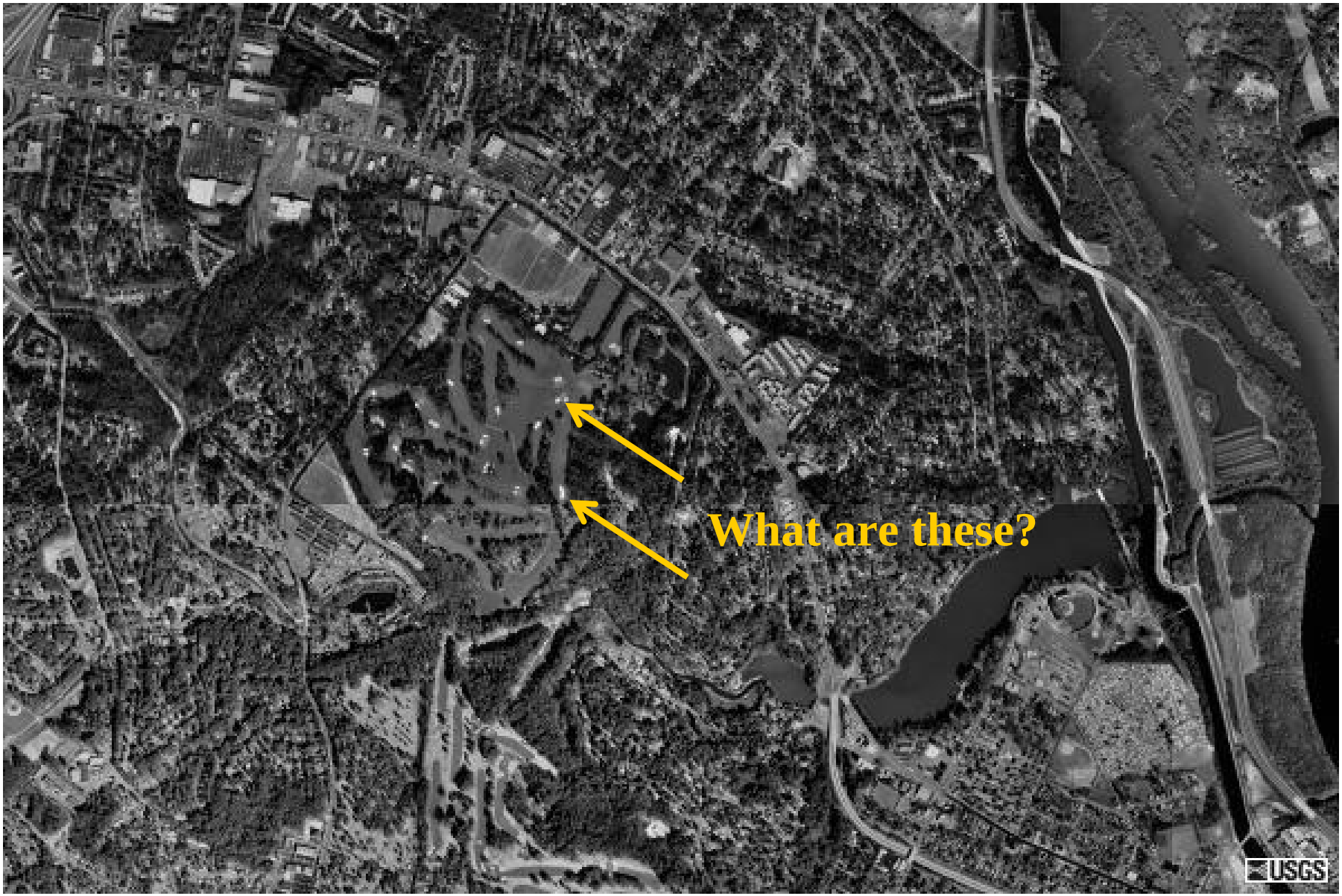
Photo Interpretation


What are these?
USGS


10 Nov 2002


22 Dec 2002

Sanitization of Ammunition Depot at Taji

Advantages of Aerial Photos

- Excellent, and selectable, spatial resolution
- Multiple discipline uses
- Large database of existing photos going back to 1930’s
- Relatively Easy to obtain
- Cost effective - although their processing may not be
- Stereoscopic coverage is readily available.
- Enables photo interpretation, rather an image analysis approach.

Photo Interpretation

Defined

> “The act of examining photographic images for the purpose of identifying objects and judging their significance.”

Objective

> To be able to recognize landscape features on a aerial photograph and make inferences about features on the surface of the Earth.

Requirements

- Long hours of practice
- Ground visitations
- Have a background in earth sciences and biological sciences

Photo Interpretation: Seven Basic Principles

Paine lists seven principles of photointerpretation

- Size (Relative or Absolute)
- Shape
- Shadows
- Tone or Color
- Texture
- Pattern
- Association/Location

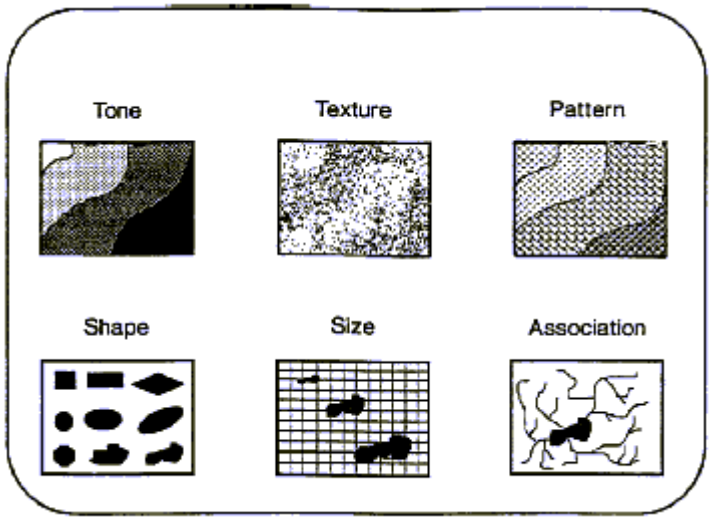


Photo Interpretation: Seven Basic Principles

Principle 1: Absolute and Relative Size

Relative size: the size of an unknown object in relation to the size of a known object.

Absolute size: the actual size of a landscape features, requires an understanding of the photo scale.

Size can also be used in judging the significance of objects and features (size of trees related to board feet which may be cut; size of agricultural fields related to water use in arid areas, or amount of fertilizers used; size of runways gives an indication of the types of aircraft that can be accommodated).

- Size: the size of an object is one of the most useful clues to its identity. Also, understanding the size of one object may help us understand the sizes of other objects.
- For example, most of us have a feeling for the size of a baseball field, and football field. When we observe these objects on a photograph, it will help us to understand the sizes of other objects on the photograph.
- For example, on another part of the photograph we have a trailer park. This could easily be confused with a parking lot, but when we understand the size of the objects we will realize that the objects in the trailer park are much too large to be cars.

