

### RESOLUTION, ASPECT RATIO AND SIZING IMAGES FOR OUTPUT

Resolution in photography is important because it indicates how much information is contained within the image. However, resolution is often confused with other terminology, in particular when applied to printing. Aspect ratios are important when considering output options and often lead to confusion. So here are some simple definitions:

#### Image Resolution

Refers to the total number of pixels contained within an image. Expressed as width x height. For example, a 24 Mega (million) pixel image file is likely to be approximately 6000 pixels wide x 4000 pixels high (in a 3:2 aspect ratio). Simply, the more pixels an image contains, the more information there is and the larger the image can be printed for optimal results.

#### Print Resolution

Refers to the maximum number of pixels per inch (printing still refers to inches and hasn't converted to metric) that the printer requires for optimal printing. 360 ppi for Epson, 300 ppi for Canon.

#### Dots per Inch

Refers to the number of dots of ink that a printer lays down to produce the printed image. Typically, a high resolution printer will lay down 2880 x 1440 dots per square inch. Therefore, for a 360 ppi printer, there are around 12 micro dots of ink per pixel). Not to be confused with print resolution.

#### Screen resolution

Refers to the total number of pixels available to display the image. Desktop monitors, televisions and data projectors refer to their resolution in some obscure terms (HD, 1080P, 4K etc): Commonly, televisions would have "HD" (High Definition) resolution, which is 1920 x 1080 pixels. Newer televisions that are "4K" have 4 times the resolution of HD, or 3840 x 2160 pixels. Desktop monitors generally have at least "HD" resolution, with some high end monitors having up to 4K resolution. The most common resolution seems to be 1920 x 1200 pixels, which is a little over HD. Projectors used by most camera clubs work on "HD" resolution, so resizing images for projection entails downsizing images to fit within the 1920 x 1080 maximum ( less than 2 Mega pixels).

**See the procedure at the end of this paper for instructions on resizing images.**

## Aspect Ratio

Refers to the relationship between the width and height of an image. Full frame and crop frame sensors in most cameras have an aspect ratio of 3:2 (1.5:1). Other formats such as "Micro four Thirds" sensors are in the proportion of 4:3. Medium format cameras have differing aspect ratios, mimicking the sizes of film. Smaller size sensors in mobile phones and drones have a similar ratio to full frame and crop sensors, but not necessarily 3:2. Output devices have vastly differing aspect ratios, so some changes and decisions have to be made when choosing the type of output. (See the separate document "**Aspect Ratio**" for more details).

## Colour Spaces and bit depth

While not strictly part of resolution, colour spaces and bit depth impact the amount of information that is contained within each pixel.

**Colour spaces** define the number of colours that can be displayed by a device:

- sRGB is the smallest colour space and is only suitable for screens and projectors,
- Adobe RGB is a much larger space used by high end monitors and printing
- ProPhoto RGB covers the entirety of human vision and is used for editing and printing. Printing requires some other adjustments to optimal quality (see the separate workshop on printing).

**Bit depth** refers to the amount of data contained within each pixel:

- An **8 bit** image (JPEG) can contain a maximum of **256 levels** of tone within each of the three channels, often referred to as a 24 bit image. For many instances 8 bits is not enough for smooth tonal graduations and is **not** recommended for editing. It is, however, the only option for projected images and the web using the JPEG format.
- A **12 bit** image captured as RAW data can contain a maximum of **4096 levels** of tone within each channel, allowing for much more precise editing. A **14 bit image** likewise can contain up to **16,384 levels** of tone per channel. This ensures you have a lot of image information available for editing and tonal adjustments.
- RAW files are processed using their native captured bit depth and ProPhoto colour space, for maximum detail (using Lightroom or Adobe Camera RAW). When exported to Photoshop or into any file format (JPEG, TIFF, PSD) the bit depth and colour space is set by the user (using the preferences settings for external editing). JPEGs can only be 8 bits but TIFF and Photoshop files (.PSD) can be 16 bit and colour space kept at ProPhoto RGB.
- Photoshop files saved as 16 bit images are actually 15 bits + 1 level (8,193 levels) per channel, but this is more than sufficient for most situations.
- HDR images are converted to 32 bit files but need to be converted back to 16 bits in order to be editable.

