Introduction

Preparation of files for prints was the top ranked program in the FGCC survey.

Great images require precise captures. Large prints magnify capture errors. Post processing can not fix significant capture errors. Common capture errors will be covered briefly.

Current Adobe based recommended post processing workflows involve Lightroom, Camera Raw and Photoshop either alone or in combinations. Presets and Actions are great time savers and are popular. This program will cover the broad concepts. A follow up workshop to demonstrate the details is proposed.

www.luminous-landscape.com offers three downloadable training video series, each about 6+ hours long at $40 apiece, which formed much of the background for this program. They are: "From Camera to Print"; "Guide to Adobe Camera Raw" and "Guide to Adobe Photoshop Lightroom 2". Highly recommended.

In addition, presentations, workshops, tutorials, essays and/or books by Bruce Fraser*, Jeff Schewe*, Greg Gorman*, Mac Holbert*, John Paul Caponigro*, Andrew Rodney*, Vincent Versace, Michael Reichmann, Scott Kelby, Mark Johnson, Craig Tanner and many others were sources. Attendance and discussions at Photoshop World, the Epson Print Academy and other workshops provided many inputs.

* The Pixel Mafia

Sensor to Print Magnification

A. Large prints magnify abnormalities. Greater attention to detail is required.

   1. Content – Composition, Alignment, Perspective, Clutter, Hot Spots, etc.

   2. Sharpness – Unwanted Blur at Capture

   3. Post Processing – Color Cast, Noise, Lack of Contrast, Over Sharpening, etc.

B. Print View Distance must be considered.

Viewing Distance
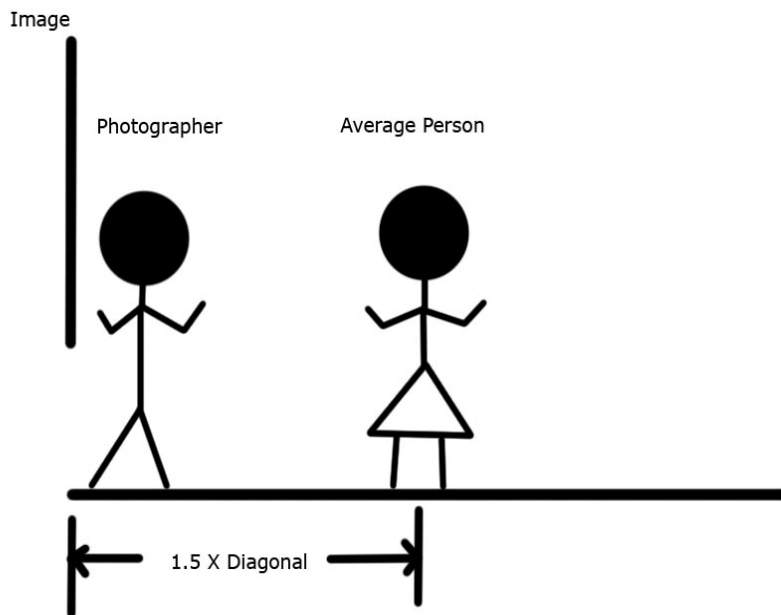
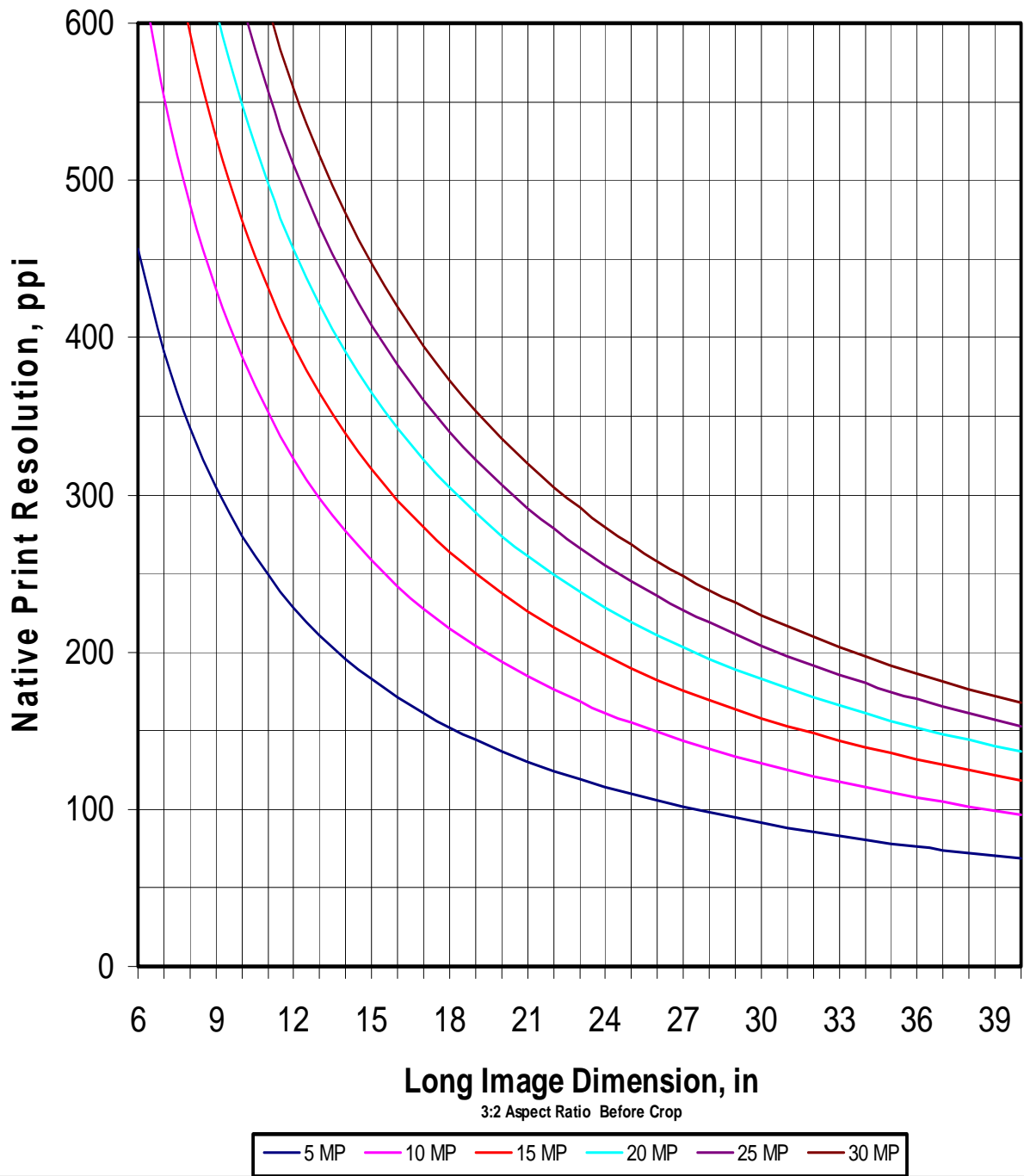C. Very Large Prints can be made from DSLR cameras.

