Landscape Photography with a Scanning Back

Tools and Techniques for the Highest Image Quality

Unsurpassed Image Quality

- A large format scanning back provides the purest and most direct method of making a high-quality photographic image

- Landscapes can be excellent subjects for scanning photography

- Motion is less of a problem with latest generation of scanning backs, and can sometimes produce distinctive results

"Use the highest-performance camera you can carry" – paraphrase of Ansel Adams

…but not without some effort

- Sturdy 4x5 camera, lenses, laptop and scanning back are fairly big and heavy
- A sturdy tripod is also essential
- Camera setup and focus must be perfect
- Still have to be in the right place at the right time for an interesting subject

Mike's Photo Kit
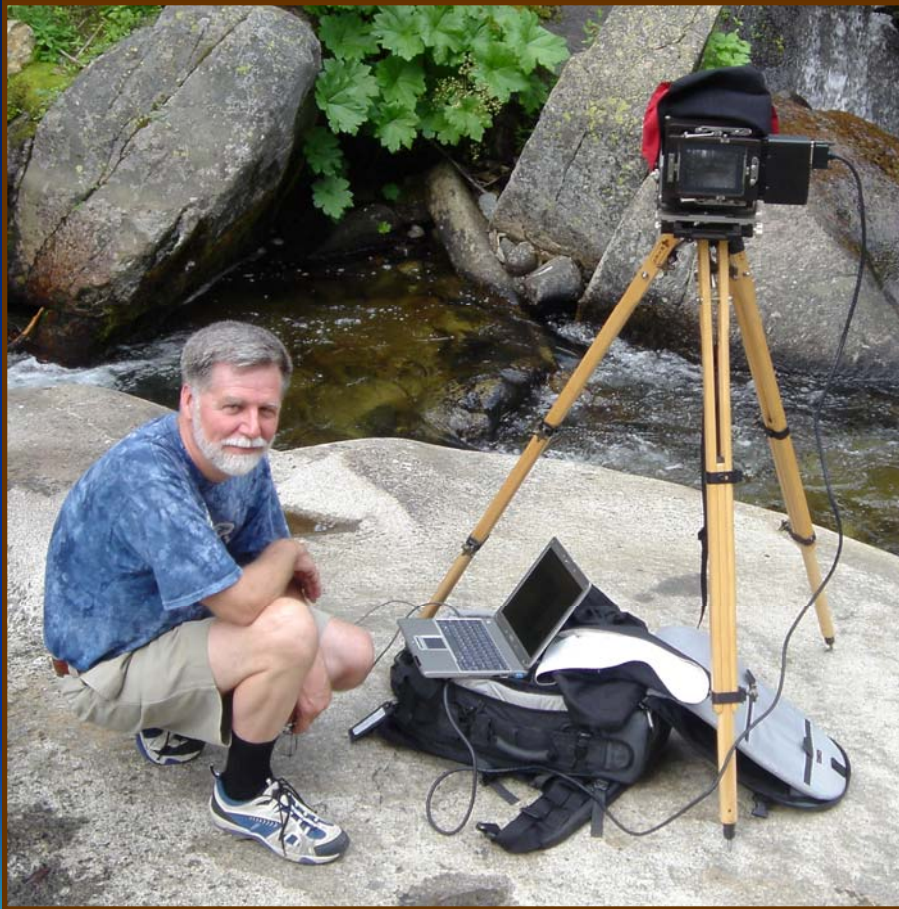
Ebony SV45U2 field camera*
Ries J100-2 tripod
  (also **Gitzo** G1548 tripod)
Lowepro Pro Trekker pack
80, 135, 210, 300, 450 lenses
  (also Cooke PS945 lens)
Better Light Super6K-HS
  with lithium battery
Dell X300 laptop
  (now with extended battery)
Focusing cloth, loupe, filters,
  RM digital gray card, e-wipes
(Pano adapter in its own case)

* Camera now equipped with standard pleated bellows instead of original universal bellows that leaks infrared

Keeping Everything Organized

Space for cables

Scanning back
in holder

BL lithium battery

USB2 control box

**Total pack weight
about 33 pounds**

3+ lenses

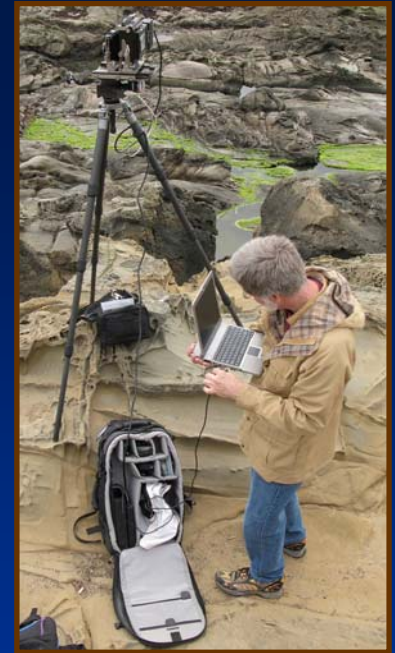Filter holder
Gray card
E-wipes
Lens & loupe

4x5 camera

Laptop

Typical Setups

This job has its perks…

Above - Yosemite NP
Left - Point Lobos SR
Right - Pebble Beach

(Pebble Beach photos by Robert Leslie www.leslieimage.com)

Exceptional Results

Above & Below – Point Lobos State Reserve

Above – Yosemite National Park   Below – Pebble Beach pano

…but not without some effort

- **Camera setup and focus** must be perfect (worth repeating!)
- **Exposure** should be optimized – avoid overexposure of brightest highlights
- **Tone expression** should be determined at capture time (often affects exposure)
- **Post-capture processing** is essential for bringing out the best in each image

All true for both film and digital photography!

Achieving Perfect Setup & Focus

For the Pebble Beach pano (March 2007), the tripod legs are extended largest sections first and set firmly into pockets in the rock to prevent them from slipping.

The BL pano adapter is mounted securely onto the tripod head. The head is then rotated to place the pano adapter in a convenient position, and rough-leveled.

The pano adapter arm is mounted to the 4x5 camera, and the arm and camera are then mounted onto the pano adapter.

The camera is initially set up with full front fall plus 2 cm. of rear rise to eliminate the horizon, and then rough-focused.

The position of the camera on the pano adapter arm is now adjusted to place the lens nodal point over the axis of rotation of the adapter.

The tripod head is now fine-leveled using the camera levels.

The camera is now fine-focused along a line down the center of the image area (for this panoramic photograph), with a slight amount of tilt applied to the front standard to optimize near-far focus.

Finally, the scanning insert is put into the camera back and its cables are properly routed and secured to the tripod.

Photo by Robert Leslie

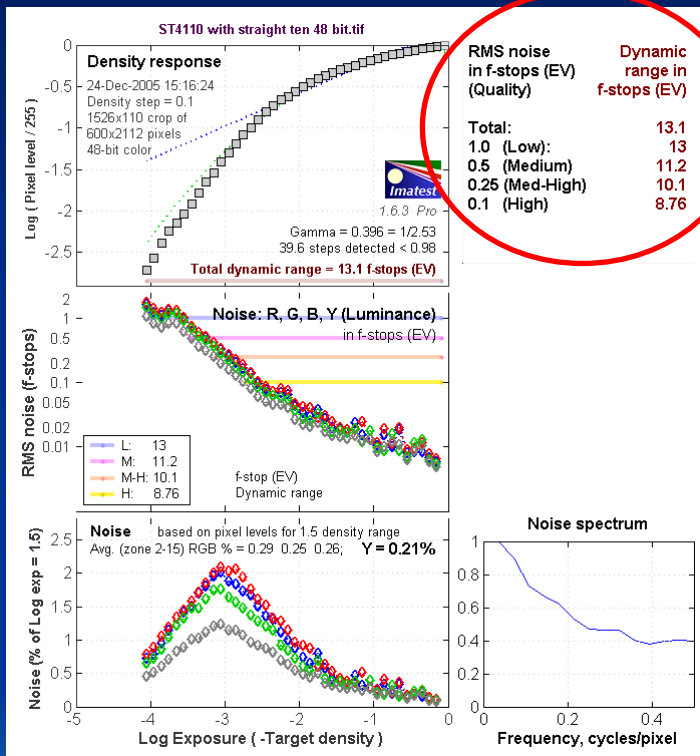**Practice makes perfect…**

Tips for Perfect Focus

- Choose a sturdy camera and lock all movements after adjustments are made
- Use a Zig-Align™ to check your camera for proper alignment (not necessarily in the field)
- Use a good 7 to 10 power focusing loupe
- Focus the loupe on the ground glass first
- Use lens aperture settings between 11 and 22
- Use view camera movements to optimize the region of best focus
- Use SuperView to verify proper focus

Optimizing Exposure

- **Greatest dynamic range** is obtained by using shortest* Line Time and lowest ISO settings

- **Shortest scan time** is obtained by using shortest* Line Time setting

- Increasing ISO sensitivity increases image noise faster than increasing Line Time, but doesn't increase scan time

- Optimum exposure often depends on subject

* 1/240 sec for 4K, 6K, S6K; 1/160 sec for S8K; 1/120 sec for S10K

Measuring Dynamic Range

If you can tolerate the noise, the scanning back has as much as 13 f-stops of dynamic range

A backlit density step chart was photographed with a 6000-HS under near-optimum exposure conditions (1/120s @ ISO 204), using a special Tone curve that spans the entire range of the scanning back.