## Resizing images for output

Differing output options require different treatments, with printing requiring the highest resolution (see the separate notes on "**How Much Resolution Do You Need for Printing**") and social media requiring the lowest. But resizing images is not just about removing pixels, images that have been re-sampled to a lower resolution require sharpening to counteract the loss of data and to maximise the appearance of the image on screen. Here we set out the requirements for several different output options:

### Fit or Fill?

The first thing to consider when resizing for output is whether you want to **fill** the space available, or whether you want to **fit** the image into the confines of the space provided. This is important because projectors and printer papers are in different aspect ratios to the default aspect ratio of your image (see the separate document – **Aspect Ratio**).

For example, a "full frame" image is in a ratio of 3:2 (the width is 1.5 times the height – more correctly 1.5 to 1, but usually rounded to 3:2). Metric size papers all come in an aspect ratio of 1.4:1, which means if you choose "Fill" the paper size, some cropping of the image will occur – from 1.5:1 down to the paper ratio of 1.4:1.

**FITTING AN 3:2 IMAGE ONTO A4 OR A3 PAPER USING "FILL" CROPS SOME OF THE IMAGE**



**Above:** Using "**Fill**" onto photo paper will result in some cropping – **this is what happens at photo labs and online printers.**

If printing yourself, you can choose to “**Fit**” the page available, which results in a slightly smaller image and uneven borders, but all the image is visible. (**See the separate paper and workshop notes on printing for further details, as there is a lot more to printing photos than just aspect ratios**).

**FITTING AN 3:2 IMAGE ONTO A4 OR A3 PAPER USING “FIT” LEAVES UNEVEN MARGINS**



**Above:** Printing yourself onto A3 or A4 paper, you can fit the image to the paper size, with larger margins top and bottom.

A third alternative is to crop the image to the paper proportions, in this case from 1.5:1 to 1.4:1 (actually 1.414:1) and then print to fill the page size.

**CROPPING A 3:2 IMAGE TO 1.414:1 FOR A4 OR A3 PAPER USING “FILL” MAXIMISES THE AREA**



**Above:** Cropping to the aspect ratio and then printing to fill maximises the print size.

### Digital projection at “HD” resolution

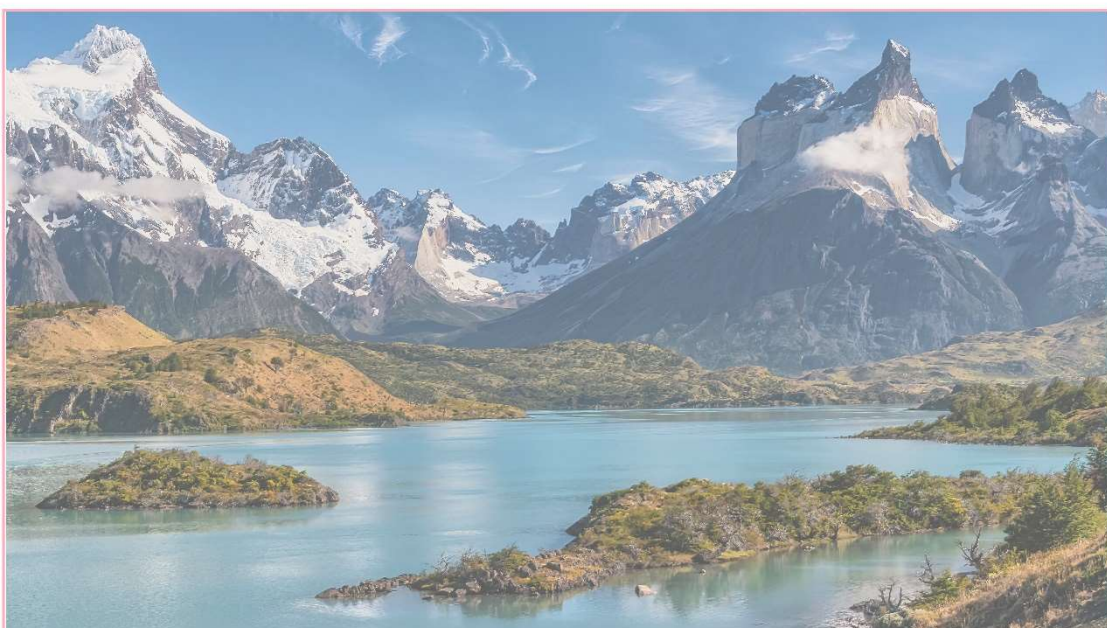
A data projector with HD resolution has a maximum of 1920 x 1080 pixels (16:9), which is **NOT** at a 3:2 aspect ratio. Therefore, when resizing a 3:2 aspect ratio image we need to fit within the maximum of both width and height. So, a 3:2 image will end up at 1620 x 1080 pixels. (See the accompanying diagram). Alternatively, the image can be cropped to the 16:9 aspect ratio and then resized, although this does not always work as you lose a large part of the image.