Camera	Sensor	Size	Max	Resolution	Pixels	Pixel Pitch	Magnification, Sensor to Print			CoC
	Length, mm	Height, mm	Length, pixels	Height, pixels	Million	Microns	X to 8x12	X to 13x19	X to 16x24	mm
C 1Ds Mk III	36.0	24.0	5616	3744	21.0	6.4	8.5	13.4	16.9	0.030
C 5D Mk II	36.0	24.0	5616	3744	21.0	6.4	8.5	13.4	16.9	0.030
C 1Ds Mk II	36.0	24.0	4992	3328	16.6	7.2	8.5	13.4	16.9	0.030
C 5D	35.8	23.9	4368	2912	12.7	8.2	8.5	13.5	17.0	0.029
C 1D Mk II	28.7	19.1	3504	2336	8.2	8.2	10.6	16.8	21.2	0.024
C 1D Mk III	28.1	18.7	3888	2592	10.1	7.2	10.8	17.2	21.7	0.023
C 50D	22.3	14.9	4752	3168	15.1	4.7	13.7	21.6	27.3	0.018
C 40D	22.2	14.8	3888	2592	10.1	5.7	13.7	21.7	27.5	0.018
C PS G10	7.6	5.7	4416	3312	14.6	1.7	40.1	63.5	80.2	0.006
C PS SD870	5.8	4.3	3264	2448	8.0	1.8	53.0	83.9	106.0	0.005
N D3/D700	36.0	23.9	4256	2832	12.1	8.5	8.5	13.4	16.9	0.030
N D300	23.6	15.8	4288	2848	12.2	5.5	12.9	20.4	25.8	0.019
N D2X	23.6	15.8	4288	2848	12.2	5.5	12.9	20.4	25.8	0.019
N D90	23.6	15.8	4288	2848	12.2	5.5	12.9	20.4	25.8	0.019
N D40x	23.6	15.6	3872	2592	10.0	6.1	12.9	20.4	25.8	0.019
N D200	23.6	15.8	3872	2592	10.0	6.1	12.9	20.4	25.8	0.019
N D80	23.6	15.8	3872	2592	10.0	6.1	12.9	20.4	25.8	0.019
N D70s	23.6	15.6	3008	2000	6.0	7.8	12.9	20.4	25.8	0.019
Fuji F30	7.60	5.70	2848	2136	6.1	2.7	40.1	63.5	80.2	0.006
Phase 1 P45	49.1	36.6	7216	5412	39.1	6.8	6.2	9.8	12.4	0.040
6 x 7 cm	70	60	NA	NA	NA	NA	4.4	6.9	8.7	0.057
4 x 5 in	127	98	NA	NA	NA	NA	2.4	3.8	4.8	0.104
8 x 10 in	254	196	NA	NA	NA	NA	1.2	1.9	2.4	0.208

CoC -- Circle of Confusion (Pre WW II Standard)

Pixel Pitch -- The length of one side of a square pixel

Micron -- one millionth part of a meter

Native Resolution vs Camera MP

Native Print Resolution, ppi

Long Image Dimension, in

3:2 Aspect Ratio Before Crop

5 MP — 10 MP — 15 MP — 20 MP — 25 MP — 30 MP

Shoot Raw

RAW Truth #1

The JPEG shooter and the RAW shooter both capture RAW data. The JPEG shooter uses the camera as their RAW converter (developer) and is willing to give up the potential to do a better development in the future. The RAW shooter, saves the RAW data (and maybe a camera developed JPEG as well) so that the potential of the image can be maximized by using his or her RAW converter of choice.

Shooting RAW allows any photographer to maximize the potential for image quality, both now and in the future. I would suggest that one never knows...

• When that once in a lifetime shot will come into our viewfinder.

• When our White Balance will be accidentally set wrong

• When we have set the camera "settings" inappropriately (ever try to remove too much sharpening from a camera JPEG)?

• When our client will want a 16x20 from an underexposed capture.

• When our ISO is accidentally set wrong.

