

# **A Case Study in Applied Geography: Making GIScience Profitable**

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# Introduction

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**- Geography as an academic discipline is just a list of place names?**

\* So what is its utilitarian purpose?

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**- Geography as an academic discipline is just a list of place names?**

\* So what is its utilitarian purpose?

**- In reality, geography has been applied long before it was ever an identified academic discipline**

\* Yet in the 2004 Encyclopedia Britannica, applied geography was mentioned in only a paragraph of a 37-page epic definition of geography

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**- No recent advancement lends itself more to applied geography than Geographical Information Science**

\* along with the related set of technological discoveries dubbed Geographical Information Systems (GIS)

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- **No recent advancement lends itself more to applied geography than Geographical Information Science**

\* along with the related set of technological discoveries dubbed Geographical Information Systems (GIS)

- **Any problem that has a spatial component can be analyzed using GIScience theory and GIS techniques**

# Introduction

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**- Many age old trades and services are beginning to see the boon of geography**

\* Opportunities for geographic application not only exist, but they are competitively sought after by private firms

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**- Many age old trades and services are beginning to see the boon in geography**

\* Opportunities for geographic application not only exist, but they are competitively sought after by private firms

**- *Geography can be profitable!!!***

# Introduction

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- 1. Familiarizing the Chimney Pan**
- 2. Remote Sensing as a Data Collection Tool**
- 3. GIS and Profitability**
- 4. Potential Problems**
- 5. Questions**



# Familiarizing the Chimney Pan

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- ***Chimney Cap/Pan*** – an object used externally on all residential homes with chimney chases



# Familiarizing the Chimney Pan

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- ***Chimney Cap/Pan*** – an object used externally on all residential homes with chimney chases



- An uncovered chimney flue presents two problems:

1. water infiltration
2. organism infiltration

\* we want the pan to prevent this from occurring

# Familiarizing the Chimney Pan

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- In practice, there are two kinds of chimneys that are found on residential homes:



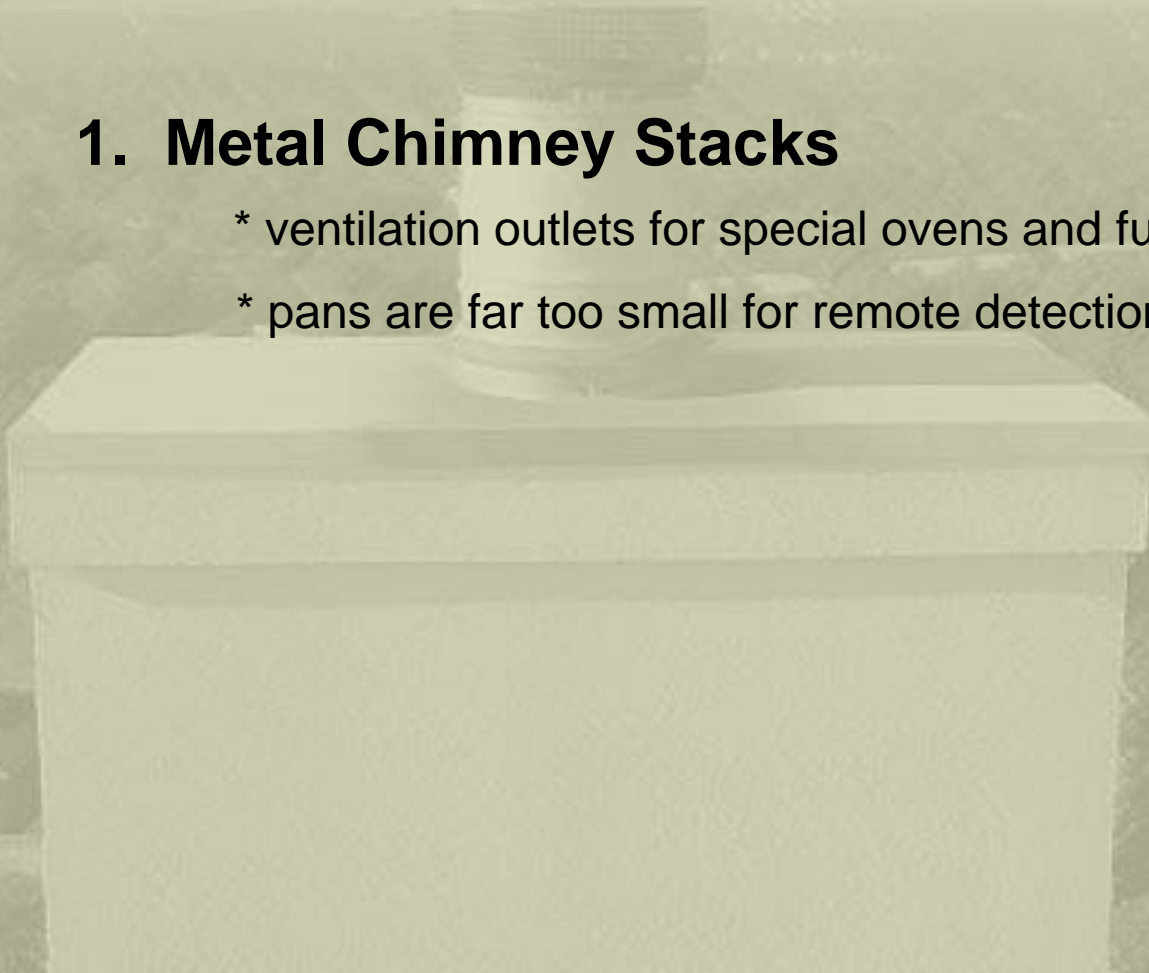
# Familiarizing the Chimney Pan

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## 1. Metal Chimney Stacks

- \* ventilation outlets for special ovens and furnaces
- \* pans are far too small for remote detection



# Familiarizing the Chimney Pan

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- In practice, there are two kinds of chimneys that are found on residential homes:

## 1. Metal Chimney Stacks

- \* ventilation outlets for special ovens and furnaces
- \* pans are far too small for remote detection

## 2. Masonry Chimney Stacks

- \* smoke outlet for home fireplaces
- \* multiple meters on each dimension

# Familiarizing the Chimney Pan

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- The pans themselves can be made of cement or brick, but are most commonly manufactured from metal

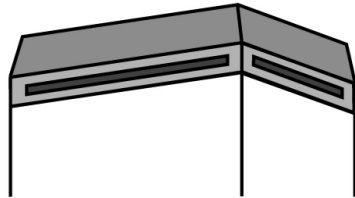


cement chimney pan

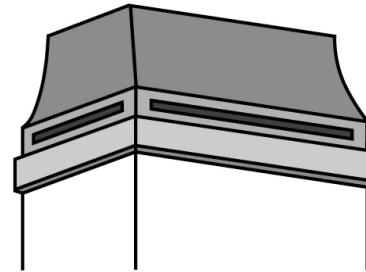
# Familiarizing the Chimney Pan

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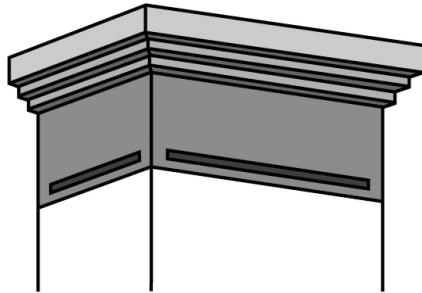
## Common Chimney Pan Designs



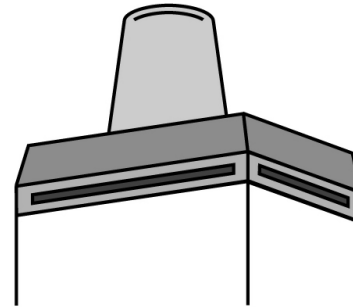
Standard



Radius



Stepout



Single Cone

Derived from "Specialty Products for the Home."