The resulting digital image was analyzed by Imatest* software to derive the device's *total* discernable dynamic range, as well as the dynamic range at several levels of *usable* performance.

Imatest found that the scanning back resolved 39.6 out of the 40 steps below the topmost step on the test target, for a *total* dynamic range of 13.1 f-stops, and a *usable* range of 11.2 f-stops (medium quality level).

Extremely exaggerated section of digital image shows resolution of all 41 steps PLUS opaque surround!

Dynamic Range Trade-offs

Optimum sensor dynamic range in f-stops

0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11

Increasing ISO sensitivity directly reduces dynamic range by the same amount:

1 f-stop of boost "costs" 1 f-stop of range …but doesn't change the scan time

USABLE dynamic range with both ISO boost and longer Line Time

Increasing Line Time indirectly reduces dynamic range by a smaller amount:

1 f-stop of boost "costs" ½ f-stop of range …but also doubles the scan time

Example shows two f-stops of ISO boost and four f-stops of Line Time boost, equivalent to 1/15 sec at ISO 800

Usable Dynamic Range

Calculated Usable* Dynamic Range in f-stops for various combinations
of Line Time (fraction) and ISO settings

* Usable = minimum 10-to-1 signal to noise ratio

USABLE DYNAMIC RANGE, F-STOPS

7.5 GREAT
6.5 GOOD
5.5 FAIR

fraction	ISO 200	400	800	1600	3200
240	11.5	10.5	9.5	8.5	7.5
120	11.0	10.0	9.0	8.0	7.0
60	10.5	9.5	8.5	7.5	6.5
30	10.0	9.0	8.0	7.0	6.0
15	9.5	8.5	7.5	6.5	5.5
8	9.0	8.0	7.0	6.0	5.0

Based on calculated shot noise from signal plus typical dark current

Scan Time Considerations

- Shorter scan times can minimize potential subject motion artifacts
  - Less time for movement to occur
  - Less movement per line
  - Periodic movement stretched out (more fluid)
- Longer scan times can help smooth subject movement in some situations
  - More time for movement to occur
  - More movement per line
  - Periodic movement compressed (more jagged)

Scan Time Example

This section scanned in 6.3 seconds
1/160 sec Line Time
ISO 2094

This section scanned in 33.3 seconds
1/30 sec Line Time
ISO 398

Scan Time Flexibility

This section scanned in 1.6 seconds
1/160 sec Line Time
ISO 2094

This section scanned in 8.3 seconds
1/30 sec Line Time
ISO 398

Note the very low noise, even at ISO 2000, when the Line Time can be kept short

Tips for Optimizing Exposure

- Shoot brighter subjects!
- Use wider lens apertures plus camera movements for best focus utilization
- When more exposure is needed:
  - Increase ISO to keep scan time short
  - Increase Line Time to keep noise down
- Use higher-contrast Tone curves with marginal exposure settings to limit dynamic range
- Capture (color) infrared at low light levels

Determining Tone Expression

- Only necessary at capture time to the extent that exposure might be affected
- Difficult to make visual judgments in the field – poor laptop viewing conditions
- Most important to avoid overexposure
- Also desirable to capture entire scene range
- Numeric data analysis using ToneZones™ can be very effective

The Tone Curve

The Tone curve maps raw data values (light levels) to output data values (brightness)

Raw data values are logarithmic with respect to light levels, while output data values are linear with respect to perceived brightness (halfway values circled)

output values

16-bit	8-bit
64K	255
56K	224
48K	192
40K	160
32K	128
24K	96
16K	64
8K	32
0	0

brightness

light levels

f-stops	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0
14-bit raw values	16	32	64	128	256	512	1K	2K	4K	8K	16K
14-bit raw values per f-stop		16	32	64	128	256	512	1K	2K	4K	8K
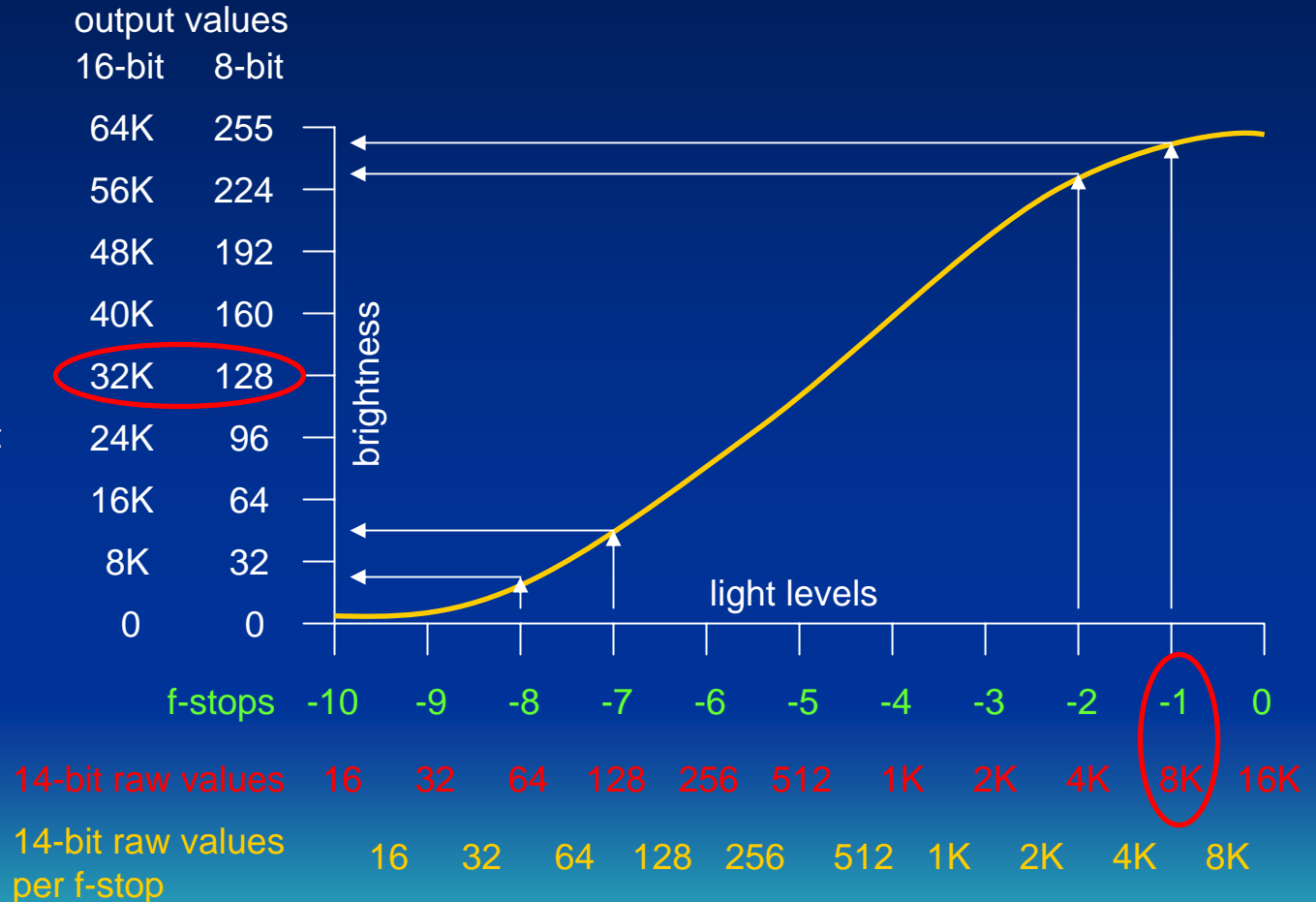
There is increasingly less raw information per f-stop at lower light levels, and it gets increasingly noisy

Optimizing the Tone Curve

Tone curve A requires 2 f-stops less exposure than curve B, but is also 4 times noisier