• When the money shot smacks us in the face and we are not full prepared

• When mixed lighting will produce havoc with our color

• We simply need the maximum from a specific shot or series of shots

By preserving the RAW data when we shoot, we offer ourselves the best chance of creating the vision that we first saw in the viewfinder. Shooting "JPEG" limits the technical potential of every photograph that we take.

However,

A JPEG image can be:

• Viewed on any computer with no special software

• Viewed on many handheld devices designed for viewing

• Viewed on electronic picture frames

• Uploaded to the web for viewing or printing

• Brought to your local Wal-Mart (or whoever) and have prints back in an hour or less

• Printed directly onto many newer desktop printers from the memory card, even without a computer

• Processed by photojournalists and transmitted to editors within a few minutes. More readily accepted as unaltered.
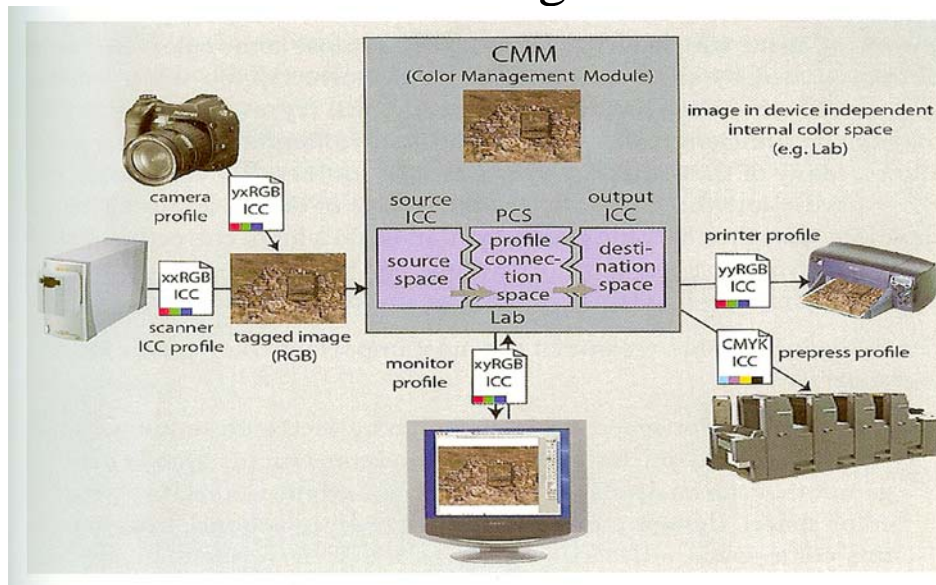