**FITTING A 3:2 ASPECT RATIO IMAGE INTO A 16:9 FORMAT FOR PROJECTION MEANS THE IMAGE WILL FIT WITHIN THE WIDE ASPECT RATIO. TYPICALLY 1620 x 1080 PIXELS**



**Above:** fitting a 3:2 ratio image onto a projector means the height is the governing factor and leaves some space at each side.

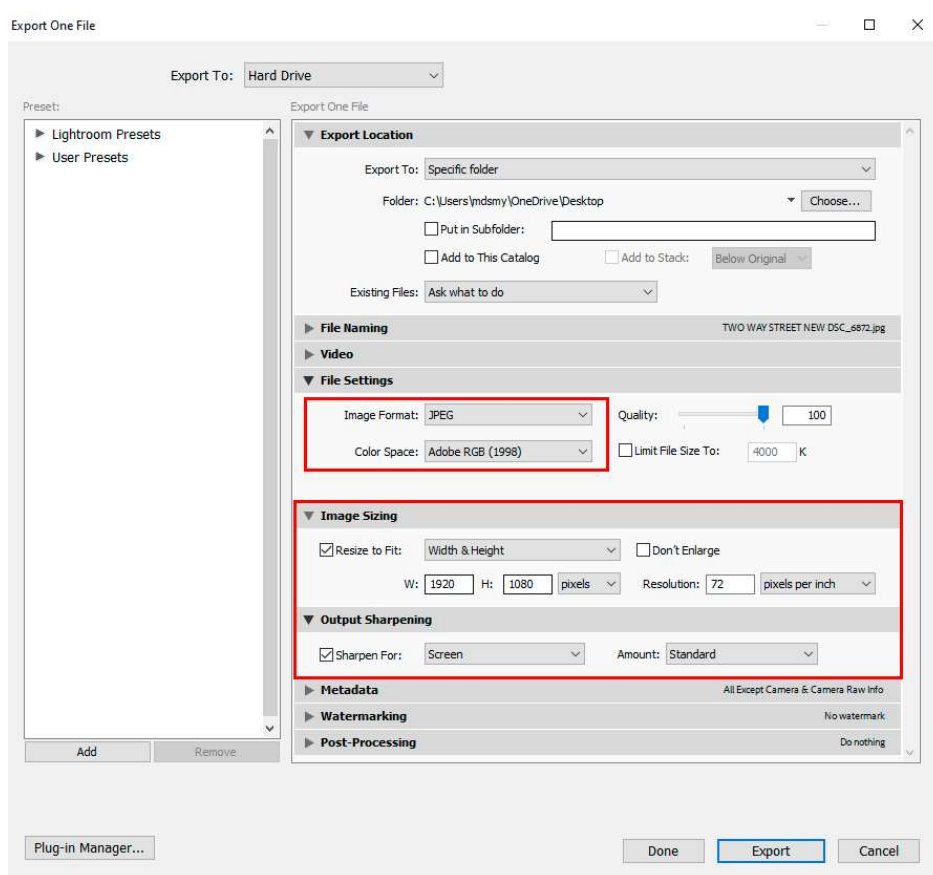
**CROPPING A 3:2 ASPECT RATIO IMAGE INTO A 16:9 FORMAT FOR PROJECTION AND FILLING THE FRAME WORKS, BUT SOME VALUABLE PARTS OF THE IMAGE CAN BE LOST.**



So, for exporting any image for projection on a 16:9 ratio (High Definition) projector requires you to either crop to these proportions or end up with some space either end of the image, unless of course the image is already in panorama or similar format.