Curve A has 4,000 potential raw (14-bit) data values, while curve B has almost 16,000 – four times more raw data values per f-stop
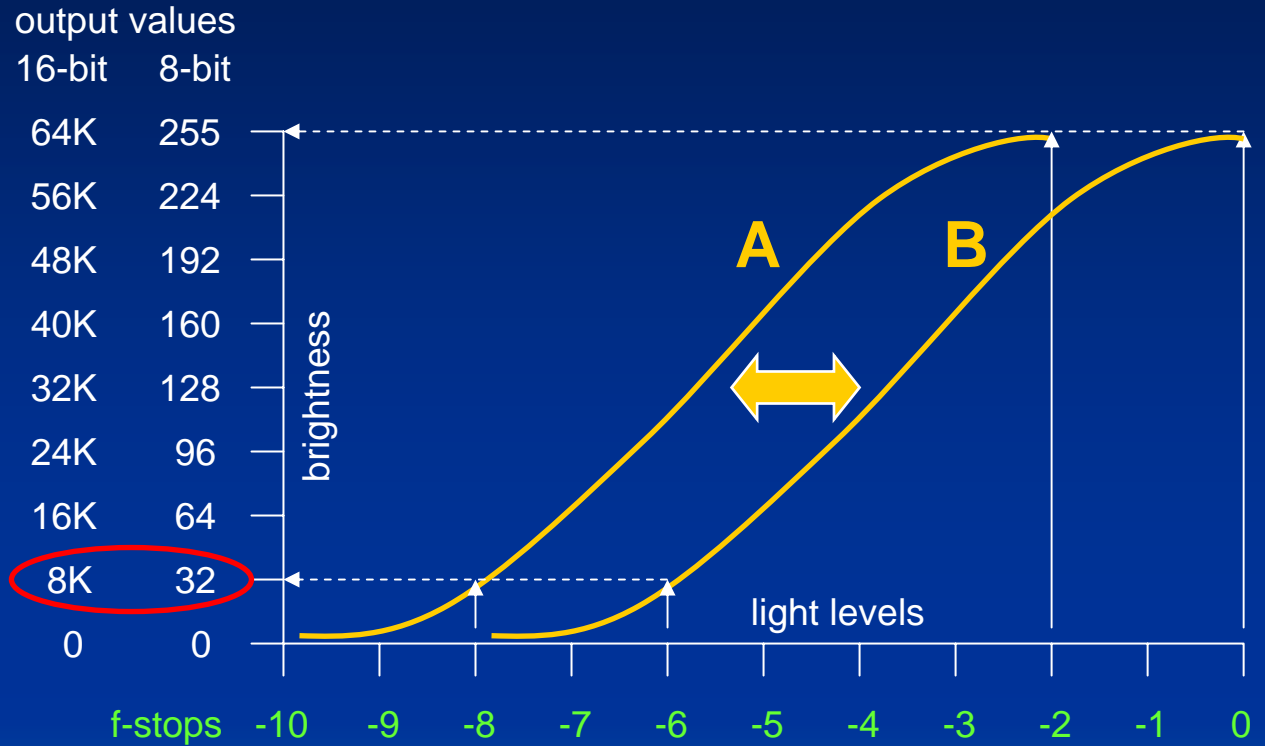
output values

16-bit	8-bit
64K	255
56K	224
48K	192
40K	160
32K	128
24K	96
16K	64
8K	32
0	0

brightness

A   B

light levels

f-stops	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0
14-bit raw values	16	32	64	128	256	512	1K	2K	4K	8K	16K
14-bit raw values per f-stop		16	32	64	128	256	512	1K	2K	4K	8K

Curve A might be suitable for a high-key subject, while curve B would be better for a low-key subject

Using Dynamic Range

Longer Line Time setting reduces sensor range

Optimum sensor range

Higher ISO setting shifts sensor range

How much of this ten-stop range is *usable** depends on Line Time and ISO settings

Right edge of the Tone curve graph indicates maximum *usable* exposure (maximum raw 16-bit data value)

Left edge of the output histogram indicates lowest *utilized* exposure for chosen Tone curve (output zero data value)

Right edge of the output histogram shows highest *utilized* exposure for chosen Tone curve (output full-scale data value)

* Usable = minimum 10-to-1 signal to noise ratio

Using ToneZones
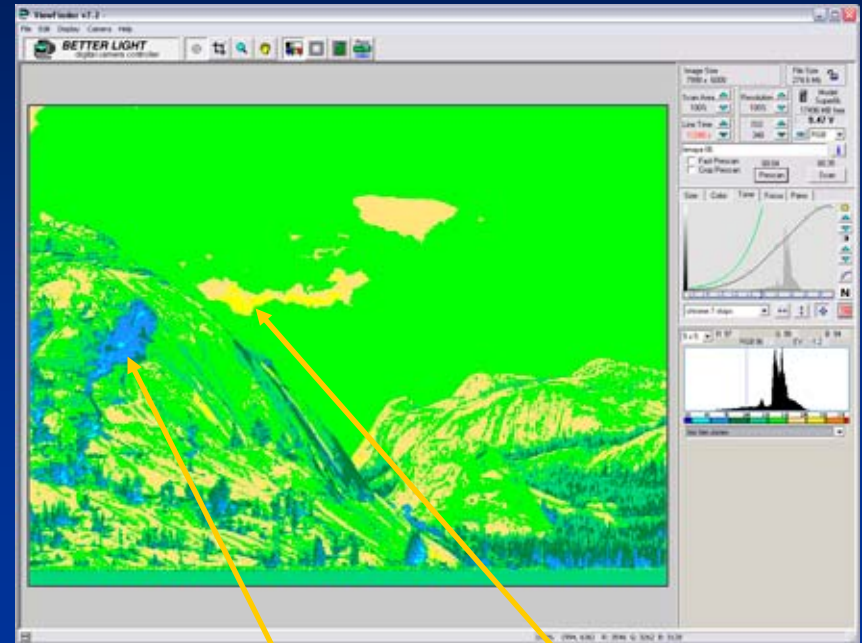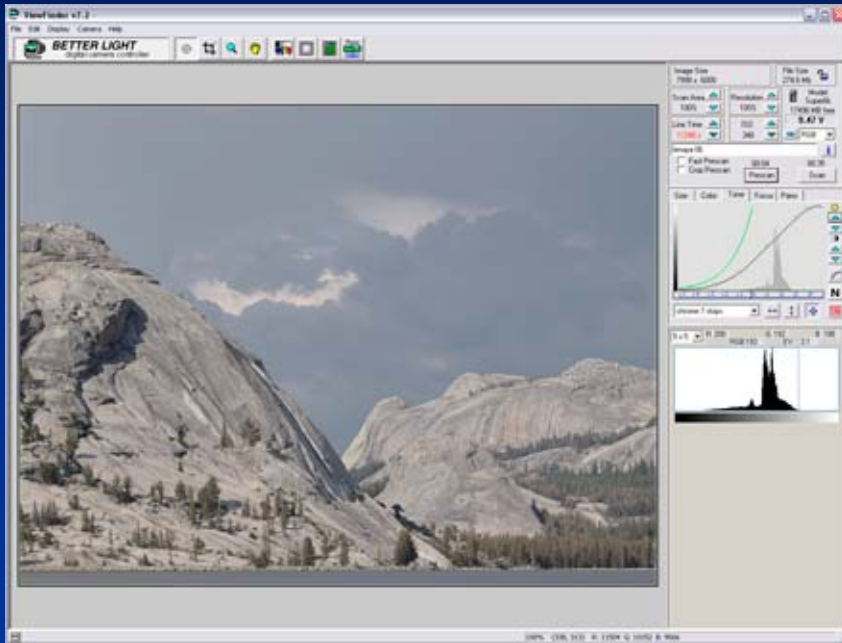
Use normal view and output histogram for visual evaluation
Use ToneZones view for numeric evaluation
Set the exposure to place highlights where desired – not too high!
Select a Tone curve to keep shadows open, as desired
(May require iteration)
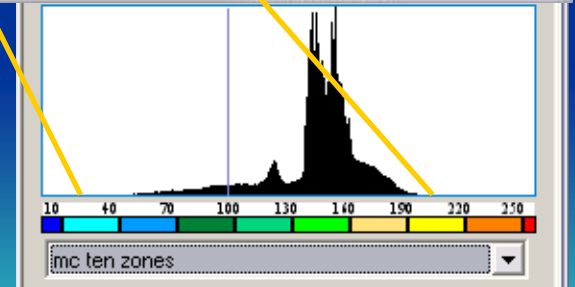
Tips for Determining Tone

- Making the image "fit" the available range is primary goal – do subtle adjustments later
- Consider available dynamic range when choosing a Tone curve
- Low-res prescan may dull small highlights – use SuperView to check
- Always save and use 16-bit per color image data
- Fairly painless to fix moderate underexposure
- Difficult to fix overexposure (data clipping)

What About Profiling?

- Landscape photography typically encourages subjectivity – it's not art reproduction
- Many landscape subjects exceed the dynamic range of profiling color targets
- Repro curves not suitable for landscape work
- An improper profile can easily create more problems than it solves
- Resulting color rendition is not always desirable (or repairable) – particularly greens
- Better Light scanning backs have a "native" color space complementary to Adobe RGB 1998

What About DNG?