Expose to the Right
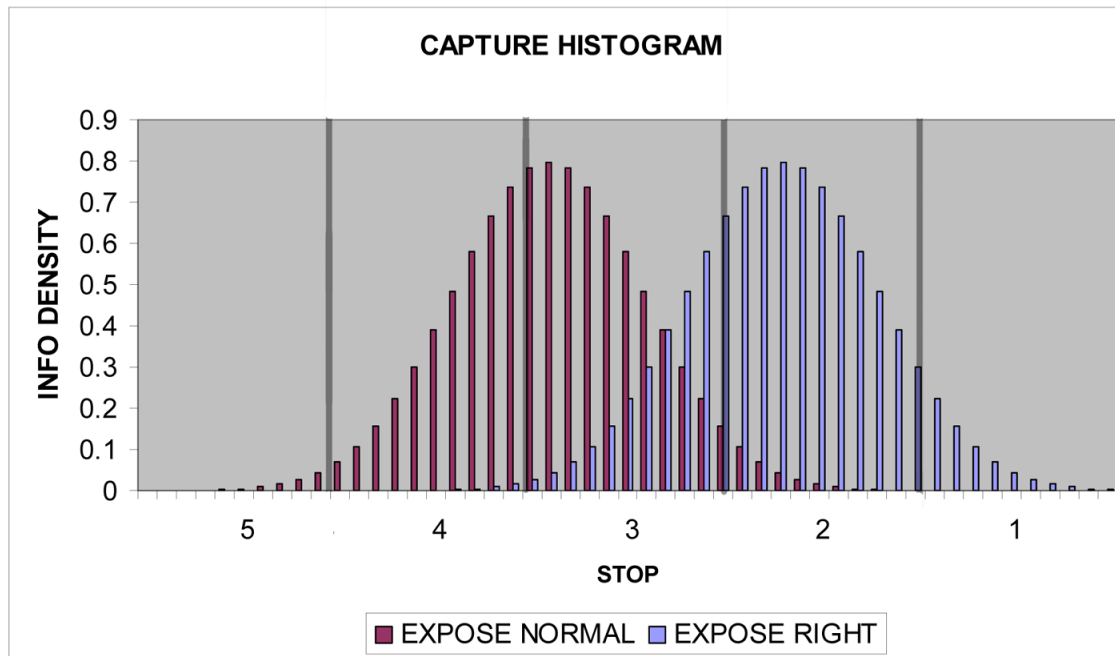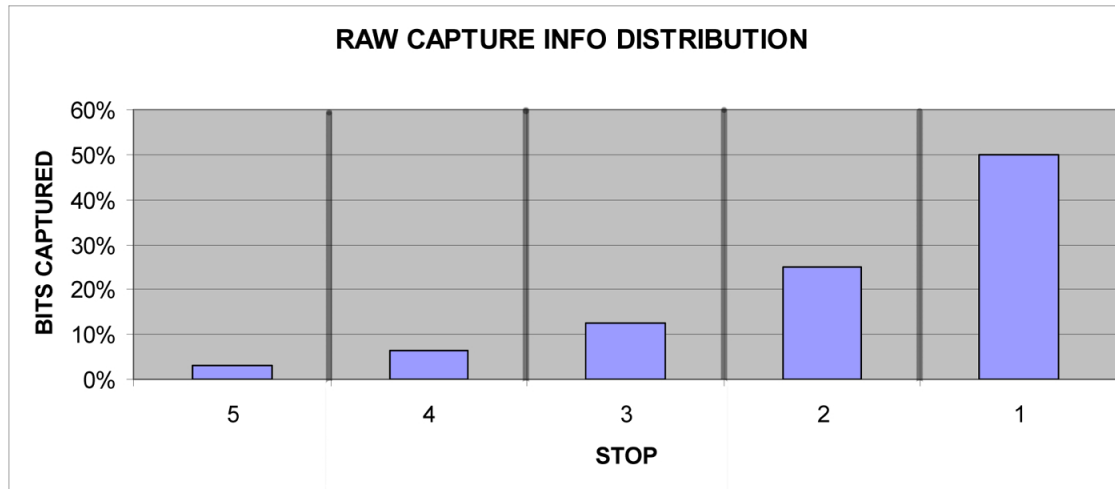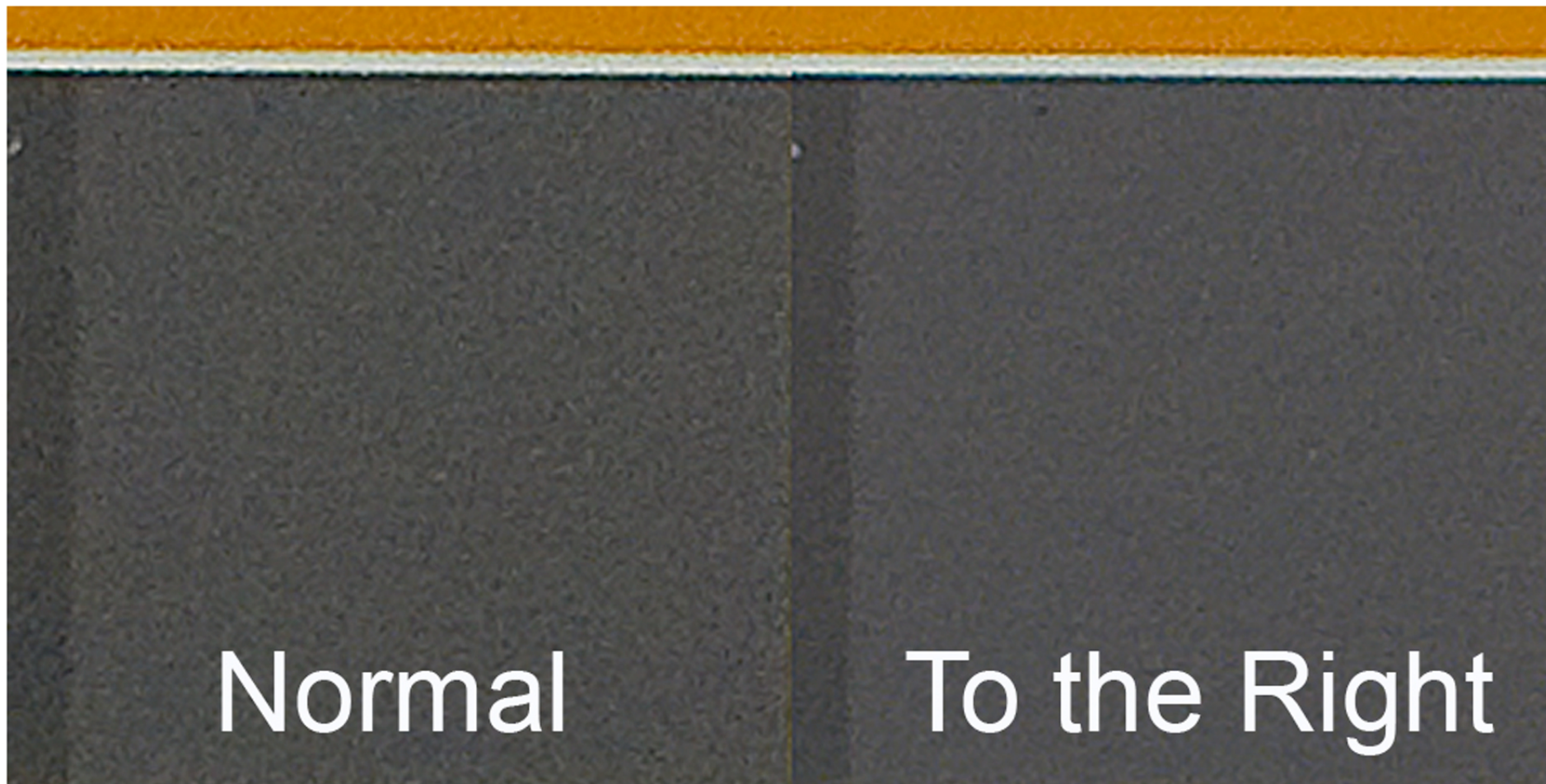
EXPOSE TO THE RIGHT

Color Management

Proper color management is an essential part of controlled printmaking. The relationship between the image colors is device dependent. Each image capture device is tagged with an ICC* profile that mathematically defines the colors in the image. Each output device requires a tagged ICC profile for the image file that allows that device to create an image that yields the color relationships desired by the printmaker. For example, for inkjet printing, an overall color working space is assigned and an ICC profile for the specific printer, ink and paper is applied.

The CMM translates the input profiles into the specified output profiles. The components of CMM are available within the computer's operating system and are managed and enhanced by the software involved, e.g. Photoshop.