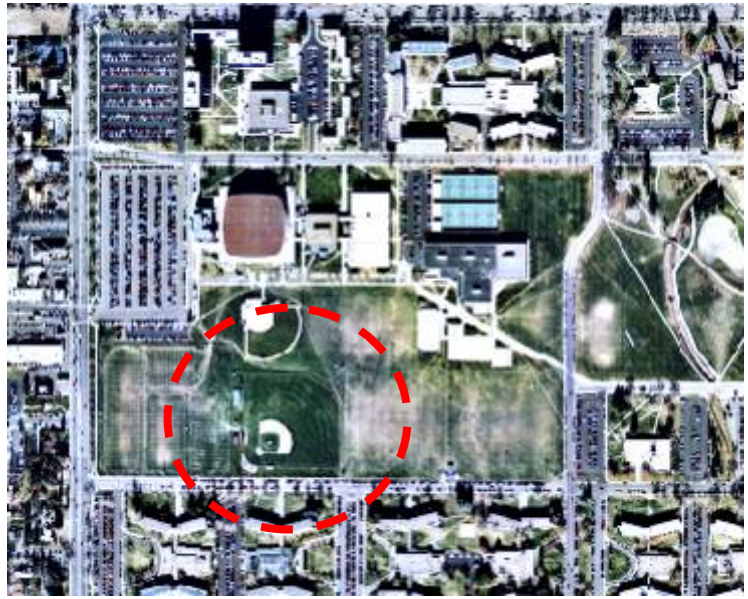


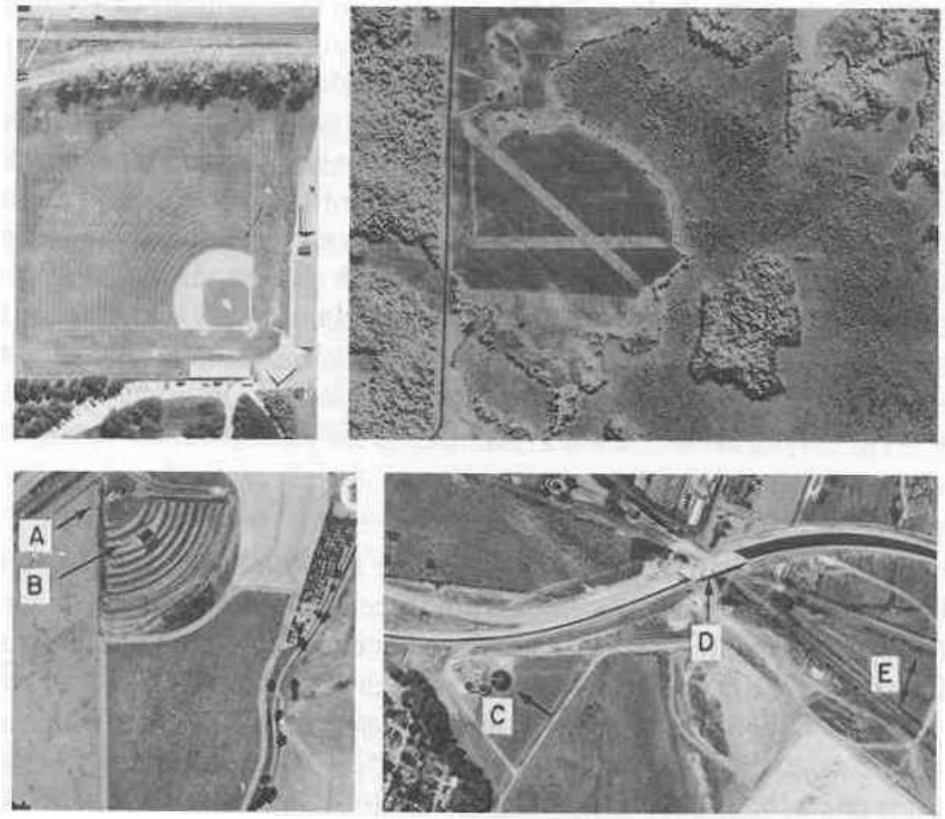
Photo Interpretation: Seven Basic Principles

Principle 2: Shape

We must be able to recognize landscape features on a photograph by their shape as viewed from above.

Example: transportation systems and their type: railroad, highway, secondary roads

Example: vegetation: powerlines, airport runways



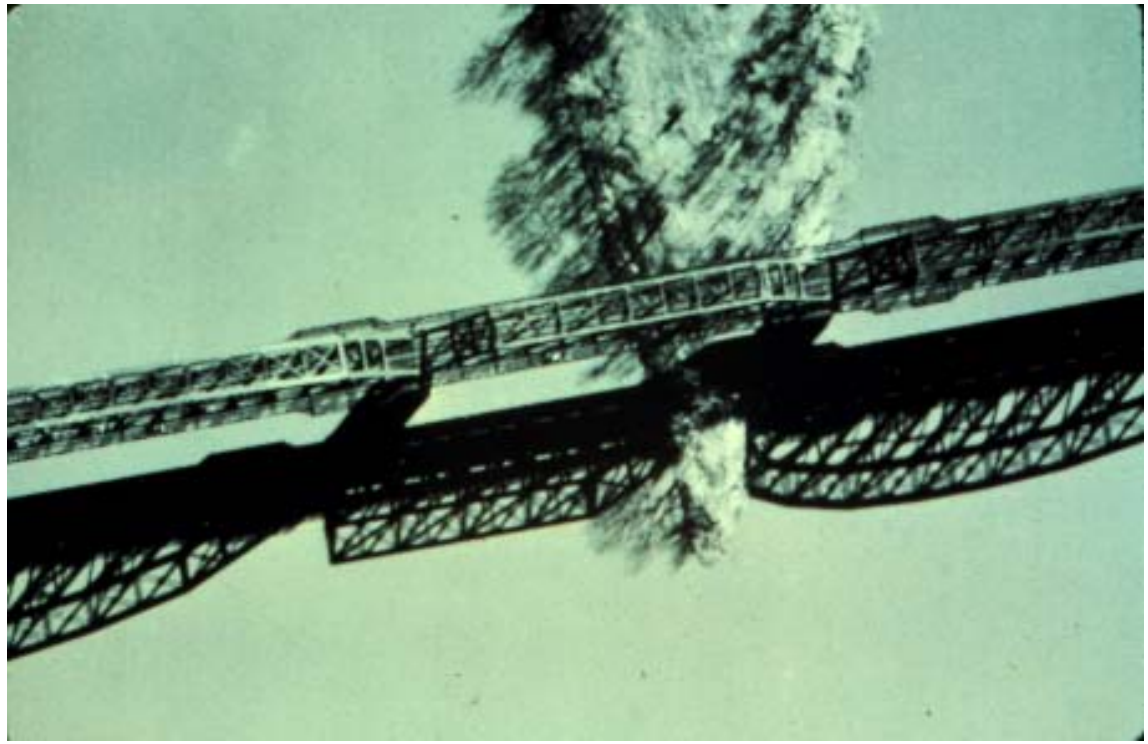
- **Shape**: Shapes can often give away an object's identity. For example, a cloverleaf is a very distinctive feature of a highway, while a stream's meandering gives away its identity.
- And again, the baseball diamond we just looked at also has a distinctive shape.

Photo Interpretation: Seven Basic Principles

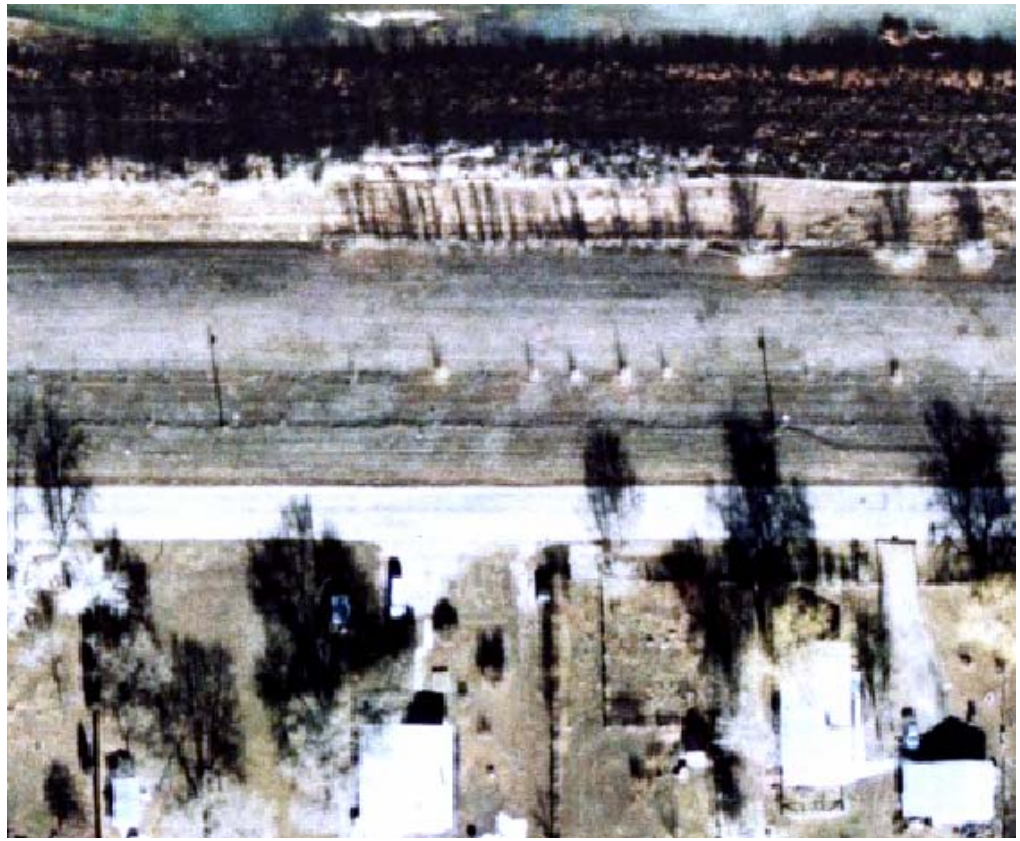
Principle 3: Shadows

Give clues to the profile shape and relative sizes of landscape features.

Can obscure detail in other landscape features.



- **Shadow**: shadows often give us an indication of the size and shape of an object. When we look at aerial photographs we often see a vantage point we are not used to: an overhead view.
- Shadows can let us “cheat” a little to see the side of an object. Although the orthophotos are geometrically corrected for displacement, any shadows in the image remain.



