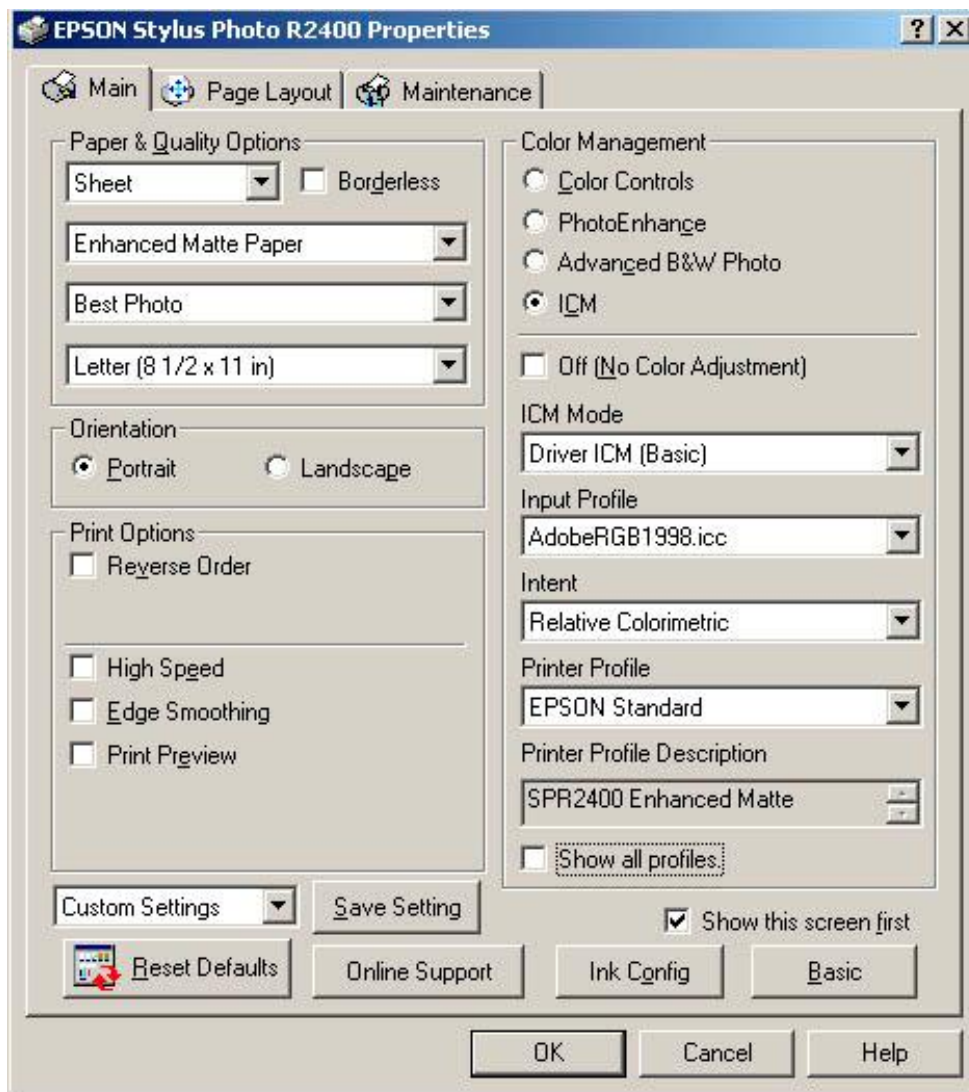
Options

- Because we are using a custom profile, select *Let Photoshop Determine Colors.* Select the custom profile from the *Printer Profile* list. Make sure that you turn off color management in the printer driver settings to avoid double profiling and funky colors.

- Select *Relative Colormetric* for rendering intent unless you have a significant out-of-gamut color warning.

- Check *Black Point Compensation* to give a richer print.

3.5. Color Printer Driver Settings (Epson)

The details of how to configure a printer driver vary from printer to printer and between Mac and Windows. The rest of this section assumes the Epson Stylus R2400 printer on Windows. Refer to your printer documentation for your specifics.

3.5.1.   Printer Settings Using Epson Paper and Profile (Color)

This following shows the print driver settings if you are using an Epson paper. In this case, this setup is for Enhanced Matte paper. Notice that I am using the Epson printer profiles here.

Paper & Quality Options
- Use *Sheet* but do not use *Borderless*. Borderless printing wastes a lot of ink and degrades print quality along the edge. Trim your paper instead.

- Select the paper from the drop down list. Because I had Matte Black ink cartridge installed, my paper choices are the Matte paper choices.

- Always use *Best Photo.*

- Select your paper size. There is a user-defined option for odd paper sizes.

Orientation

- Select portrait or landscape depending on what you need.

Print Options

- Do not use *High Speed*. You can lose details in saturated shadow areas due to over-inking especially with matte papers.

- Do not use *Edge Smoothing* because you have already fine-tuned your image in Photoshop.

Color Management

- Select *ICM* because we are using the vendor profiles and do not check *Off* (*No Color Adjusment)*.

- Make sure your Input Profile is *Adobe RGB 1998*. Make sure that your image in Photoshop is in Adobe RGB 1998 color space.

- Use *Relative Colormetric* rendering intent if your image does not have any significant out-of-gamut warnings. Otherwise, choose *Perceptual* rendering intent.