A critical part of the process is to give the printmaker a means to accurately monitor the appearance of the image during the image optimization process. The prime goal is to assure that what is seen on the monitor will visually match the final print. This requires a monitor with broad color and tone characteristics that can be calibrated to maintain consistency. Monitor calibration involves creating an ICC profile for the monitor using a color measuring device and profile creating software. Popular systems are the X-Rite Eye-One Display 2 and the ColorVision Spyder 3 Pro.

Prior to printing, soft proofing is recommended to further increase the chances of a good monitor/print match. Many recommend hard proofing as well.

Reference: Fine Art Printing for Photographers, Steinmueller and Gulbins, Rocky Nook, 2007, 2008

* International Color Consortium
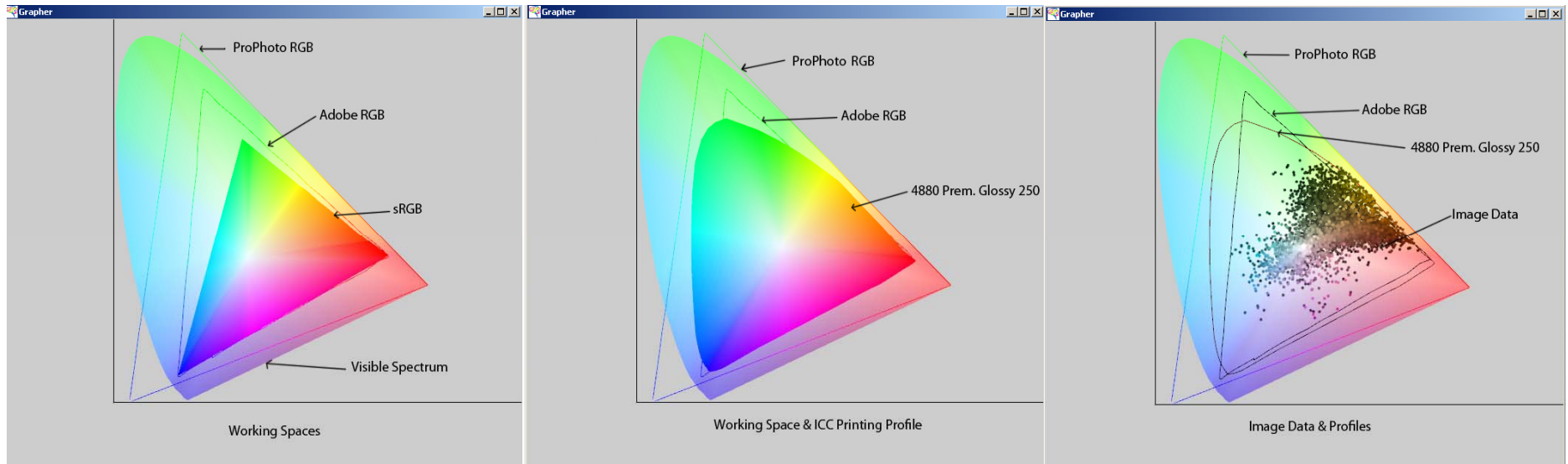
Working Spaces and Printer Profiles

1. sRGB working space is not suitable for fine art printing.
2. Adobe RGB is suitable for small gamut paper/ink combinations. (e.g. Epson 1270 Dye based inks)
3. ProPhoto RGB should be used for large gamut ink/paper combinations. (e.g. Epson UltraChrome, UltraChrome K3 and UltraChrome HDR inks)
4. Most DSLR cameras are capable of creating image data that exceeds the limits of the Adobe RGB working space.
5. Do not use ProPhoto RGB for web publishing, projector files or Costco/Walmart/Ritz type quick prints. Use sRGB.
6. When using ProPhoto RGB, open in that space from the raw converter and be very careful not to accidently convert to a smaller gamut space during post processing.
7. Check Out: http://www.luminous-landscape.com/tutorials/prophoto-rgb.shtml   Good stuff.

Bit Depth

1Bit	8 Bits	12 Bits	14 Bits	16 Bits

$$2^1 = 2 \qquad 2^8 = 256 \qquad 2^{12} = 4096 \qquad 2^{14} = 16384 \qquad 2^{16} = 65536$$

The bit depth of an image file determines the levels of information available to create the tones and colors in the image.

A bit depth of 1 would create an image with just pure blacks and pure whites, e.g. a line drawing with no tonality.

A bit depth of 8 per channel would create an image with 256 tone levels for each color in the working space. For RGB, 256 tones would be available for each of the three colors.

$$256^3 = 16777216$$

Thus, 16.7 million different colors are possible in an 8 bit, 3 color space.

Capture - Digital cameras, shooting JPEG, capture 8 bit files. Digital cameras, shooting RAW, capture 12 and/or 14 bit files. Scanners can capture 8, 16 and higher bit files.

Post Processing - RAW files are processed in a 16 bit space. JPEGS should be processed in an 8 bit space. Increasing the processing of JPEGS to 16 bits does not increase image quality.

32 bit processing is available but requires powerful computers. (Or lots of time.)

For RAW processing, it is recommended that the file be converted as a 16 bit file when opened from the raw convertor. It should be left as a 16 bit file through most of the processing workflow. If it is accidentally changed to 8 bits, go back in history to when it was 16 bits. Do not mode change back to 16 bits.

If the file is to be upresed at the end of the workflow and you are concerned about processing time, this can be done at 8 bits followed by output sharpening.

Printing usually is done at 8 bits. Some newer printers have 16 bit drivers.