- **Shadow**: while shadows are helpful, they can also be a hindrance. The yard of this house is obscured by the shadow cast by a large tree.

Photo Interpretation: Seven Basic Principles

Principle 4: Tone or Color

Remember:

B&W photography: 200 shades of gray

Color photography: thousands of shades of color

Tone is described in terms of pattern:

uniform, mottled, banded, etc.

..... and in terms of boundary sharpness:

sharp, distinct, gradual, fuzzy

Tone varies both within and between photographs, between seasons of the year, and with the position of the sun in relation to the camera.

- **Tone**: You can see the tonal contrast between a reservoir and the land area. Also, there is good tone representation for wet or dry soils, and cultivated vs. non-cultivated soils.

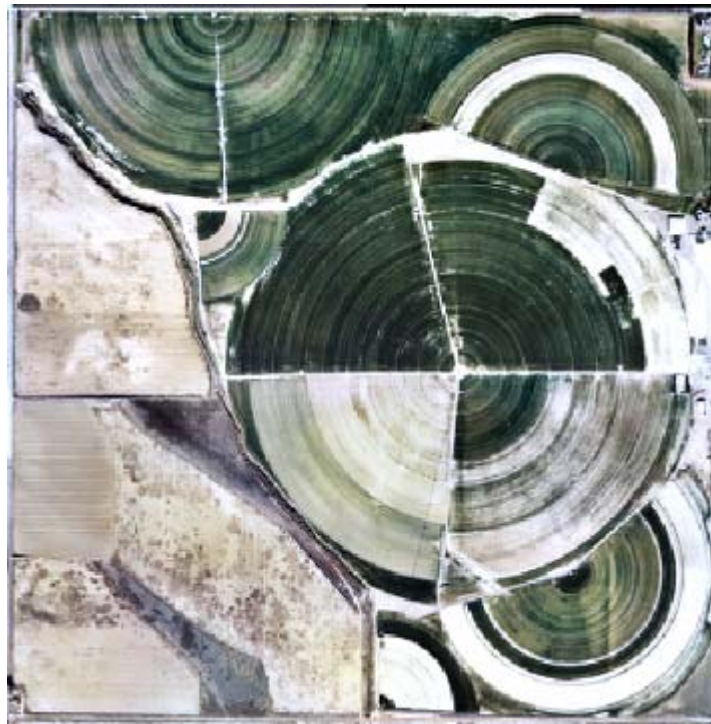
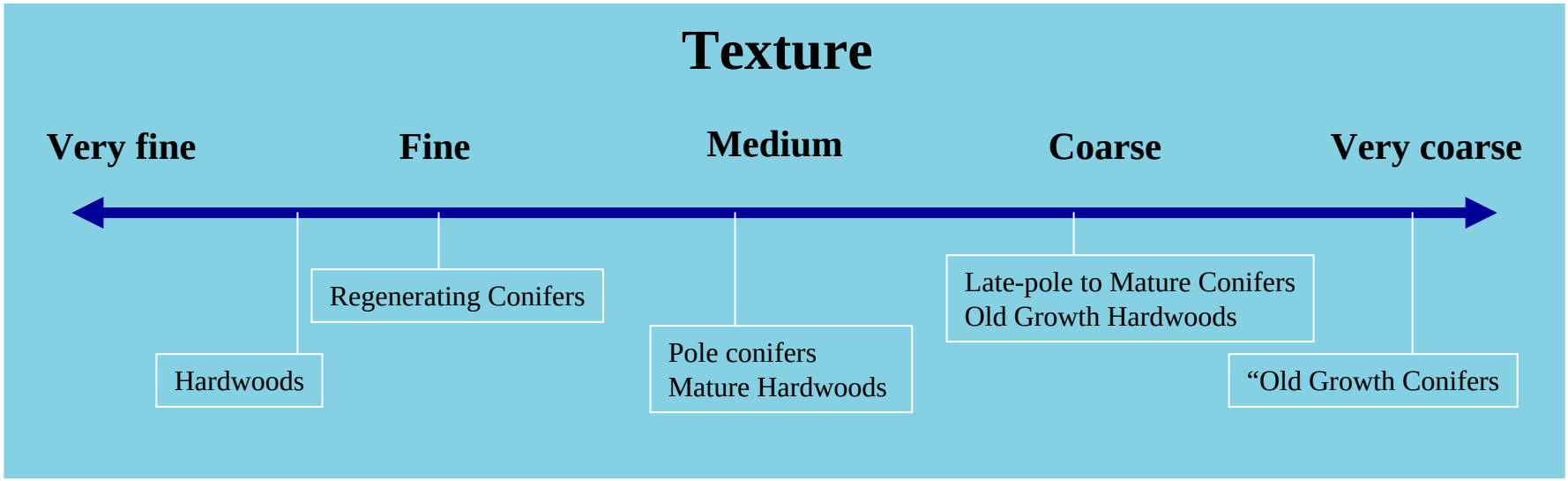


Photo Interpretation: Seven Basic Principles

Principle 5: Texture

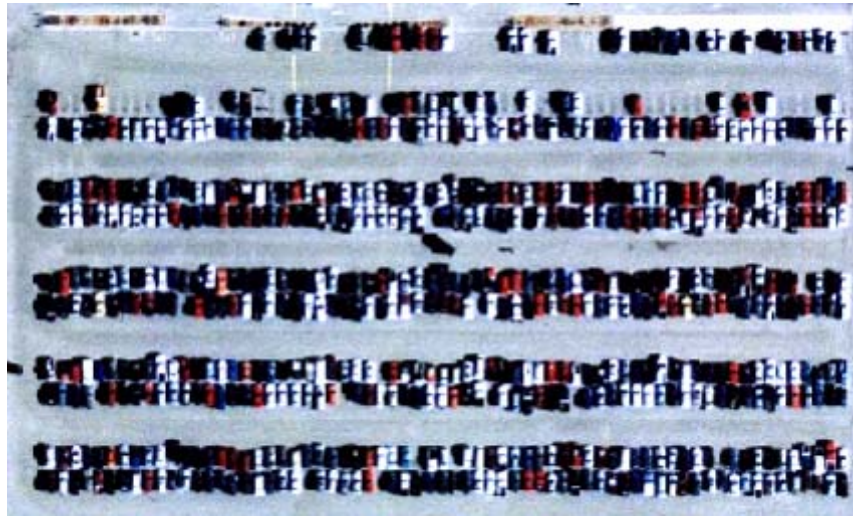
The result of changes in tone, or the arrangement of tone on a landscape

Forests: spectrum of textures
Grasslands typically have very fine textures
Shrublands/chapparal have medium textures.

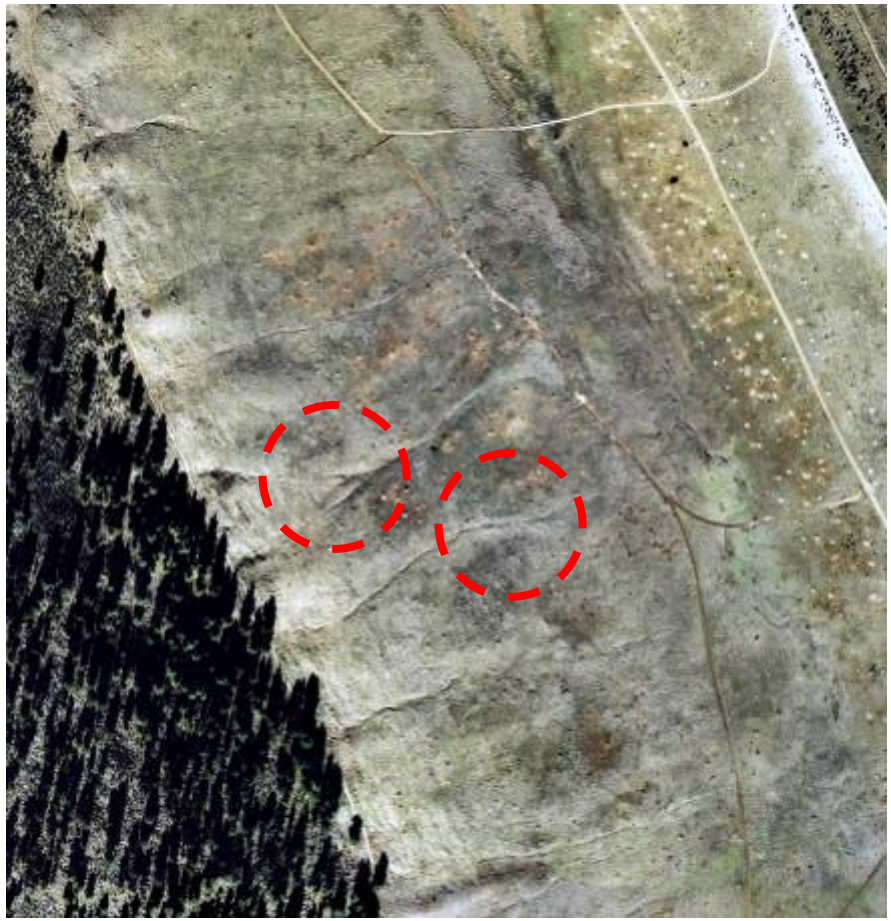


- **Texture**: In these photos, we see the effect of differences in the density of vegetation on the texture (and pattern) of a photo.