- DNG format is raw 16-bit per color data with color transform information

- Available preprocessors don't allow control of color transform, have too many sliders

- Some profiling problems also affect DNG

- Using a 16-bit Tone curve typically retains 80% or more of the original raw data values, in a readily usable form

Post-capture Processing

- Images retrieved from the scanning back should be sharpened, and may need:
  - Artifact removal
  - Color cast removal
  - Final tonal adjustments
- It's OK to make subjective alterations
- 16-bit per color data allows considerable adjustment without visible degradation

Suggested Workflow

- **Original** image is retrieved through 16-bit Tone curve, usually determined at capture
- If needed, image is **cleaned** of artifacts using destructive editing techniques
- (Cleaned) image is subjectively **adjusted** using multiple layers and masking
- Adjusted image is sharpened and flattened to produce **final** image (8 or 16 bits/color)

Multi-stage Processing

Original image, as retrieved

SAVED as 274 MB TIFF

Cleaned-up image (if necessary) **(destructive edits)**

(SAVED as 274 MB TIFF)

Layered MASTER with adjustments (can be changed)

SAVED as <274 MB PSD*

FINAL image sharpened and flattened

SAVED as 137 or 274 MB TIFF

Don't try to do everything with a single (usually gigantic) image file!

* Photoshop CS2 layered PSD with "Maximize Compatibility" turned OFF

Image Cleanup

- Dust streaks (from dust on CCD glass)
- Bird and bug blips (flying through scene)
- Camera shake motion artifacts
- Subject and air motion artifacts
- Horizon leveling (slight image rotation)
- Lens chromatic aberrations
- (Image noise in severe cases)
- Usually removed using destructive editing

Cleanup using a Temporary Adjustment Layer

Original image

Exaggerated image

R

G

B

2 Edit each channel of the Background (image) layer to remove the artifact with the clone tool or healing brush
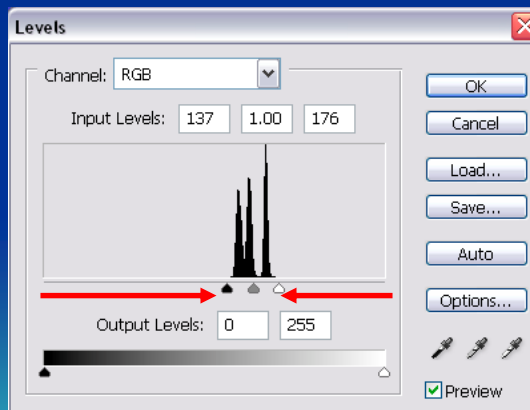
Levels can be re-adjusted for each color channel to maximize visibility

Layers | Channels | Paths
Normal   Opacity: 100%
Lock: 🔲 ✏ ➕ 🔒   Fill: 100%
👁 ⬛ 🖌 | ⬜   Levels 1
👁 ⬜   *Background*   🔒

Levels
Channel: RGB
Input Levels: 137 1.00 176
OK
Cancel
Load...
Save...
Auto
Options...
Output Levels: 0 255
☑ Preview

3 Discard the temporary Levels adjustment layer after cleanup is complete

1 Add a temporary Levels adjustment layer to boost image contrast in the area being edited

Dust streak example above is shown at reduced size

Cleanup using a Color Brush

2 Desaturate the selected color slightly for best results (move color selector towards neutral, as shown)

1 Pick a representative Foreground color to replace the colored artifacts
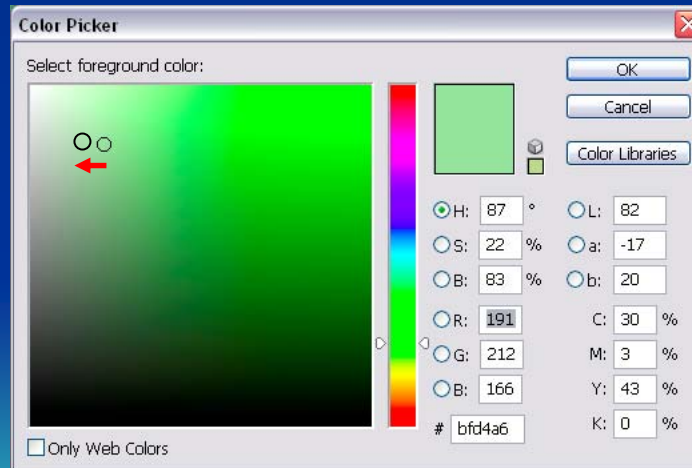
3 Carefully paint over the colored artifacts using a small brush set to Color mode with 100% Opacity

Viewing the image at high magnification helps this process

Color Picker

Select foreground color:

OK
Cancel
Color Libraries

H: 87 °   L: 82
S: 22 %   a: -17
B: 83 %   b: 20
R: 191   C: 30 %
G: 212   M: 3 %
B: 166   Y: 43 %
                K: 0 %
bfd4a6

Only Web Colors

Subject motion artifact above is shown magnified 200%

Global Cleanup of Minor Artifacts

2 Apply Photoshop CS2's Reduce Noise filter to the duplicate layer, with Strength and Sharpen Details set to 0; adjust Reduce Color Noise setting to eliminate artifacts

1 Make a duplicate copy of the Background (image) layer, and set the duplicate layer to Color mode
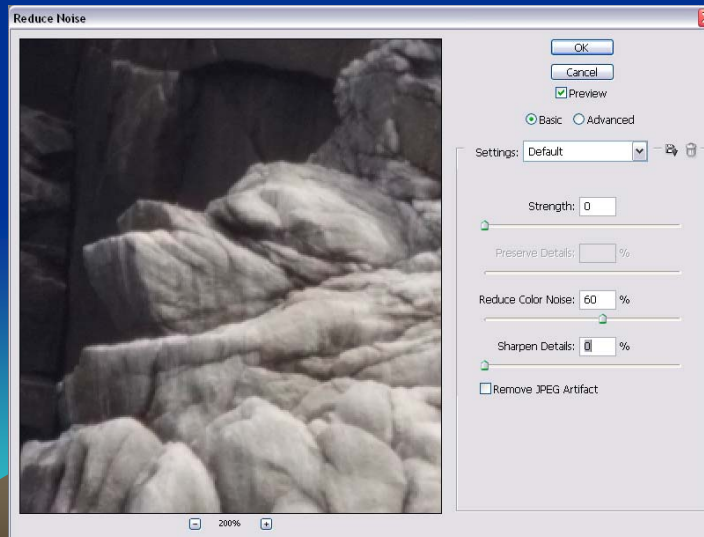
3 Flatten the cleaned-up image and save it before continuing with further processing

This technique also dulls small color details – use sparingly

Air motion example above is shown magnified 200%

Cleaning up Moving Water
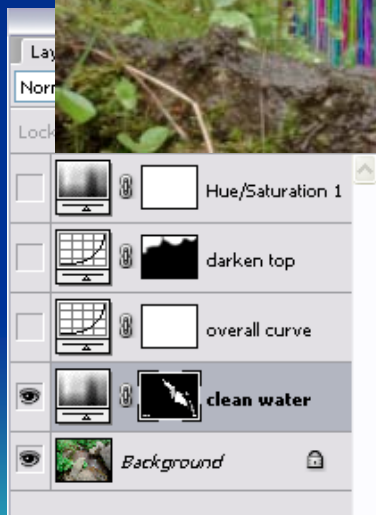
1 Add a Hue/Saturation adjustment layer and set the Saturation to -90*

2 Use the paint bucket to fill the entire mask for this layer with black

3 Use brushes to paint the mask white where color should be removed

(This non-destructive technique can be an image adjustment)

* Lets a tiny amount of color remain – adjust to taste

Image Adjustments

- Overall brightness & contrast changes
- Local brightness & contrast changes
- Color cast removal
- Color saturation changes
- Dynamic range interpretation
- Accomplished using multiple adjustment layers with masking
- Non-destructive – can be changed later