Why Process at 16 Bits? - Higher bit depths have exponentially more information. This can increase shadow detail and create less stress on the file when making tone, color and other adjustments. Stressed files often show comb-like histograms and can create banding in the image. However, quite often these technical shortcomings are not visible in the printed image. Therefore, if computer power and time are a problem, you might try doing everything at 8 bits and compare to a 16 bit processed image. The safest thing is to stick with 16 bits.

Image Optimization/Output Prep

I. <u>Programs</u> -- There are several image optimization programs. Only Photoshop (PS), Adobe Camera Raw (ACR) and Lightroom (LR) are covered here. The emphasis will be on optimizing RAW images captured with digital cameras.

    A. PS and ACR
        1. ACR editing of RAW files is non-destructive.
        2. Only a fraction of PS's capabilities are used by photographers.
        3. ACR 4.x to 5.1 (CS4) supports presets, camera profiles and local adjustments.
        4. ACR 5.1 local adjustments include exposure, brightness, contrast, saturation, clarity, sharpness, color, a graduated filter, and spot and red eye removal.
        5. A large portion of the editing can be done in ACR. For well captured images, PS only is necessary for upresing and output sharpening.

    B. LR
        1. LR 2.1 and ACR 5.1 share the same RAW conversion engine.
        2. LR was designed for photographers.
        3. All operations can be done non-destructively.
        4. Pixel Genius (PK Sharpener) designed the capture and output sharpening built into LR 2.1.
        5. Compared with PS, LR's print engine is more versatile and easier to use. Printing presets are reliable.
        6. LR's GUI follows the workflow.

    C. LR --> PS --> LR
        1. LR does not support layers, masks, selections, alpha channels, transforms, type, soft proofing and other special tasks.
        2. LR does support temporarily working in PS to perform tasks only available in PS. This includes PS plug-ins. After performing these tasks, work can continue in LR.
        3. The use of smart objects while in PS can simplify revisiting PS to make changes.
        4. Many in the Pixel Mafia use this approach.

II. <u>Workflow Within the Programs</u> -- There are many opinions regarding the specific workflow steps required to optimize a file for printing. Those below commonly are taught in tutorials and workshops.

Image Optimize
  A. Correct White Balance
  B. Crop and Align
  C. Noise Reduction
  D. Capture Sharpen
  E. Set Black Point
  F. Set Neutral Point
  G. Global Changes
        1. Tone
        2. Color
        3. Midtone Contrast
  H. Area Changes
        1. Brightness, Contrast
        2. Saturation, Hue
        3. Creative Sharpen
  I. Local Changes
        1. Spot Removal
        2. Creative Editing

Output Prep
  J. Set Resolution and Print Size
        1. Native
        2. Upres with Special Sharpening
  K. Soft Proof (PS)
        1. Printer/Paper ICC Profile
        2. Rendering Intent
        3. Create Proof Layer Group
  L. Save (PS)
        1. Save a Work File for Readjustments
        2. Save the Print file

There is no fixed recipe for image optimization. The approach can vary with the specific image, the program used, the equipment involved, and the personal tastes of the photographer.
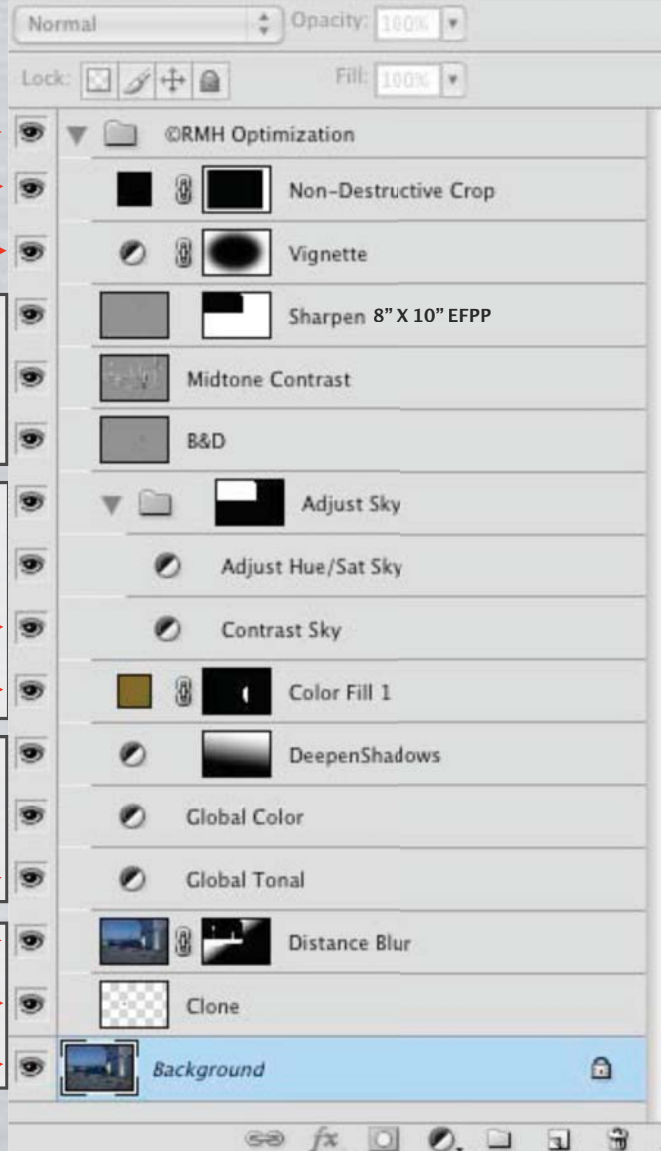
Many of the steps involved can be automated via Actions, Presets, Scripts and Batch processing. A straight-forward, well captured image can be optimized in less than two minutes. Creative changes often require an iterative approach which can go on for several minutes to several days.