- **Pattern**: There are so many examples related to pattern. These would include the rectilinear pattern of the more urban neighborhoods in Fort Collins, the complex patterns of the more recent development, or the familiar configuration of a parking lot.



- **Pattern**: the drainage pattern for a particular property on this photo is easy to see. Also, because the drainage is relatively straight, we can assume that a moderate to steep slope exists, as water did not have much opportunity to meander.



Pattern

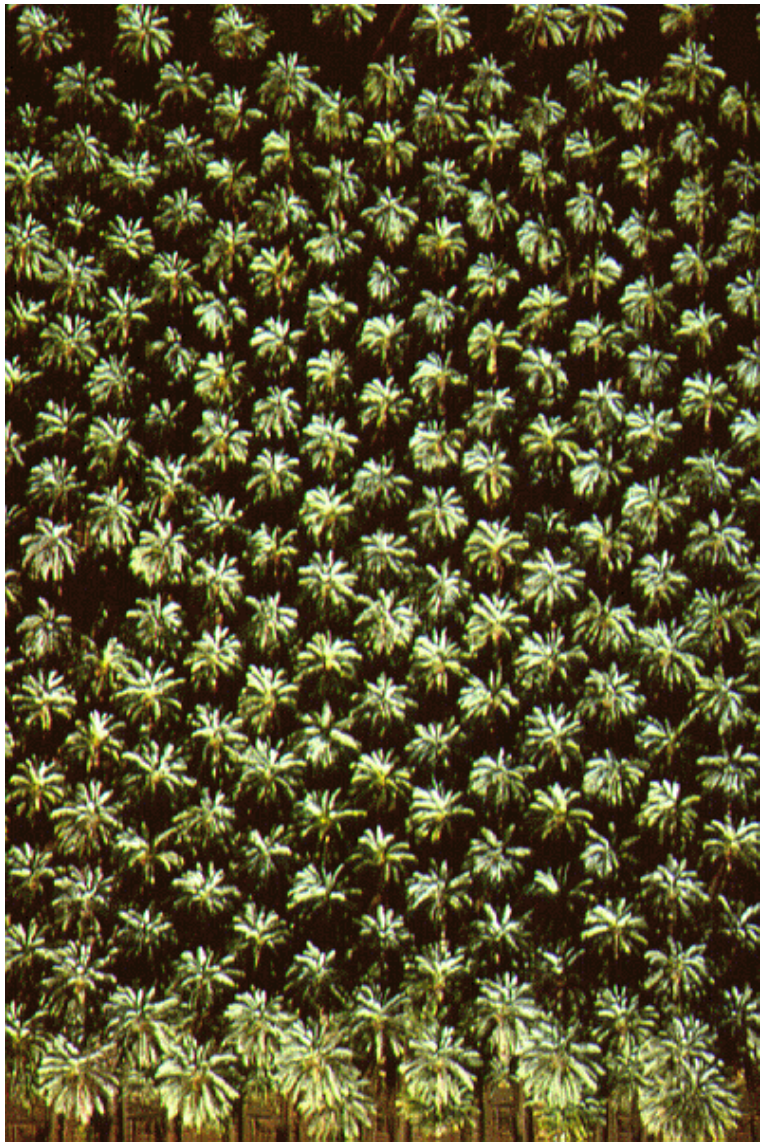


Photo Interpretation: Seven Basic Principles

Principle 7: Location, Association, Convergence of Evidence

A reasoning process to relate an object to its surroundings.

Biological association is important in resource management.

Requires knowledge of biological and geomorphic processes.

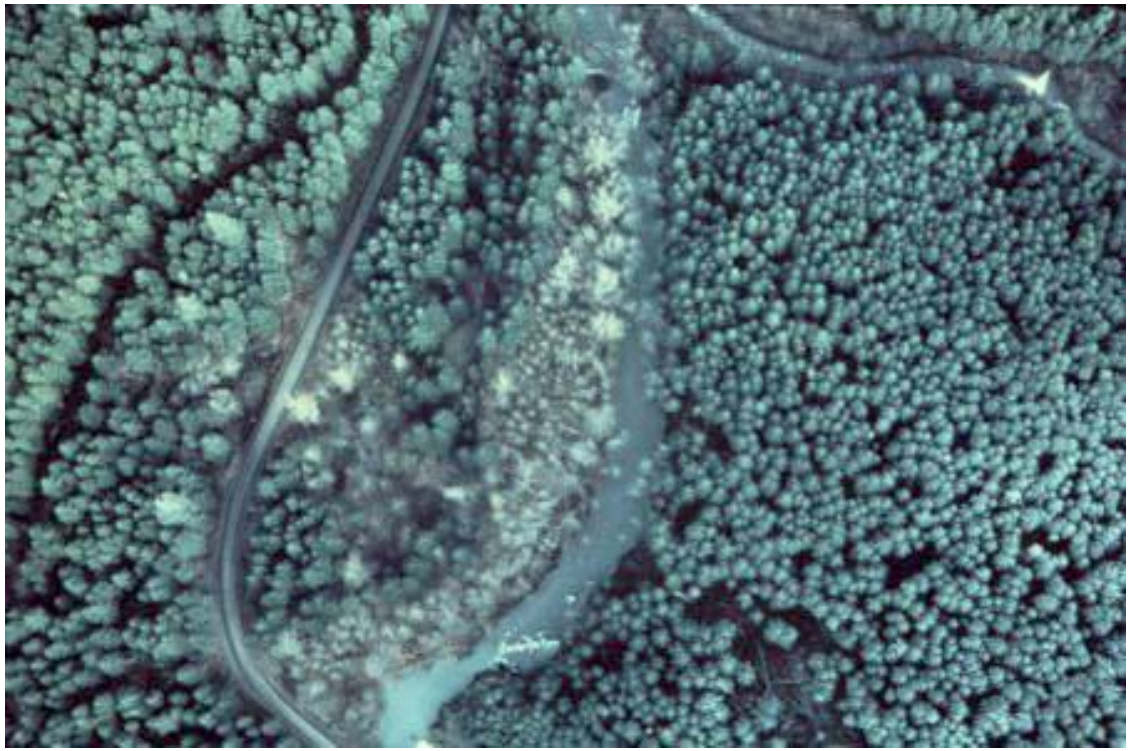
Uses shape, size, textural, pattern, and tonal/color information.

Locational or Positional Elements

Site - How objects are arranged with respect to one another; or with respect to various terrain features, can be an aid in interpretation.

Association - Some objects are so commonly associated with one another that identification of one tends to indicate or confirm the existence of another. Smoke stacks, step buildings, cooling ponds, transformer yards, coal piles, railroad tracks = coal fired power plant.

Association



Association can help identify trees, too. In this photo from Oregon, it's very likely that the hardwoods near the stream are alder.

Association is one of the most helpful clues in identifying man made installations. Aluminum manufacture requires large amounts of electrical energy. Absence of a power supply may rule out this industry. Cement plants have rotary kilns. Schools at different levels typically have characteristic playing fields, parking lots, and clusters of buildings in urban areas. Large farm silos typically indicate the presence of livestock.