Photoshop Workspace

Tool Palette

Layers & Masks

Navigator & Info

Histogram
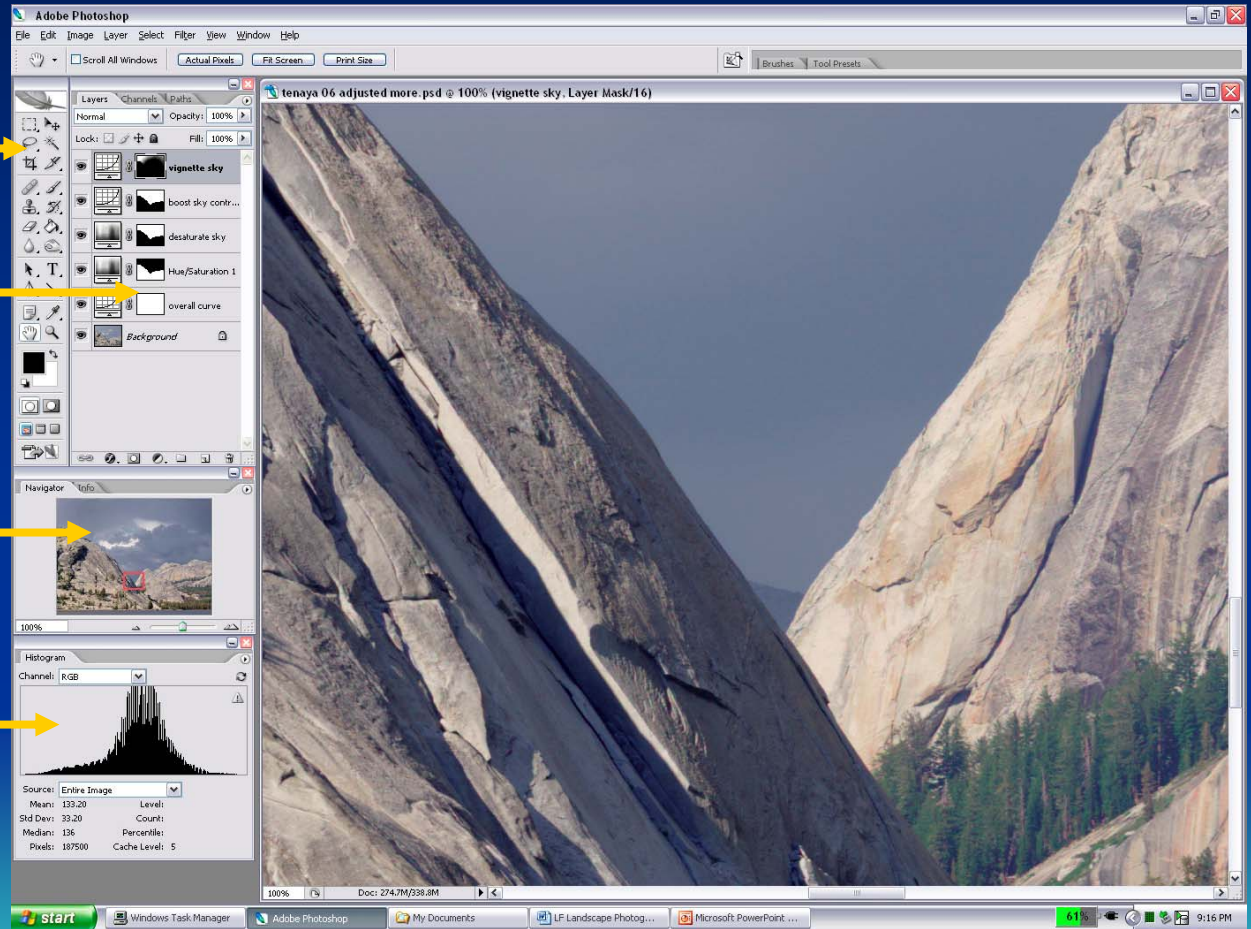
Using Adjustment Layers

Start with the cleaned-up 16 bit per color image (or the original image if no cleaning was necessary)

Apply adjustment layers in a logical sequence – attempt to minimize the number of adjustments that are done to any given location in the image by using layer masks

Cleaned image before adjustments

Overall Curve
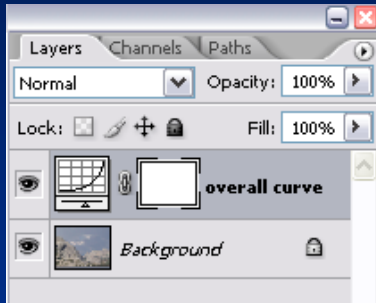
The overall curve is usually applied to the entire image (no mask)

After overall curve adjustment
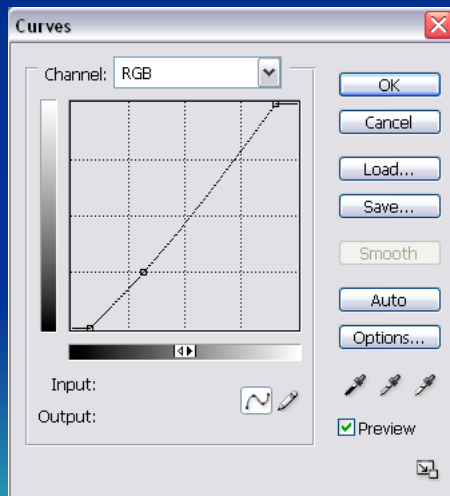
The overall curve is typically used to tidy up exposure and Tone expression

Increase Color Saturation
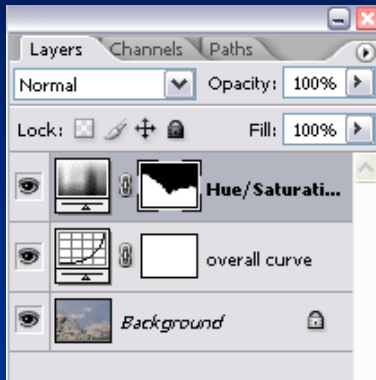
Sky is masked, so only the mountains are affected by this saturation boost

After increase color saturation

Lower-contrast Tone curves typically benefit from a Saturation boost to restore appropriate color
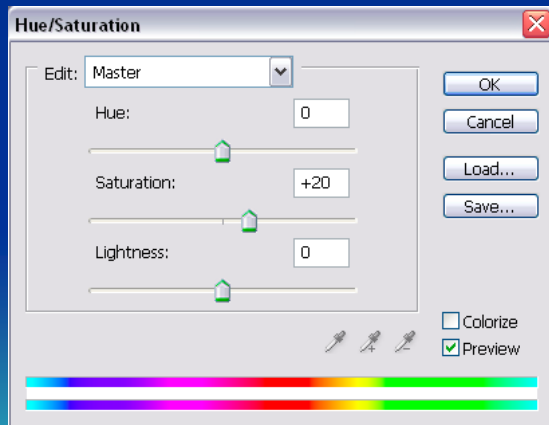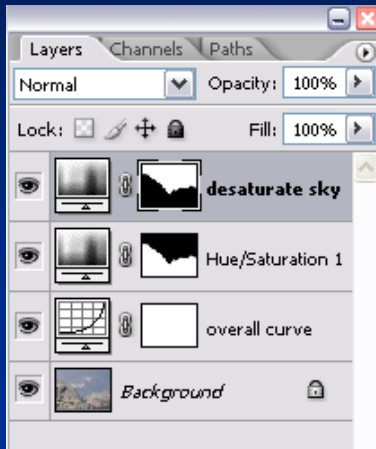
Desaturate Sky

Mountains are masked, so only the sky is affected by this saturation reduction

After desaturate sky
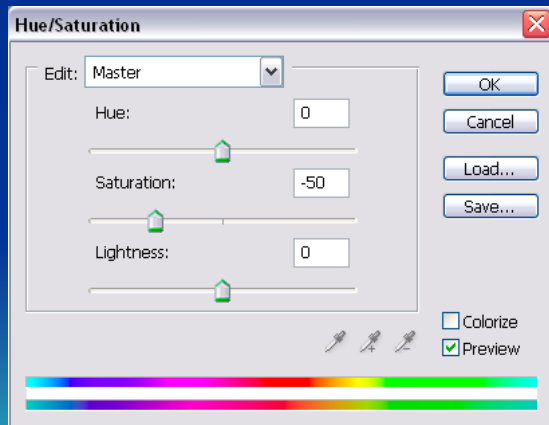
The desaturate sky and boost sky contrast adjustments were done iteratively

Boost Sky Contrast
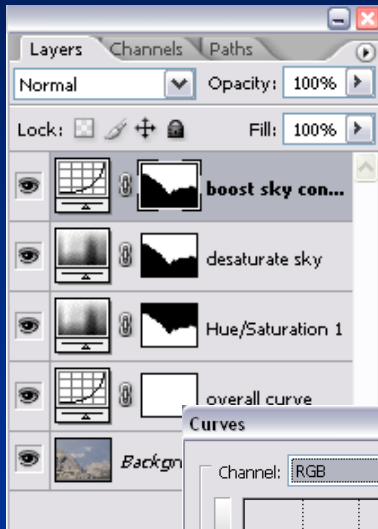
Mountains are masked, so only the sky is affected by this contrast boost
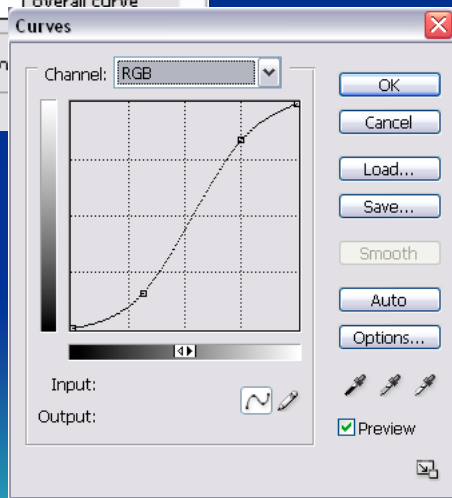
After boost sky contrast