The follow up workshop that we are proposing will be designed to give hands-on experience with the listed steps in ACR, PS and LR. The use of actions and presets will be covered.

Optimization Rules of Thumb

- Adjust major image issues first
- Make global adjustments prior to regional
- Adjust luminosity before color (hue and/or saturation)
- When adjusting color - hue before saturation
- Keep your layer stack clean, labeled and well organized
- Work non-destructively. Always leave yourself a backdoor

A Well Organized Layer Stack

Overall Optimization Group → 👁 ▽ 📁 ©RMH Optimization

Non-Destructive Crop → 👁 ■ 🔗 ■ Non-Destructive Crop

Vignette → 👁 ⊘ 🔗 ⬮ Vignette

50% Overlay Sharpen with Mask → 👁 ◻ ◱ Sharpen 8" X 10" EFPP

50% Overlay Midtone Enhancement → 👁 ◻ Midtone Contrast

"SPOT" 50% Overlay Tonal → 👁 ◻ B&D

Adjustment Group → 👁 ▽ 📁 ◱ Adjust Sky

Color Adjustment → 👁 ⊘ Adjust Hue/Sat Sky

REGIONAL Tonal Adjustment → 👁 ⊘ Contrast Sky

Color Adjustment → 👁 ◻ 🔗 ■ Color Fill 1

Tonal Adjustment → 👁 ⊘ DeepenShadows

GLOBAL Color Adjustment → 👁 ⊘ Global Color

Tonal Adjustment → 👁 ⊘ Global Tonal

Distance Blur → 👁 ◻ 🔗 ◱ Distance Blur

PIXELS Clone Layer → 👁 ▨ Clone

Original Image → 👁 ▨ Background 🔒

Normal — Opacity: 100%
Lock: ◻ 🖌 ✛ 🔒   Fill: 100%

⊝ fx ◻ ⊘. 📁 ◲ 🗑

Fine Art Workflow

- Confirm Settings

- Crop & Clean Up

- Major Image Issues

- Global Tonal / Color Adjustment

- Analyze Image - Determine a "destination"

- Image Editing

- Regional Tonal / Color / Pixel Adjustment

- Sharpening

- Final Image Cleanup

- Output

Image Specifications

Objective:

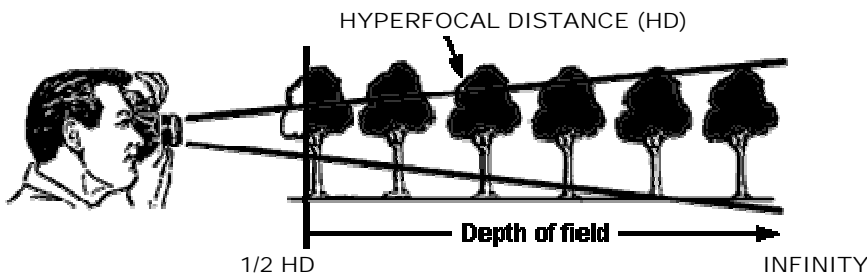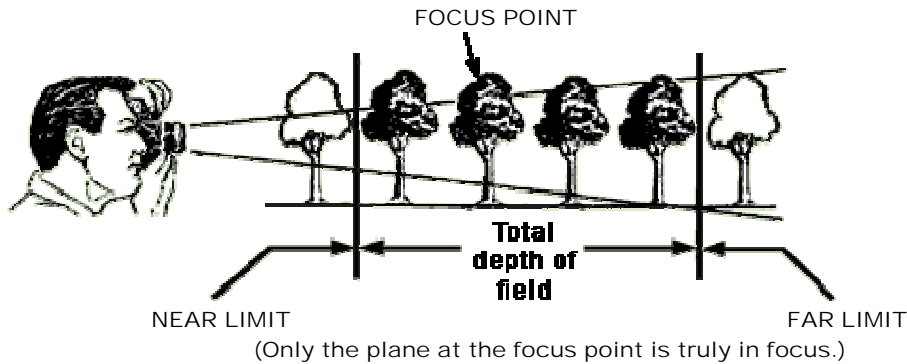To insure initial image settings are correctly so as to optimize image tone, color & resolution

Method:
• Monitor calibration
• Imaging software color settings
• Appropriate image size and resolution
• Correct mode (RGB, CMYK or Grayscale)
• If working on a scan SAVE AS A NEW ITERATION!

Common Imaging Mistakes

Destructive Workflow
Over/Under Sharpening
Lack of Midtone Separation
Unrealistic Size Expectations
Cross Purpose Adjustment Layers
Untagged Files
Image Alignment
Incorrect Layer Stack Order
Contaminated Neutrals
Imprecise Cropping
Imprecise Masking

Depth of Field

FOCUS POINT

Total depth of field

NEAR LIMIT　　　　　　　　　　　　　　　**FAR LIMIT**

(Only the plane at the focus point is truly in focus.)

HYPERFOCAL DISTANCE (HD)

Depth of field

1/2 HD　　　　　　　　　　　　**INFINITY**

This represents the classic concept of depth of field. The lens markings and tables commonly used were developed before WW II. They were based on viewing an 8" X 12" print from a distance of 15". Applying these standards to large prints can result in a significant lack of sharpness at reasonable viewing distances.