- **Relationship**: observing relationships on photographs is one of the more fun observations. For example, a school and a factory are interpreted differently due to relationships:
  - While both have many large structures on them, schools typically have playing fields
  - Also, factories usually have larger parking areas

Principles of Aerial Photo Interpretation

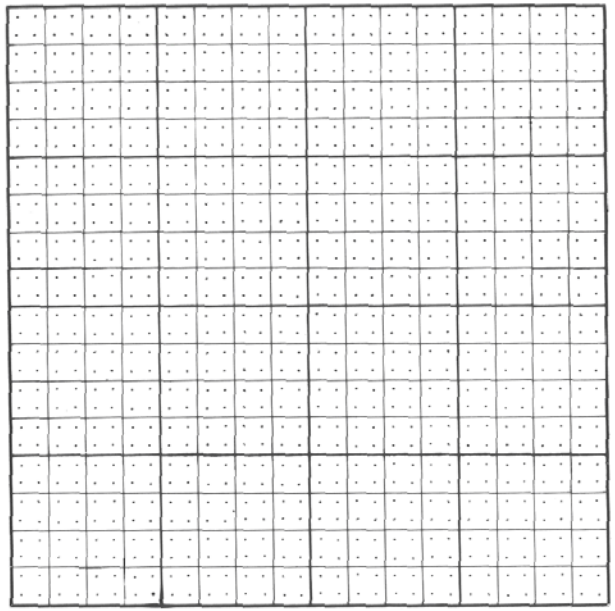
First order -- Basic
- Tone/Color
- Resolution
  - Second order -- Geometric Arrangements
    - Size
    - Shape
  - Second order -- Spatial Arrangement of Tone/Color
    - Texture
    - Pattern
      - Third order -- Locational or Positional Elements
        - Site
        - Association
      - Third order -- Interpreted from lower order elements
        - Height
        - Shadow

Photo Interpretation Tools

- Stereoscopes
- Templates
- Planimeters
- Parallax Bars
- Magnification Lenses
- ZTS or other image transfer equipment (A+B Pg 87)

- PI Keys and Guides

Photo Interpretation Tools: Templates



MODIFIED ACREAGE GRID

(64 dots per square inch.)

To be used for acreage determinations on maps of any scale.

Place grid over area to be measured; count dots, multiply by converting factor to compute total acreage. When dots fall on area boundary count alternate dots.

MAP SCALES AND EQUIVALENTS

Fractional Scale	Inches Per Mile	Acres Per Square Inch	Converting Factor Each dot equals:
1" = 7,920"	8.00	10.000	0.156 Acres
1" = 9,600"	6.60	14.692	0.230 Acres
1" = 15,840"	4.00	40.000	0.625 Acres
1" = 20,000"	3.168	63.769	0.996 Acres
1" = 31,680"	2.00	160.000	2.500 Acres
1" = 63,360"	1.00	640.000	10.000 Acres
1" = 125,000"	0.507	2,490.980	38.922 Acres
1" = 250,000"	0.253	9,963.906	155.686 Acres
1" = 500,000"	0.127	39,855.627	622.744 Acres

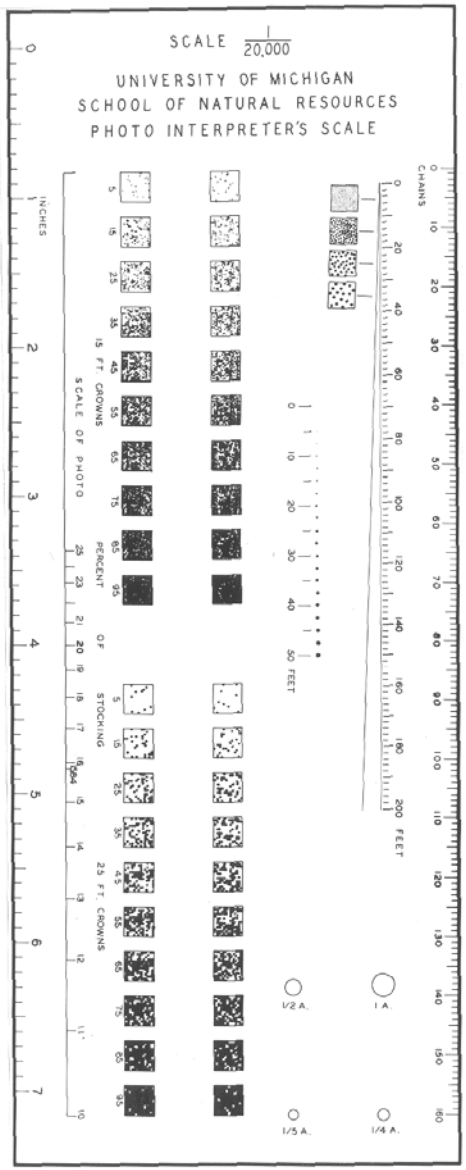


Photo Interpretation Tools: Keys

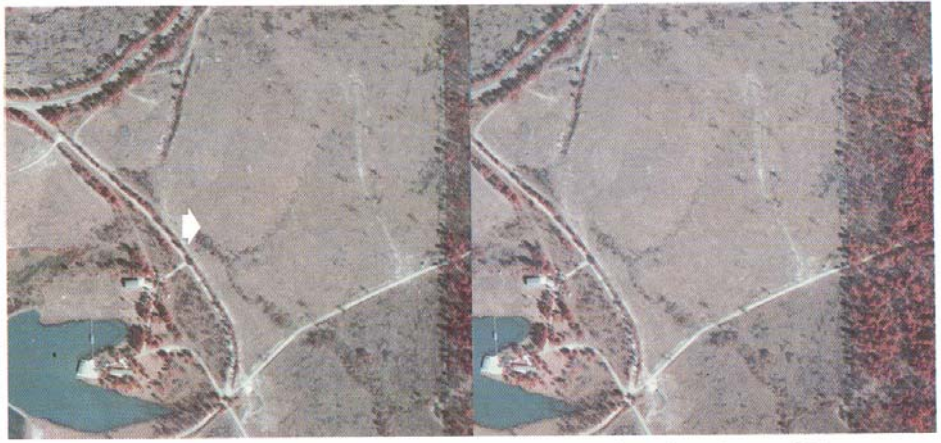
- Dichotomous Keys
- Selective Keys

Table 3.10 Dichotomous Airphoto Interpretation Key for the Identification of Several Forest Tree Species in Eastern Tennessee Using Normal Color Film Transparencies (From [4], Copyright 1975, American Society of Photogrammetry, Reproduced with Permission)

1. Branching is layered, radially triangular; crown margin is serrate, crown foliage is light green to moderate green	*White Pine*
1. Branching not radially triangular; crown margin is not serrate	Go to 2
2. Leaves mostly inconspicuous, tree branches virtually bare	Go to 3
2. Leaves present in crown	Go to 5
3. No foliage present; dark colored bole and branches completely bare	*White Basswood*
3. Very little foliage remaining (< 5 percent)	Go to 4
4. Branching gives crown a fine textured appearance	*White Ash* or *Black Walnut*
4. Branching appears medium textured	*Yellow Buckeye*
5. Crown foliage thinning; trees losing a significant portion (40 percent) of leaves in early fall	Go to 6
5. Crown foliage is dense or full; leaves abundant on branches	Go to 8
6. Branching appears finely divided or dissected; crown margin shape is circular or oval and usually large. Branches are a silver gray color. Crown foliage is finely textured, crown color is a moderate orange yellow to dark orange yellow	*American Beech*
6. Branching appears more massive and is moderately divided; crown shape and size are variable	Go to 7
7. Crown apex domed or tufted, crown margin moderately sinuate; crown foliage colors moderate red and/or moderate reddish orange	*Blackgum*
7. Crown apex rounded, crown size small, crown color dark pink to grayish red	*Sweetgum*
8. Crown margin shape circular or oval and generally entire	Go to 9
8. Crown margin shape is generally irregular with medium to large sinuations; crown apex is doomed, tufted, or billowy	Go to 10
9. Crown texture fine and feathery; crown small with random lineation. Predominant crown colors are moderate olive green to yellow green	*Shortleaf Pine* or *Virginia Pine*
9. Crown texture very fine, crown apex rounded to broadly oval, small sized crowns with tufted or parted appearance, crown color is light yellowish green	*Black Locust*

PI Keys and Guides: Dichotomous

PI Keys and Guides: Selective Keys



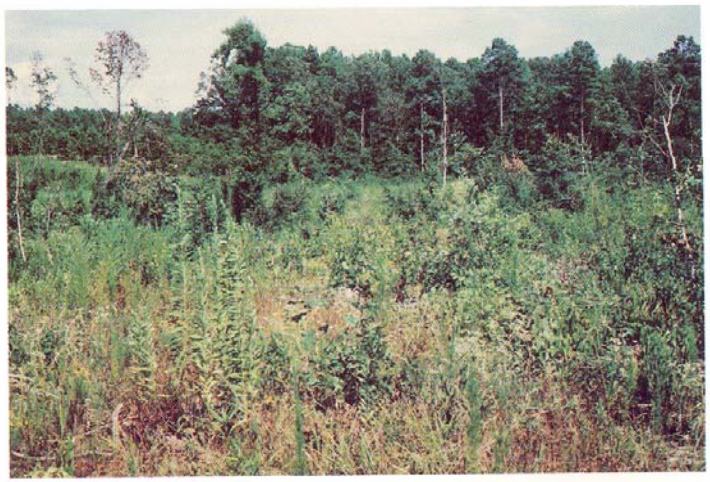
Site 1.1: Caldwell Parish, Louisiana (Township 12N, Range 3E)

SITE DESCRIPTION

Species: Unplanted
Competition: Sparse vegetation; grasses and annual weeds
Site index: Unavailable

AERIAL PHOTOGRAPH DESCRIPTION

Approximate scale: 1:9,700
Offset angle: 33°
Texture: Smooth
Color: Light gray
Remarks: No seedlings visible; some hardwood trees left standing



Ground photograph (August 12, 1980): Not planted at the time of ground visit; scattered hardwoods left standing; primarily grasses, weeds, and suckered vegetation at the time of ground photography.