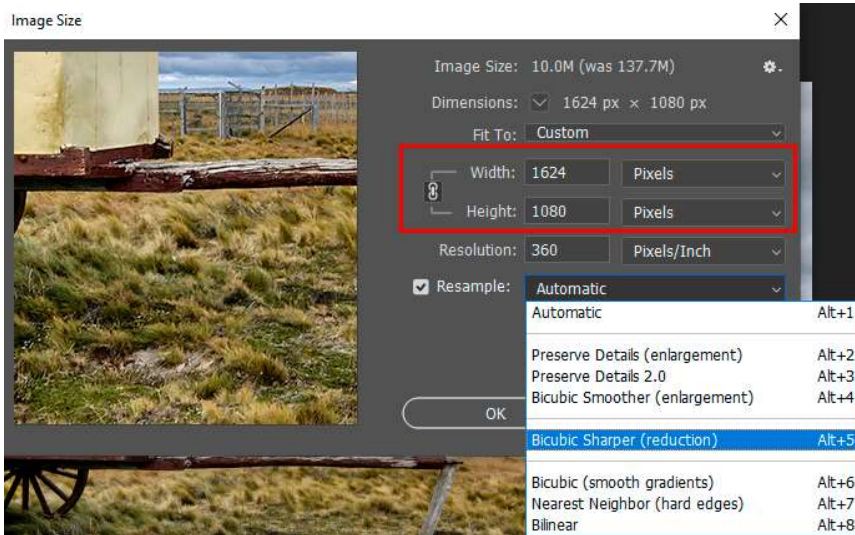
### How to avoid problems resizing for projection – use Lightroom's Export function

To export from **Lightroom**, use the **Export** Button in the Library panel. In the menu box that opens, choose the location for your exported file, select whether to rename or not, choose the file format – **JPEG** and the colour space – **Adobe RGB** is recommended (or sRGB), then set the image size to fit within 1920 x 1080 pixels and finally, ensure you select sharpening for screen. You can export multiple files at once and also save these settings as a preset.



**Above:** Lightroom exporting, and resizing is very simple, compared to Photoshop !

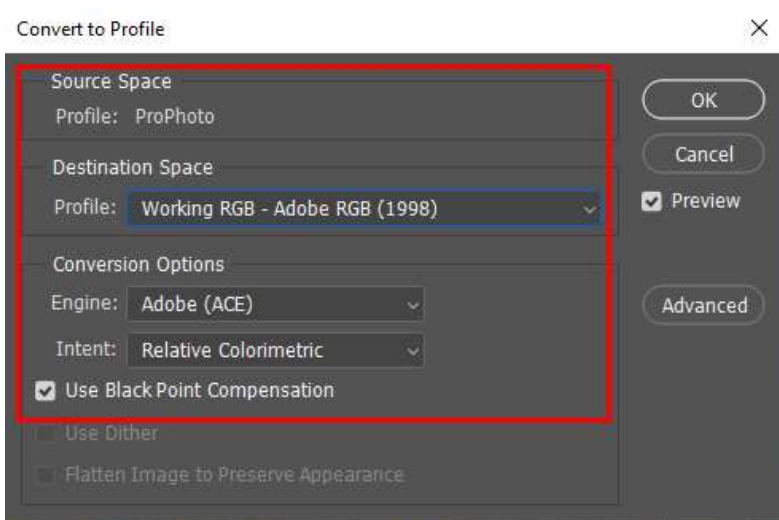
To export from **Photoshop** the steps are a little more complicated. First, open the original file into Photoshop and flatten all layers. Then go to **Image > Image Size** and select Pixels as the units. Make sure the chain symbol linking width and height is pressed, otherwise your image will be distorted. Select 1080 for the shortest dimension (Height for a landscape image, width for a portrait image). The resolution does not matter in this instance, but you will need to select the resampling method. Choose either Automatic or Bicubic Sharper. Then Click Ok to carry out the resizing.



**Left:** Image resizing in Photoshop.

This is the first part of resizing; the resulting image needs to be sharpened and the colour space changed.

Next, go to **Edit>Convert to Profile** to change the colour space from your editing space (ProPhoto RGB) to Adobe RGB or sRGB (Adobe RGB is generally preferred). Check to see that the colour rendition looks OK. If adjustment is required, apply a HSL adjustment layer to boost any loss of colour.