Newer concepts have been published that give insight to better practices. Some tips* derived form these and the classic concepts are:

1) If you want infinity to be critically sharp, focus at infinity. At small apertures within the diffraction limit, mid-range objects will be reasonably sharp with wide angle and normal lenses.

2) If you insist on using hyperfocal distance concepts, multiply the classic HD by 5 for large prints.

3) If you want two separated objects to be reasonably sharp, focus half way between them with a small aperture. (As opposed to the classic 1/3, 2/3 concept.)

Mainly apply to large print scenics shot with 35mm or slightly smaller formats.

4) For a given lens, you can double the DOF by doubling the shooting distance or by stopping down 2 stops.

5) If in doubt, focus longer not shorter.

6) Remember that if you want your main object sharp, focus on it. Do not try to play games with DOF.

7) If you want extreme DOF, consider creating two images, one focused on the far important object and one focused on the near important object. These can be stacked and aligned in Photoshop. Applying a mask to the top layer in the stack can reveal the best of both layers. This also can allow larger apertures and avoid diffraction limits.
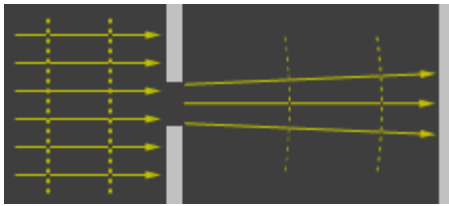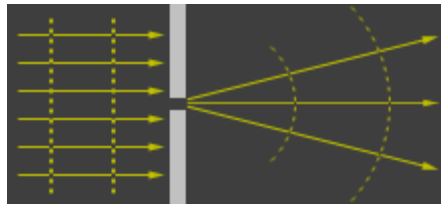
References:

http://www.trenholm.org/hmmerk/DOFR.html

http://www.normankoren.com/Tutorials/MTF6.html

http://www.clarkvision.com/photoinfo/dof_myth/

Diffraction

Low Diffraction   High Diffraction

1) Diffraction is a fundamental characteristic of all lenses.

2) It can result in decreased lens resolution and edge sharpness at small apertures (large f stops).

3) The significance of these decreases is dependent on the pixel pitch for digital cameras. Small pixel sensors can yield significant softness at small apertures.

4) It can be visible in large prints. This can be improved by image file sharpening.

5) CWS Tests:

D700 (8.5 micron pixels): f/16 Not Noticeable;   f/22 Slightly Noticeable but very usable when sharpened; f/32 Noticeable and sharpening yields slight improvement.

D300 (5.5 micron pixels): f/11 Not Noticeable;   f/16 Slightly Noticeable but very usable when sharpened; f/22 Noticeable and sharpening yields slight improvement; f/32 Very noticeable and is not improved by sharpening.

Reference:
http://www.cambridgeincolour.com/tutorials/diffraction-photography.htm

http://www.luminous-landscape.com/tutorials/understanding-series/u-diffraction.shtml

Lens Aberrations

A lens aberration is a deviation from an ideal design characteristic that causes undesirable visual image effects. In large prints, these effects can be detractions. Common lens aberrations are:

1) Distortions
     a) Barrel distortions result in convex curvatures of straight lines. Usually associated with wide-angle lenses.
     b) Pincushion distortions result in concave curvatures of straight lines. Usually associated with telephoto lenses.

2) Optical Vignetting - An illumination falloff from the center of an image towards the corners. Can be quite noticeable when shooting wide open but will disappear when lens is stopped down.

3) Chromatic - Results in color fringes within the image. Can be minimized by good lens design.

Aberrations 1), 2) & 3) can be reduced within Photoshop by using the lens distortion filters.

4) Defocus -- The lack of uniform focus within the image plane. Usually noticeable in the corners of an image when shooting wide open. Can be inherent in the lens design or the results of a bad sample.

Lens Testing - Online Reviews and Self-Testing

Online Reviews - Remember that a given review could be the result of a bad sample.

http://www.slrgear.com/reviews/index.php   http://photozone.de/
http://www.imaging-resource.com/   http://lens-reviews.com/
http://www.dpreview.com/lensreviews/
http://www.popphoto.com/cameralenses/

Self Testing - Photozone gives a good self-testing procedure for Defocus. Distortion, Vignetting and Chromatic are easily self tested.

Sample <u>Camera to Print</u> Recipe
for Large Exhibit Prints

1. Capture a great image. Post processing can not make a silk purse out of a sow's ear.

2. Shoot Raw in largest color space available (Adobe RGB). Avoid shooting JPEG. Never use sRGB.

3. Shoot at highest bit depth available (14 bit) unless it slows things down to the point that endangers the capture.

4. Before starting, set a post processing destination for the image. Do not just start and let the destination evolve. Periodically, sit on your hands and make sure you are moving towards the destination.

5. Post process non-destructively. (ACR or LR) Always leave a back door open to avoid restarts.

6. Open from ACR to Photoshop in Prophoto RGB at 16 Bits. LR prints Raw files as ProPhoto RGB at 16 bits automatically.

7. If in Photoshop, follow Holbert's workflow recommendations. Avoid degrading the file. Periodically "pixel peep" to assure the integrity of the file.

8. If in Photoshop, use presets, actions and scripts to speed the workflow. Use presets in LR.

9. Set image size following Bruce Fraser's recommendations. Applies to both Photoshop and LR.

10. Sharpen using PK Sharpener tools. PK Sharpener capture and output sharpening are built into LR 2.1.

11. Soft Proof using the proper ICC printer profile. Test for best rendering intent during soft proofing.

12. If in Photoshop, save a work copy and a print copy.

13. Check the file very closely before sending to the printer.