PI Keys and Guides: Selective Keys

Site 3.2: Caldwell Parish, Louisiana (Township 11N, Range 3E)

SITE DESCRIPTION

Species: Loblolly
Origin: Machine planted
Age: 10 years
Height; DBH: 25 feet; 5 inches
Competition: Taller hardwoods and dense understory of shrubby hardwoods
Site index: 80

AERIAL PHOTOGRAPH DESCRIPTION

Approximate scale: 1:9,200
Offset angle: 28°
Texture: Rough; pine tree crowns touching each other
Color: Red

Ground photograph (August 12, 1980): Dense stand of pines with taller hardwoods; hardwood competition dense in some areas.

Comparison of Color and CIR Photos

Color and Color-Infrared Film

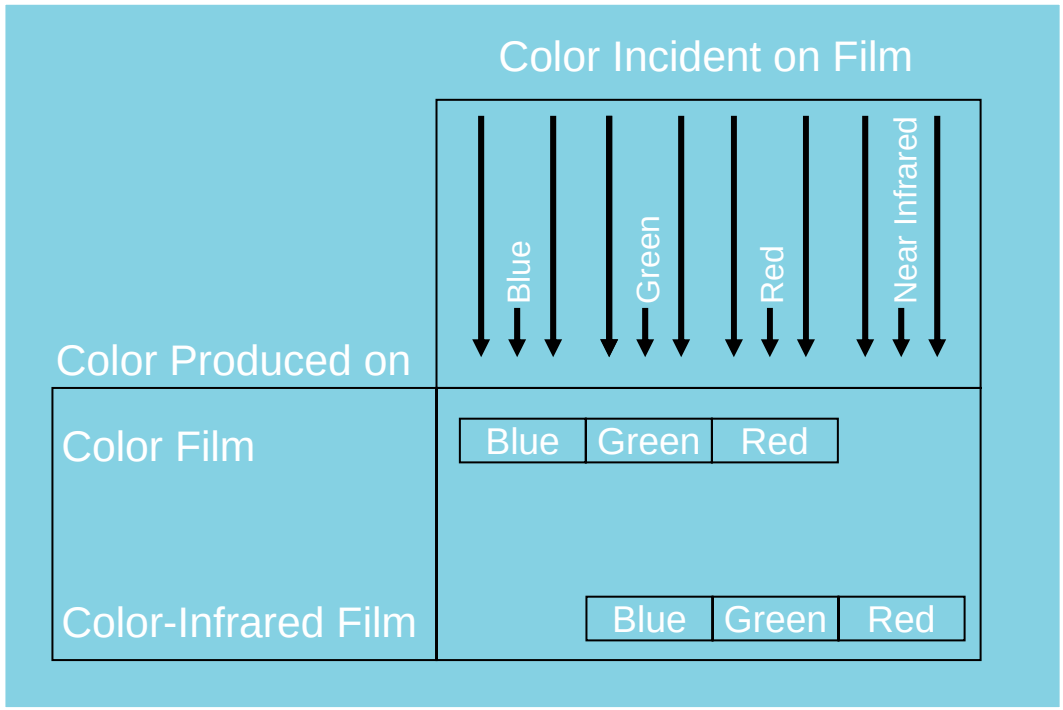
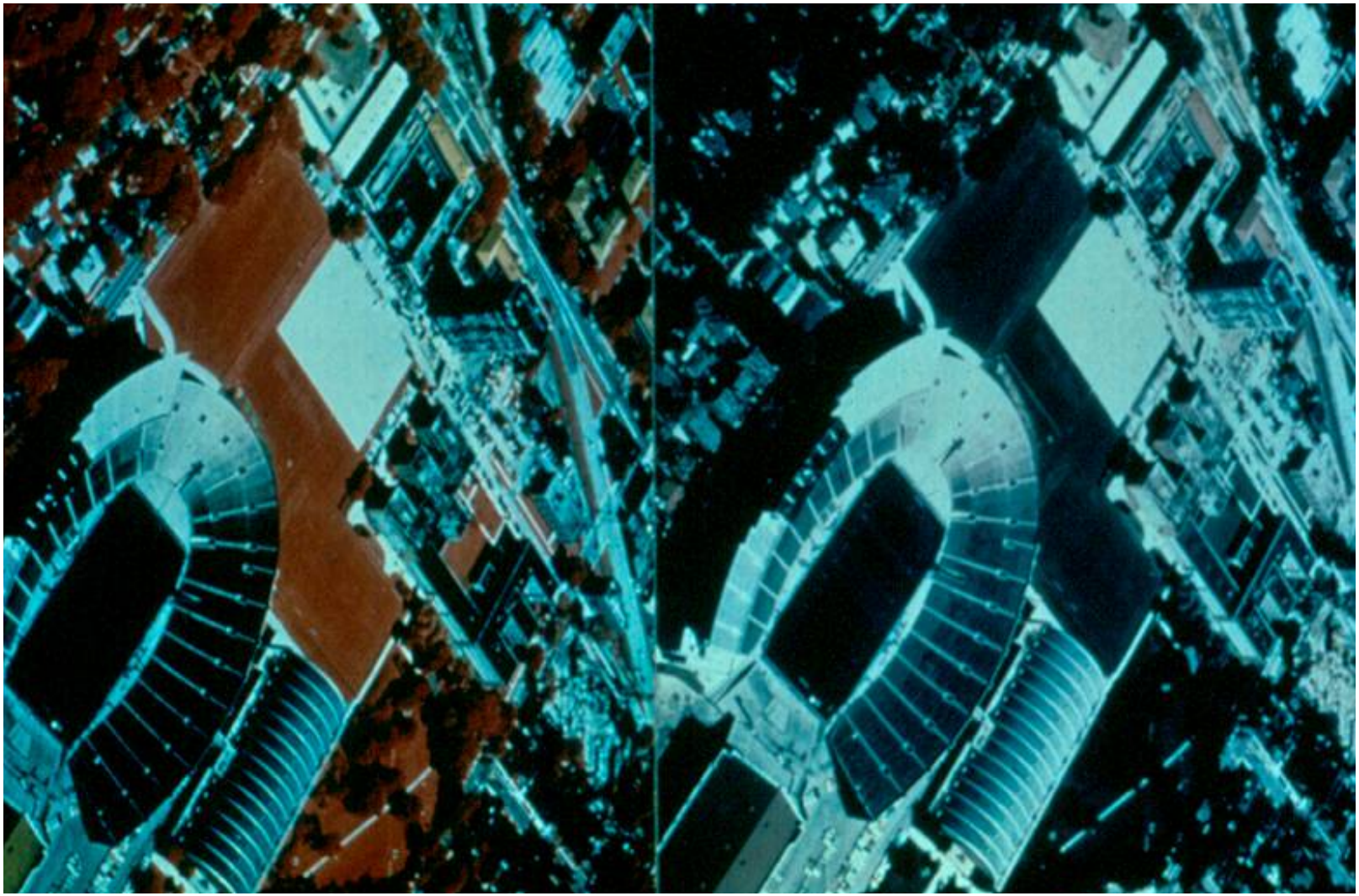