3.5.2.   Printer Settings Using Custom Profile (Color)

This following shows the print driver settings if you are a custom profile and third-party paper. In this case, this setup is for Hahnemuhle Photo Rag. Notice that I am NOT using any color management here.
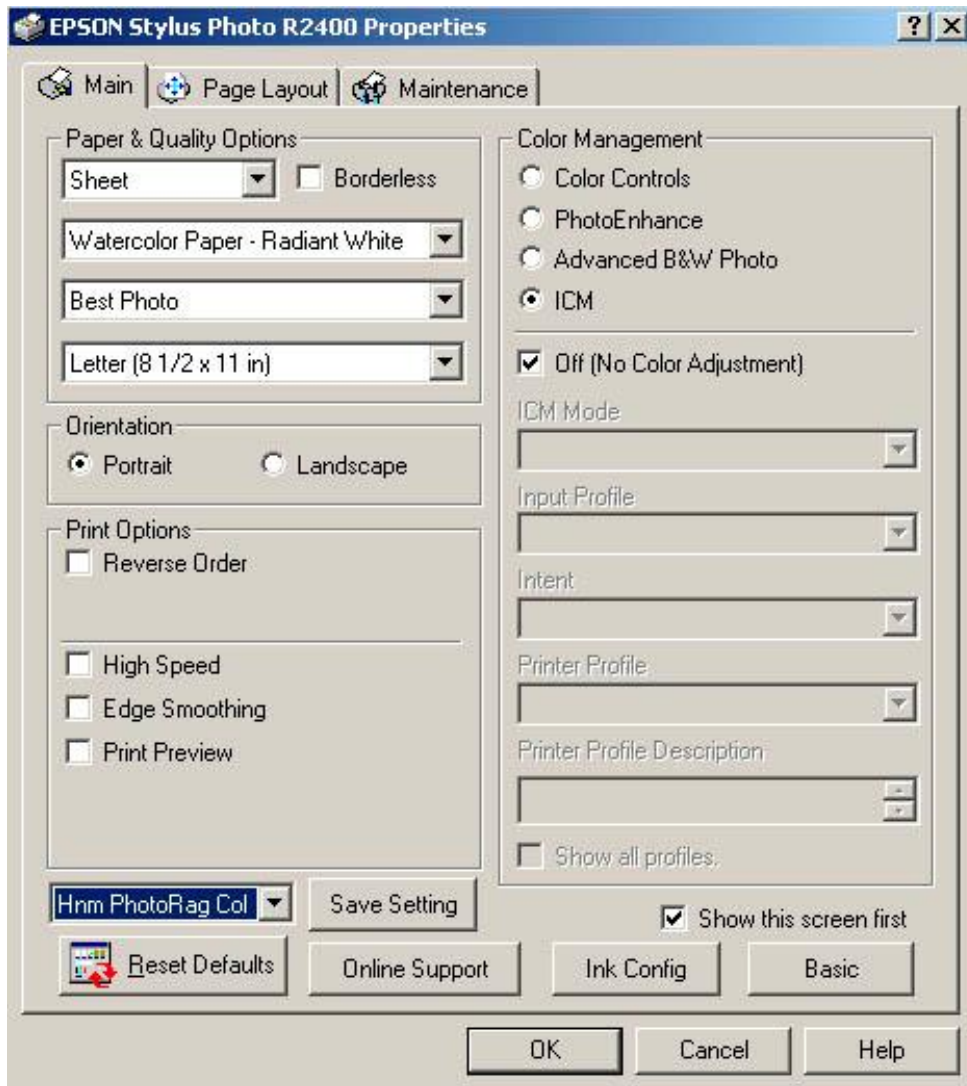
Paper & Quality Options

- Use *Sheet* but do not use *Borderless*. Borderless printing wastes a lot of ink and degrades print quality along the edge. Trim your paper instead.
- With thicker papers, you may want to use the Manual feed option.
- Select the paper from the drop down list that matches how your printed your profile targets.
- Always use *Best Photo.*
- Select your paper size. There is a user-defined option for odd paper sizes.

Orientation

- Select portrait or landscape depending on what you need.

Print Options

- Do not use *High Speed*. You can lose details in saturated shadow areas due to over-inking especially with matte papers.

- Do not use *Edge Smoothing* because you have already fine-tuned your image in Photoshop.

Color Management

- Select *ICM* and check *Off (No Color Adjustment)* and do our settings in Photoshop.

4. Paper Choices

There are an amazing set of choices for papers to use with your inkjet printer. All papers have pros and cons. To keep it simple, my recommendation for an 'archival' print is to stick with Epson papers for color printing.

- Use Epson Premium Luster if you prefer a glossy (really more satin) finish. Also, choose Epson Premium Luster if you want the best color prints. This paper has the largest color gamut and deepest blacks. Therefore, you will get the best possible color using this paper. Since this paper is expensive, I recommend using the Ilford Smooth Pearl paper for proofing.

- For a matte paper, use Epson Velvet Fine Art. This is what I personally use because I just the watercolor paper look. It does not have the color gamut or DMax (deep blacks) of Epson Premium Luster. Since Epson Velvet Fine Art is expensive, use Epson Enhanced Matte for proofing.

- Do not use Epson Enhanced Matte for your fine art prints. This paper has a large amount of optical brighteners. Therefore, it yellows with age and is not considered archival.

If you want to try third party papers, here are a few really good choices to consider.

- Hahnemuhle Photo Rag is a beautiful paper. I use it for my B&W printing. It has a more textured surface than Epson Velvet Fine Art.

- Hahnemuhle German Etching is also a beautiful paper. I have not used but it has a smoother surface than Photo Rag. Hahnemuhle says it is their best printing paper and it is recommended by Uwe Steinmueller.

- See http://www.inkjetart.com/art_papers.html for more information on other papers.