The desaturate sky and boost sky contrast adjustments were done iteratively

Vignette Sky
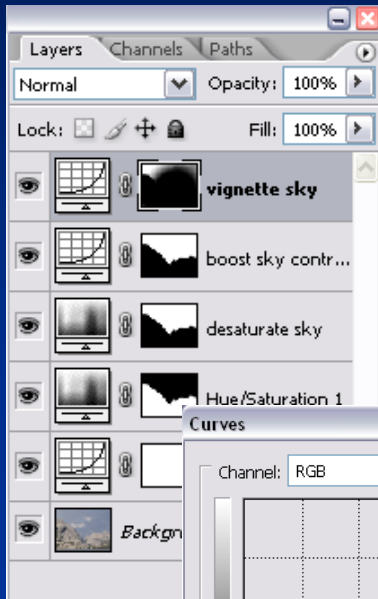
Radial gradient was used to make a mask for this layer, with manual additions
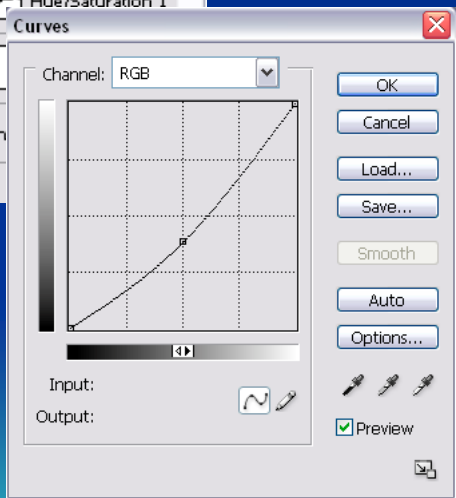
After vignette sky

Before & After

As captured
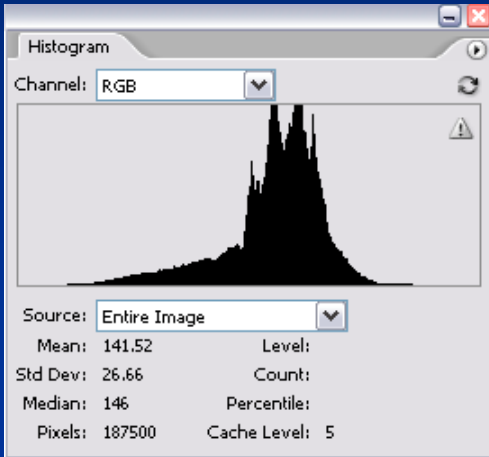
Careful field work is required to bring back a properly exposed and focused image
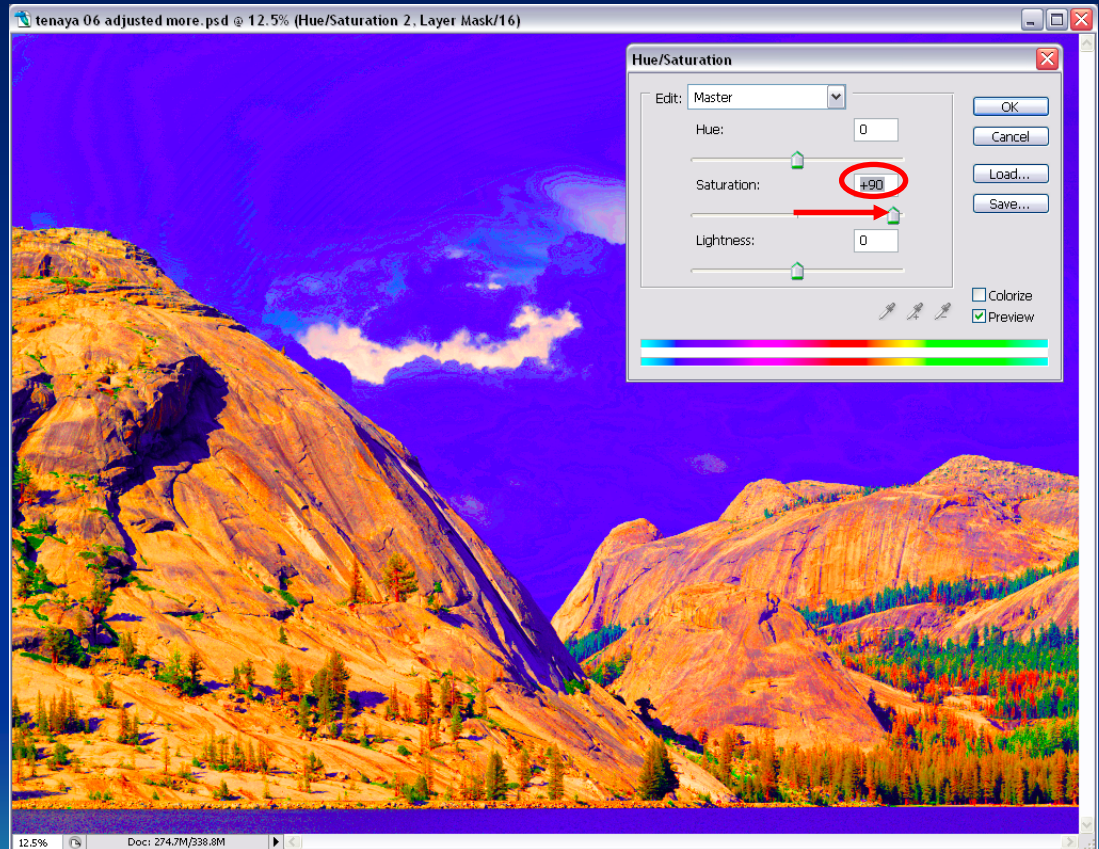
Before & After

After adjustments
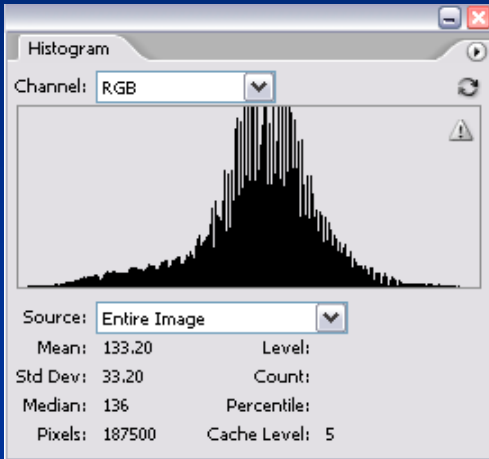
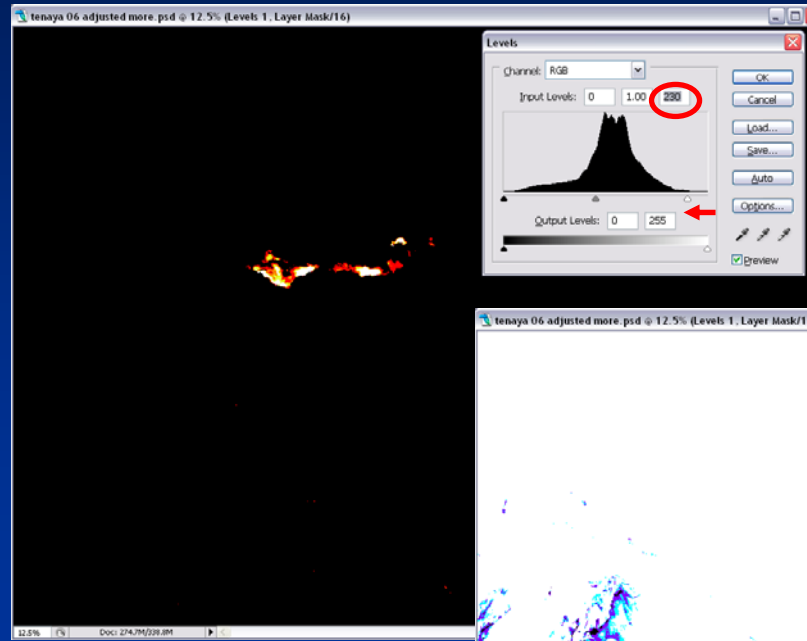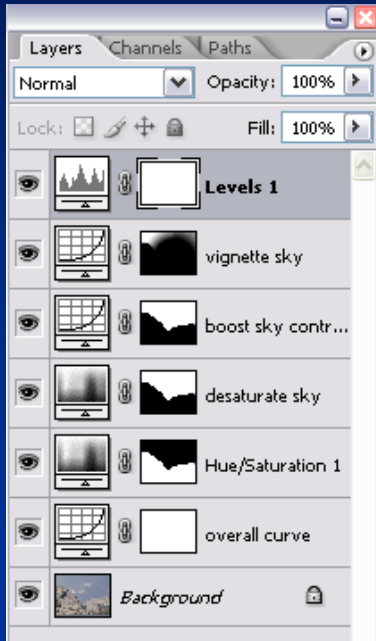Judicious post-processing is required to finish the photograph