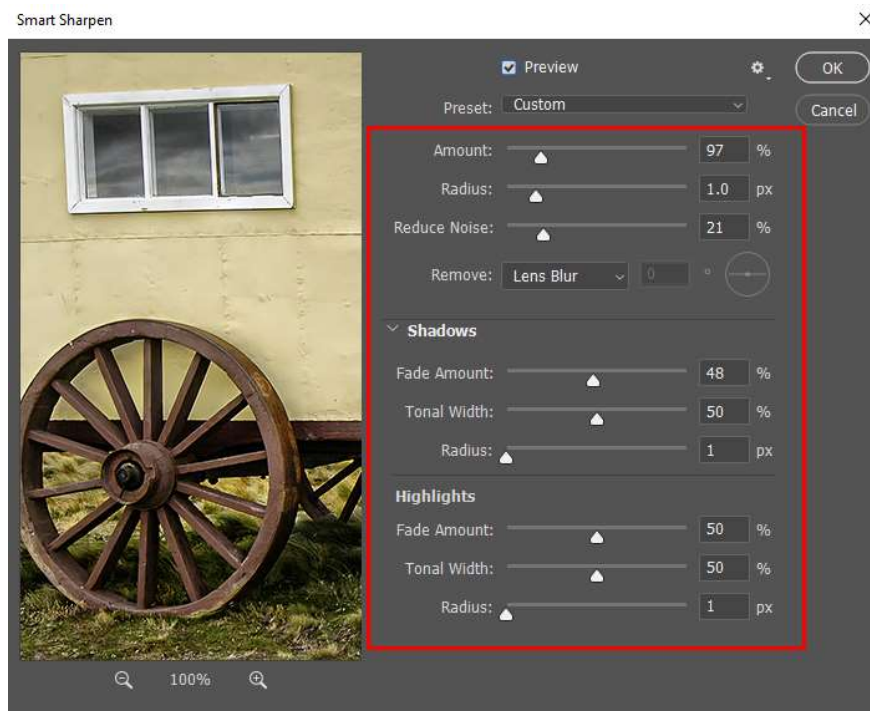
**Left:** Convert to the export profile using these settings. Photoshop handles the rendering intent, but in some cases, colour may require a boost or reduction.

Finally, we need to re sharpen the down sized image in order to minimise the loss of detail resulting from discarding over 90% of the image data.

### How Much Data is lost resizing for projection?

For a **24 Megapixel image** that is resized for projection, the output image file is 1620 x 1080 pixels (for a 3:2 aspect ratio), so the image becomes **1.75 Megapixels** (1620x1080 pixels) **a loss of almost 93%, YES 93% ! – that is why it is critically important to apply some output sharpening to the down sampled file.**

With the image file down sized and converted to the output profile, go to **Filter>Sharpen>Smart Sharpen** to apply selective sharpening to the image. We use Smart Sharpen here as it allows us to control where the sharpening is applied.



**Left:** Smart sharpening allows us to reduce sharpening in the shadows and highlights and concentrate on the mid tone areas. Try an amount around 100 at 1 pixel radius. Fade by around 50% in the shadows and highlights to avoid nasty halos at edges.

Use the preview to judge the best settings.

Finally, the image has been prepared for saving, so go to **File>Save As** and choose JPEG as the file format, choose a name (if necessary) and the location for the new file. Close your original file WITHOUT SAVING – most importantly to preserve your original file.

## Social Media

Each type of social media has different requirements, but the principles of resizing are the same as for projection, although the settings differ.

**Facebook** requires a maximum of 1200 x 600 pixels and will automatically resize any images uploaded, but of course, you have no control over the result. You can “beat the system” by resizing using Lightroom or Photoshop as above, just remember that your 24 Megapixel image (or larger) will be reduced by 97%, so check carefully.

**Instagram** has a strange square or 4:3 format that is even more difficult to fit into with a 3:2 ratio image. Here you are discarding about 95% of the image, plus the ratio is very different and may not suit some images.

See the diagram that follows for examples of output sizes and aspect ratios.

For a full demonstration of resizing and aspect ratios, see the YouTube Video here:

<https://youtu.be/oGE7BC05YhU>



**IMAGE SIZES AND RATIOS**

**6000 pixels wide**



**4000 pixels high**

**1920 pixels wide**



**1080 pixels high**

**1620 pixels wide**



**1080 pixels high**

**24 Mega pixel image at 3:2 ratio original image size**

**HD projector image at 16:9 ratio 2.07 Mega pixels**

**Resized to fit HD ratio from 3:2 original 1.75 Mega pixels a loss of 93% image data !**

**1200 pixels wide**



**630 pixels high**

**1080 pixels wide**



**1080 pixels high**

**Facebook maximum size 1.91:1 ratio or a minimum of 600 x 315 pixels or 0.756 Mega pixels (maximum)**

**Instagram size 1:1 ratio or 1.16 Mega pixels**

**1080 pixels wide**



**1350 pixels high**

**Maximum Instagram size 1:1.25 ratio or 1.45 Mega pixels**

**NOTE: IMAGE SIZES ARE NOT TO SCALE - FOR ILLUSTRATION ONLY**