TABLE 2-4 Object Signatures on Normal Color and Color Infrared Photographs

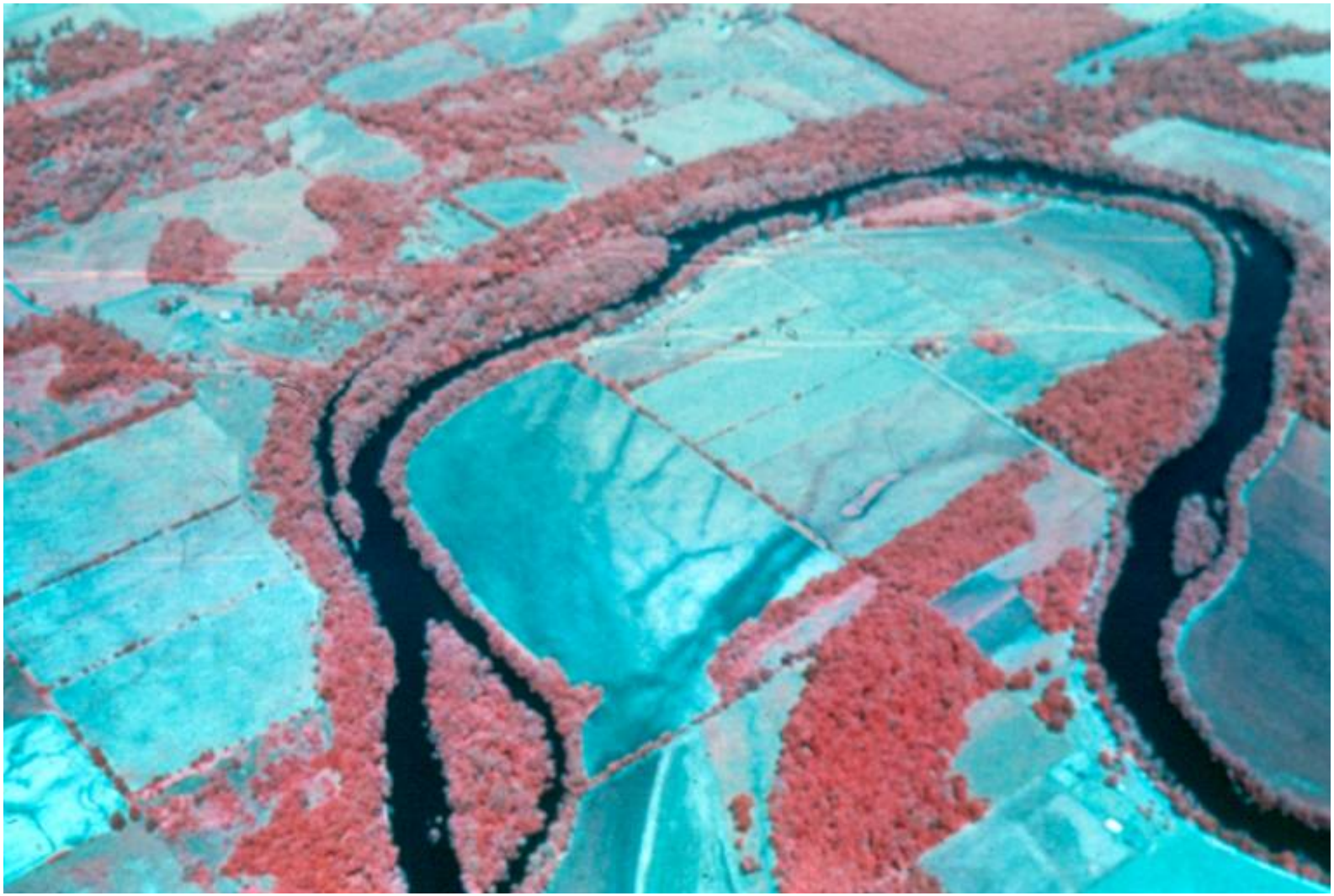
Object	Normal Color	Color Infrared
Snow	White	White
Clouds	White	White
Sky (high oblique)	Blue	Blue
Clear water	Blue or green	Black or dark blue
Silty water	Red or brown	Light blue or green
Deciduous foliage	Green	Bright red
Coniferous foliage	Green	Brownish red
Aquatic vegetation	Green	Pink
Citrus trees		
Healthy	Green	Red
Previsual stress	Green	Pink
Late stage of stress	Yellow	White
Defoliated trees	Gray	Blue or green
Artificial turf		
Dry	Green	Blue
Wet	Green	Black
Red sandstone	Red	Yellow or green
Asphalt	Black	Black
Damp ground	Slightly darker	Distinctly darker
Shadows	Bluish with details	Black

First Application: Real vs. Fake Vegetation

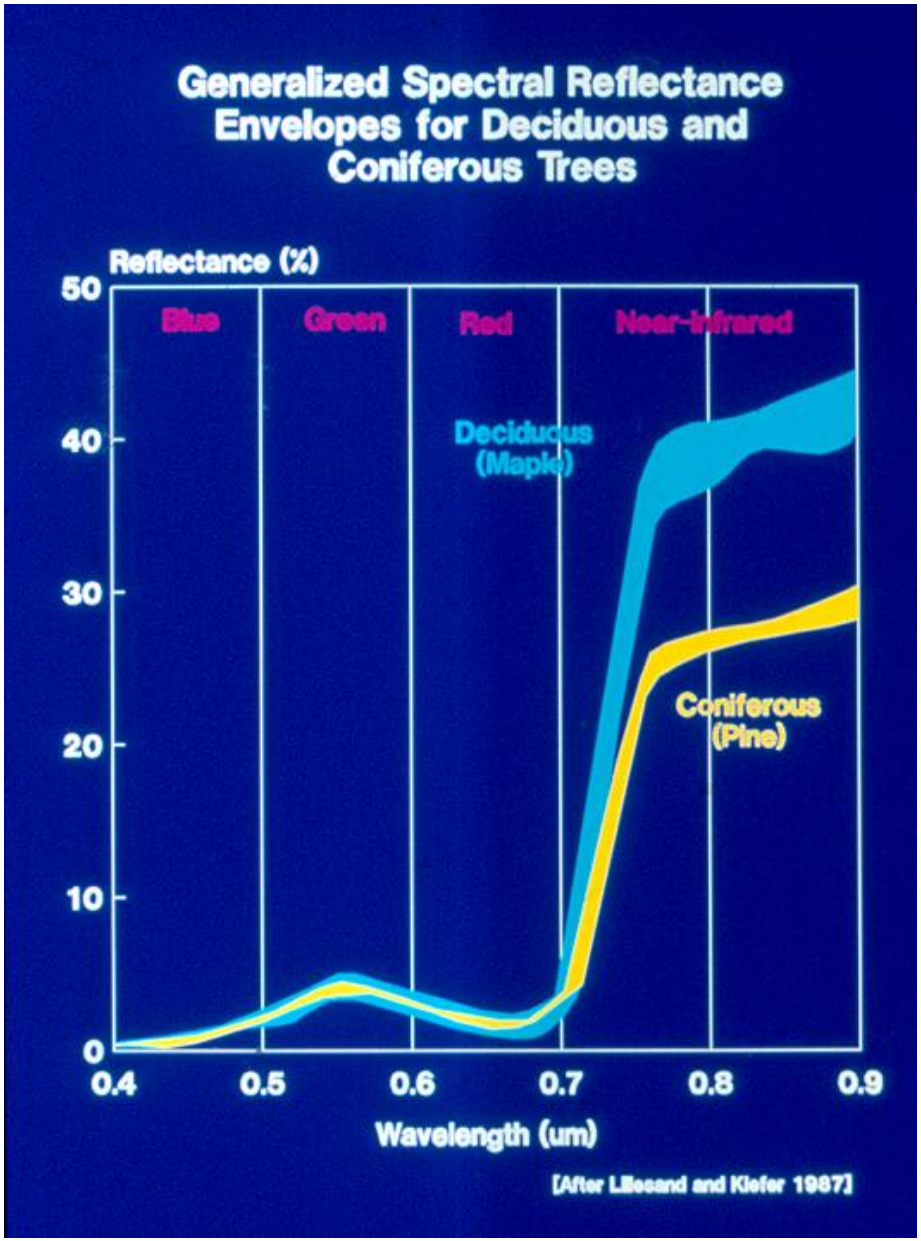


Haze Penetration: CIR

Haze Penetration: Color



Deciduous vs. Coniferous: Color


Generalized Spectral Reflectance Envelopes for Deciduous and Coniferous Trees
Reflectance (%)
50
40
30
20
10
0
Blue
Green
Red
Near-Infrared
Deciduous (Maple)
Coniferous (Pine)
0.4
0.5
0.6
0.7
0.8
0.9
Wavelength (um)
[After Lillesand and Kiefer 1987]

Deciduous vs. Coniferous: CIR

Deciduous vs. Coniferous: Color

Deciduous vs. Coniferous: CIR

Stressed Vegetation: Color

Stressed Vegetation: CIR

Turbid Water Penetration: Color

Turbid Water Penetration: CIR

ADDITIONAL HINTS FOR PHOTO INTERPRETATION OF PANCHROMATIC FILM

- Cultivated Land
  - 1. Range of tones from black to white; lighter tones predominate.
  - 2. Recently plowed or harrowed fields are darker (more moisture) than unplowed but normally cultivated land.
  - 3. Field lines, fences, roads, etc., are almost regular, often checkerboard pattern.
  - 4. Drill marks (machine planting) are sometimes visible on large-scale photography; furrows show as dark line pattern.
- Orchards
  - 1. Regular spacing and alignment of trees.
  - 2. Near other human occupation; usually away from natural woodlands.
  - 3. Spacing may indicate orchard type. Filbert trees, for example, are usually closer spaced than apple trees.
  - 4. Former orchards, long removed, are often still visible as a stippled pattern in cultivated fields.
- Grasslands
  - 1. Tone is characteristically mottled, unkempt.
  - 2. Small dark spots are brush, trees, stumps.
  - 3. Few fence lines; lacks cultivated land regularity.
  - 4. Darker patches often evident when damp or wet.