Evaluating Image Color

Add a temporary Hue/Saturation adjustment layer on top of all other layers, and turn up the image saturation to +90 to evaluate subtle image colors – discard this layer when finished
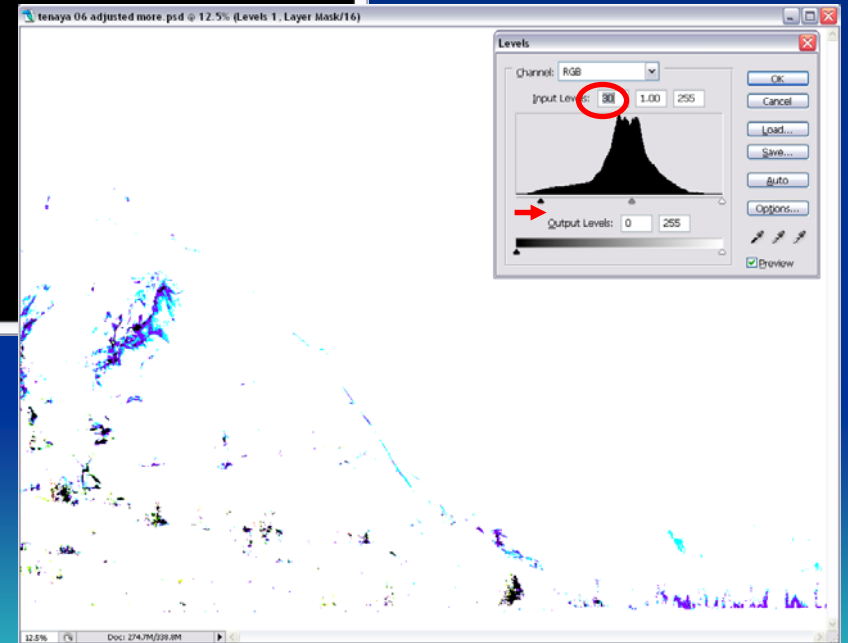
Note the red and orange trees, as well as the green ones

Evaluating Image Levels

Checking highlights
(above 8-bit value 230)

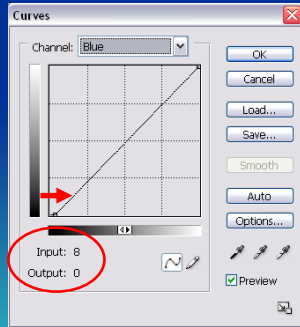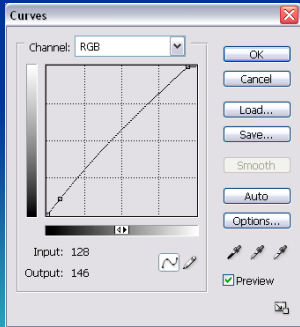Checking shadows
(below 8-bit value 30)

Add a temporary Levels adjustment layer on top of all other layers, then hold down the Alt/Option key while moving either end slider inward – discard this layer when finished

Fixing a Color Cast

Overall curve RGB

Overall curve Blue

Reduce blue shadows by moving the dark end of the Blue channel in the Overall curve adjustment layer as shown, in addition to the desired RGB curve affecting all colors

The bright snow in this image is already neutral, so only the dark end of the Blue channel is adjusted

The Adjusted Master File

- Do NOT sharpen the Adjusted image at this point – this will be performed as needed later
- Only Adjustment Layers are used – no copies or composites – to maintain modest file size
- Individual mask can be used for each adjustment to localize its effect
- Layered file is saved as Photoshop PSD format, with "maximize compatibility" OFF
- Layered PSD file size is typically SMALLER than original 16-bit per color TIFF file, even with layer masks

Layered adjusted image may appear slightly posterized – this will disappear when the image is flattened
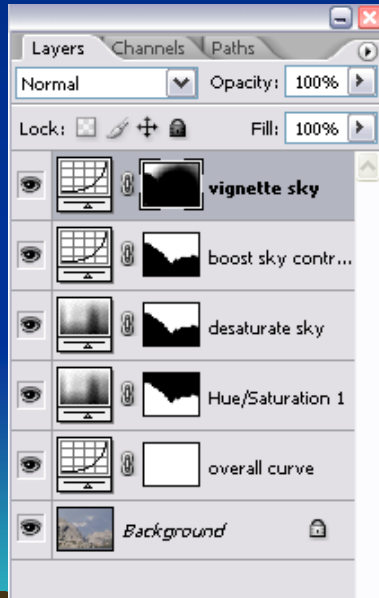
Finishing the Image

- Start with the layered PSD Master File
- Apply Unsharp Masking to the Background (image) layer
  - Use a fairly high percent, e.g., 100 to 200 %
  - Use a small pixel radius, e.g., 0.3 to 1.0 pixel
  - Use a small threshold, e.g., zero or 1
  - Typical setting 150%, 0.7 radius, 1 threshold
- Flatten the image
- Assign Adobe RGB 1998 profile
- Save as 8- or 16-bit per color TIFF file

Image size can also be changed prior to sharpening, if desired
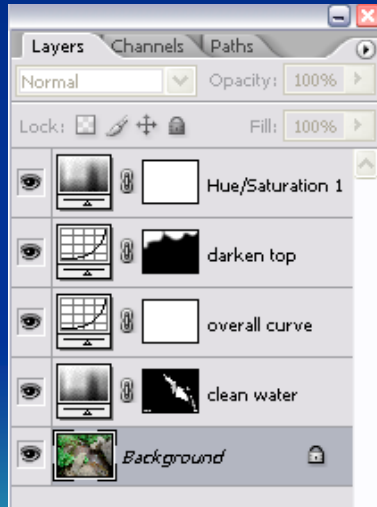
Three Trips and a Local Beach

- **Yosemite** National Park and Sierra National Forest, July 2005
- **Point Lobos** State Reserve, August 2005
- **Mt. Rainier** and **Crater Lake** National Parks, September 2006
- **Pebble Beach**, San Mateo County
  - About an hour away via winding roads
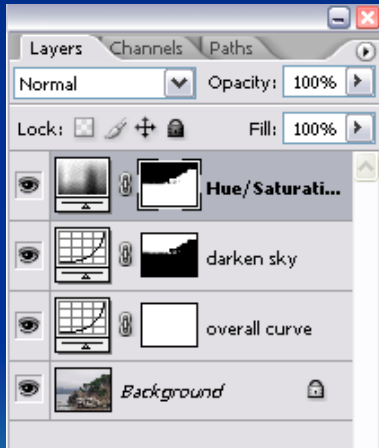 - Often foggy along the Pacific coast

Yosemite, July 2005

Tenaya Lake, Yosemite NP; July 20, 2005; 5:13 PM   1/240 sec ISO 347 300 mm f-16 chrome 7

Sierras, July 2005

Waterfall, Sierra NF; July 21, 2005; 10:45 AM   1/30 sec ISO 398 135 mm f-16 chrome 7

Point Lobos, August 2005
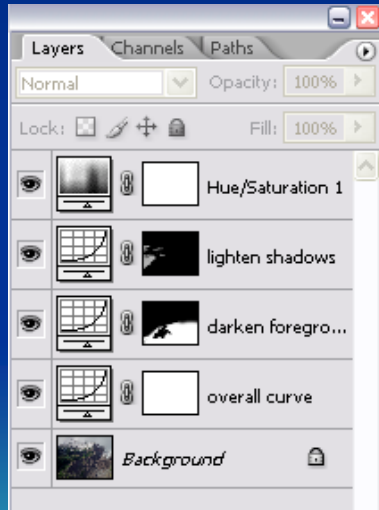
Point Lobos, August 2005

This low-contrast, almost-colorless subject came alive by using the Copy 4 Stops Tone curve – almost like color litho film.
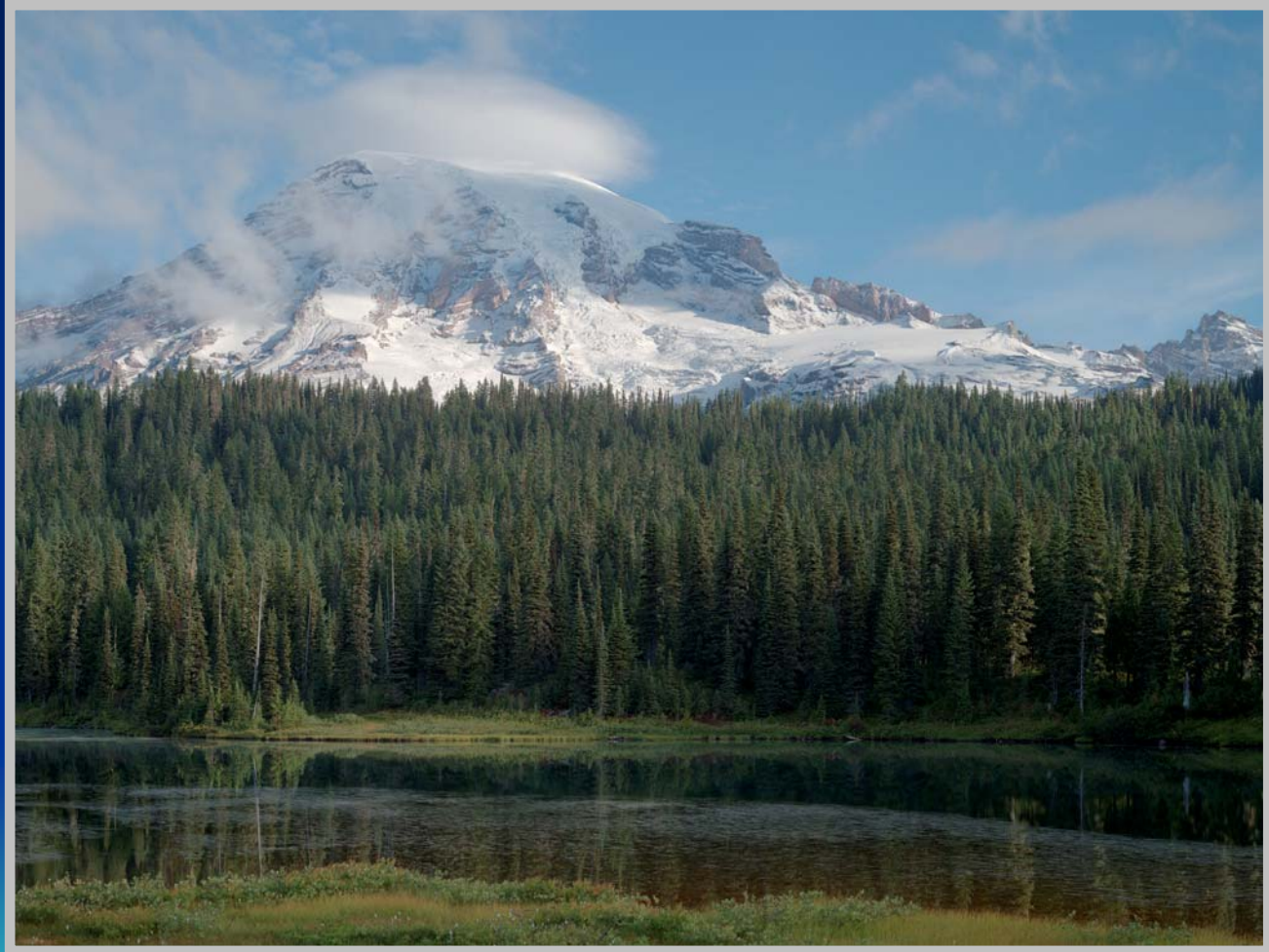
The original image only needed cleanup of a few bits of shell stuck in the cracks, plus final sharpening – no other adjustments.
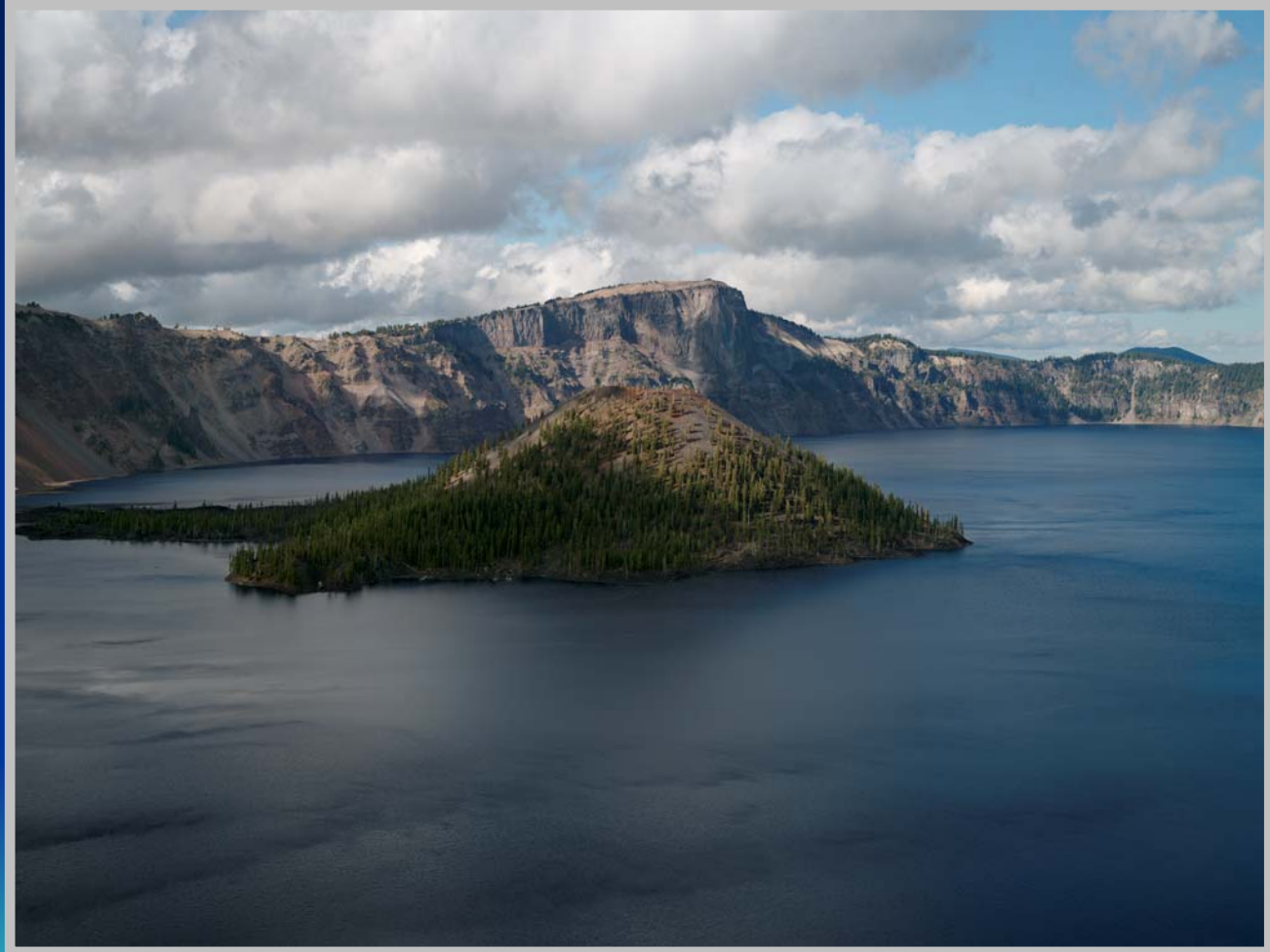
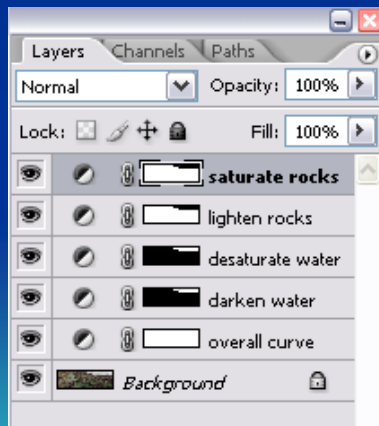Colored sandstone, Point Lobos SR; August 18, 2005; 2:01 PM   1/240 sec ISO 324 135 mm f-16 copy 4

Road Trip, September 2006

Nisqually Glacier, Mount Rainier NP; September 16, 2006; 4:27 PM   1/240 sec ISO 214 135 mm f-11 flat 8

Road Trip, September 2006

Mount Rainier, Mount Rainier NP; September 17, 2006; 8:05 AM   1/120 sec ISO 230 135 mm f-11 flat 8

Road Trip, September 2006

Wizard Island, Crater Lake NP; September 18, 2006; 4:27 PM   1/240 sec ISO 254 135 mm f-11 chrome 7

Negative Tide - Panoramic

Pebble Beach, San Mateo Coast; March 17, 2007; 3:51 PM   1/240 sec ISO 1125 135 mm f-16 chrome 7

Negative Tide – Color Infrared

Pebble Beach, San Mateo Coast; May 19, 2007; 7:28 AM in wet fog   1/120 sec ISO 811 210 mm f-16 copy 4

Negative Tide - Panoramic

Pebble Beach, San Mateo Coast; May 19, 2007; 8:49 AM   1/60 sec ISO 1125 135 mm f-16 low contrast 8
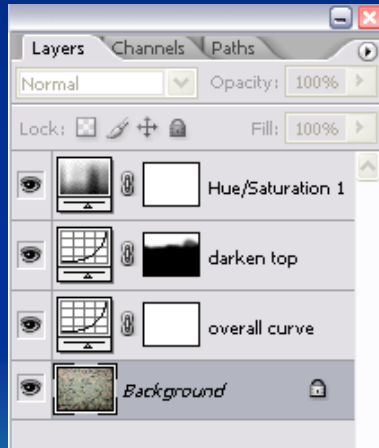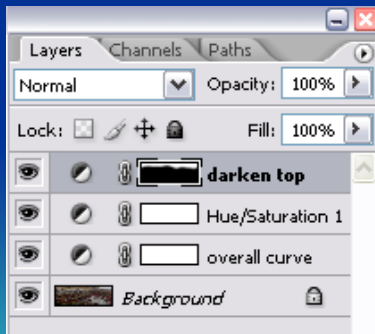
Thanks to all Better Light owners for supporting my photographic explorations!