ADDITIONAL HINTS FOR PHOTO INTERPRETATION OF PANCHROMATIC FILM

- Brushland
  - 1. Mottled; wide range of tones.
  - 2. Open spaces that lose the regular texture of woods.
  - 3. If logged over, shows traces of logging operations including skid roads, trails, possibly burns.
- Woodland
  - 1. Variable texture; smooth to billowy hardwoods and smooth to very coarse
  - textured conifers.
  - 2. Highly varied tones and textures indicate a variety of timber types.
  - 3. Tree shadows may indicate timber type.
  - 4. Conifers usually are darker than hardwoods; small even-aged stands of
  - conifers are fine textured while mature and / or all-aged stands of conifers
  - are coarser textured.
  - 5. Soil moisture conditions as related to aspect, slope, topography may help
  - with species identification if one is familiar with the ecology of the area.
- Clearing Lines and Fence Lines
  - 1. These represent changes in tone and texture between cultivated and grassland, or brush and forest land.
  - 2. Stone fences and zigzag rails are clear on large-scale photos.
  - 3. Fences are seed catchers with vegetation often growing along them- includes trees.
  - 4. Paths for cattle and lanes often are along fences or on clearing lines.
  - 5. Many highways and streams are fenced.

ADDITIONAL HINTS FOR PHOTO INTERPRETATION OF PANCHROMATIC FILM

- Fire Lines
  - 1. Multiple lines in managed forested regions.
  - 2. Easily mistaken for roads or trails; look for steep grades and lack of bridges or fords where they cross streams.
- Transmission Lines
  - 1. Cleared lanes through woods; usually wider than trails.
  - 2. Shadows sometimes are towers.
  - 3. Straight trajectory without regard to established patterns in open and cultivated country.
- Rivers, Streams
  - 1. Uniform tone, meanders, and continuous topographic features.
  - 2. Shoals, rapids, dams, bridges are often visible.
  - 3. Flood plains and high bank lines; vegetation along water course.
  - 4. Vegetation is denser along water course, especially in cultivated areas.
- Fords
  - 1. Found where river bank breaks down, thus access to streams.
  - 2. Roads, trails, tracks, etc., often coverage.
  - 3. Sometimes vehicle tracks are seen on stream bed.
  - 4. Often lighter color showing less water depth.
- Rapids
  - 1. White appearance of water between darker spots.
  - 2. Banks narrower, high bank lines, and rock ledges.
  - 3. Portage trail sometimes evident.

ADDITIONAL HINTS FOR PHOTO INTERPRETATION OF PANCHROMATIC FILM

- Abandoned Meanders
  - 1. Often occupied with marsh, brush, forest.
  - 2. Light-colored concentric markings indicate lateral stream movement.
  - 3. Show concentric banding on one side and steep undercut on the other.
- Lakes, Ponds Dam Backwaters
  - 1. A general uniform tone; tone is dependent on depth and the amount of sediment. Deeper and sediment-free water is darker.
  - 2. Shorelines have usually abrupt tone and texture change.
  - 3. Tone gradually lightening indicates shallower water near shore with shoals, sandbars, etc.
  - 4. Water bodies that are dead white indicate intense reflection of sun rays often due to their position in respect to camera.
  - 5. Dam backwaters are similar except there is an abrupt change in width where the dam is located.
- Canals, Ditches
  - 1. Both are uniform and regular, except ditches are narrower.
  - 2. Other artificial signs include dirt piles, rocks alongside, sometimes trails or roads. There may be locks and weirs on canals.
  - 3. Clear appearance of water indicates a canal is well kept or in use.
  - 4. The ground around ditches is often darker or swampy.
  - 5. Irrigation ditches sometimes follow ridge tops or side slopes; drainage
  - ditches always follow depressions.

ADDITIONAL HINTS FOR PHOTO INTERPRETATION OF PANCHROMATIC FILM

- Swamps
  - 1. Appear wet with dark irregular tone.
  - 2. Usually densely vegetated; generally, vegetation has uniform tone and texture.
  - 3. Standing water may reflect white.
  - 4. May be drainage ditches; numerous fills and ridges, some with roads.
  - 5. Flooded areas are distinguished from swamps by the absence of well-established drainage in temporarily flooded areas.
- Marshes
  - 1. Darker tone than grasslands; although covered with willows and long grass.
  - 2. Water generally shows between vegetation.
  - 3. Absence of human occupation; drainage ditches.
  - 4. Often ring-like vegetation found from brush in less wet areas to swamp grass and water in saturated areas.
- Railways
  - 1. Thin lines-straight with long gradual curves; cuts and fills.
  - 2. Widening or narrowing of right-of-way with bridges and trestles.
  - 3. Tracks rarely visible, although crossties sometimes are.
  - 4. Stations, side tracks, sidings, trains, evident.
  - 5. Crushed rock roadbed is a white or light gray; little-used railroads may
  - have some vegetation on roadbed producing a darker tone.
  - 6. Width of bridges may indicate single or double tracks.
  - 7. Tunnel mouths are small black shadows.

ADDITIONAL HINTS FOR PHOTO INTERPRETATION OF PANCHROMATIC FILM

- Roads
  - 1. White to black; concrete is white but darkens with age and use and becomes spotted and streaked with oil down the center of lanes; macadam and dirt roads are much darker; gravel is light, sometimes with a lighter streak down center where stone is heaped with use.
  - 2. First-class roads are better engineered with cuts and fills evident, while second-class roads avoid obstacles and have many bends and turns in hilly country .
  - 3. Width of right-of-way often indicate class as do the types of curves.
  - 4. Roads cutting directly cross country, regardless of previous patterns, are generally hard surface first class roads.
- Trails
  - 1. Usually follow winding courses, avoiding obstacles; however, aspect of shortcuts sometimes shown where thin straight lines go through woods, fields, pastures.
  - 2. Great numbers seen around outskirts of towns, in parks, and in rugged areas.
  - 3. Footpaths are light, almost hair-like lines, but dark, however, when snow covers the ground.
  - 4. Skid trails and roads with many branch lines cut through the timber with intervening timber cut; skid trails at more or less regular intervals.
- Bridges
  - 1. Vehicle bridges are usually wider than the approach roadway; opposite is true for railway bridges.
  - 2. A long bridge is usually trestle or truss type; a short bridge is usually a girder or arch type; more often seen by shadows.

ADDITIONAL HINTS FOR PHOTO INTERPRETATION OF PANCHROMATIC FILM

- Cemeteries
  - 1. Characteristic arrangement with drives, walks, vegetation; tombstones visible as small white images.
  - 2. Roads and footpaths have sharp and numerous curves.
  - 3. Located often along outskirts of town or rurally near church or on high ground away from drainage and water.
- Buildings (general)
  - 1. Shadows show relative height, shape and type, hip roof lines, chimneys, porches, etc.
  - 2. Use often indicated by studying surroundings.
- Urban Buildings
  - 1. Circular or semicircular shapes include some churches, fuel storage tanks, sewage disposal basins, railway roundhouses, residential driveways, traffic circles, stadiums, etc.
  - 2. Usual linear structures include row houses, warehouses, some industrial establishments, filtration plants, apartment projects.
  - 3. Factory type often distinguished by number, type, and position of various buildings in a group.
  - 4. Thin upright forms such as flagpoles and radio and transmission towers discernible only by shadow.

ADDITIONAL HINTS FOR PHOTO INTERPRETATION OF PANCHROMATIC FILM

- Rural Dwellings
  - 1. Often closer to road than other parts of farmstead; further from other buildings than other buildings are from each other.
  - 2. Smaller than barn; larger than outbuildings.
  - 3. Usually in tree clump, presence of planned landscaping or driveway; varied architectural design.
  - 4. Often grass lawn as opposed to well-beaten ground around other buildings.
- Rural Barns
  - 1. Largest farmstead structure, simple design.
  - 2. Absence of trees; farm driveway to door.
  - 3. Use of other buildings often shown by well-worn footpaths, grain bins, potato cellars.
- Rural Schools
  - 1. Geometric design; different from farmstead by lack of buildings.
  - 2. Small schools usually have evidence of playground or area of hard use and, may occupy elevated sites.
  - 3. Larger schools often have a tall chimney; very often a semicircular drive-way; athletic fields.
  - 4. Small town school often near outer edge of town.
- Churches
  - 1. Resemble schools in central location on plot and few, if any, outbuildings.
  - 2. Surroundings darker because of more and better grass.
  - 3. Steeple or some sort of roof often projects.
  - 4. Cemeteries often nearby.