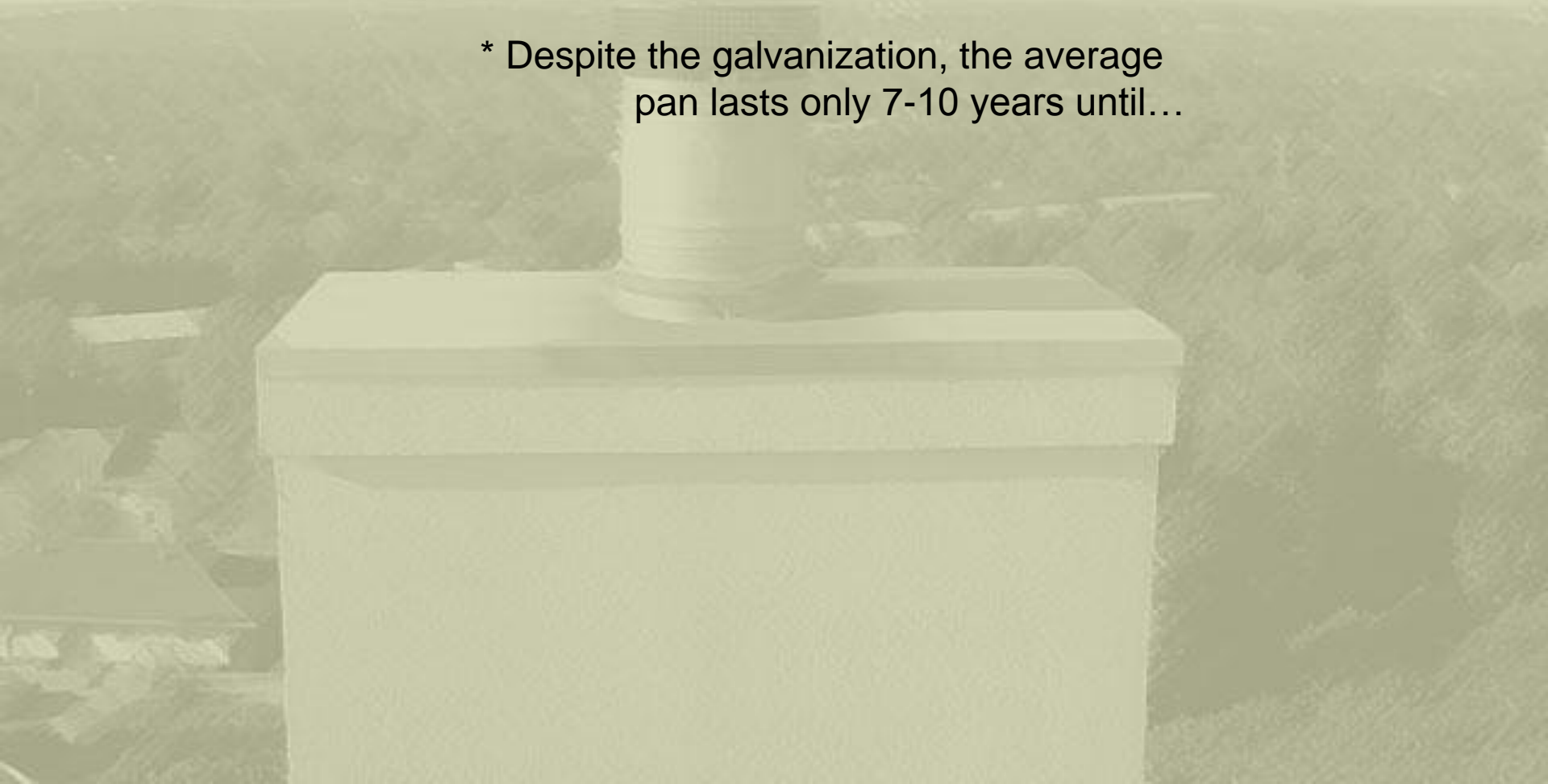
metallic chimney pans

# Familiarizing the Chimney Pan

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- **The common metals used for the pans are galvanized steel, copper, and aluminum**

\* Despite the galvanization, the average pan lasts only 7-10 years until...





# Familiarizing the Chimney Pan

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- The common metals used for the pans are **galvanized steel, copper, and aluminum**

\* Despite the galvanization, the average pan lasts only 7-10 years until...

**...RUST!!!**



# Familiarizing the Chimney Pan

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## Water Infiltration



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# Familiarizing the Chimney Pan

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## Organism Infiltration

1. rodents
2. insects
3. fungi

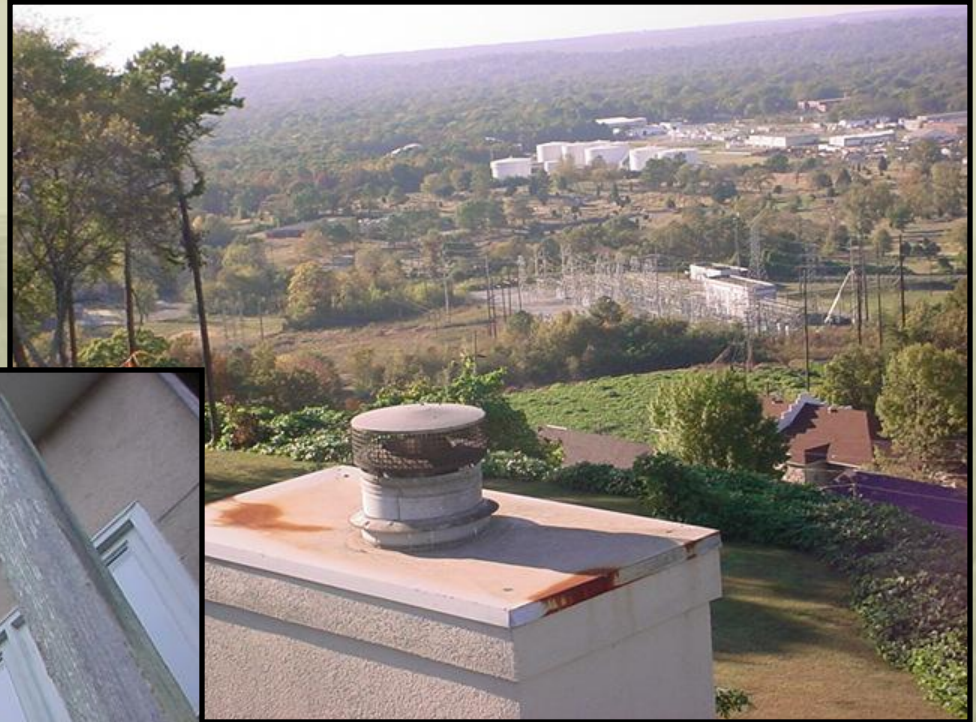


termite tracks

# Familiarizing the Chimney Pan

## Problems with manual detection

1. Inconveniently located
2. Homeowner typically unaware of problem

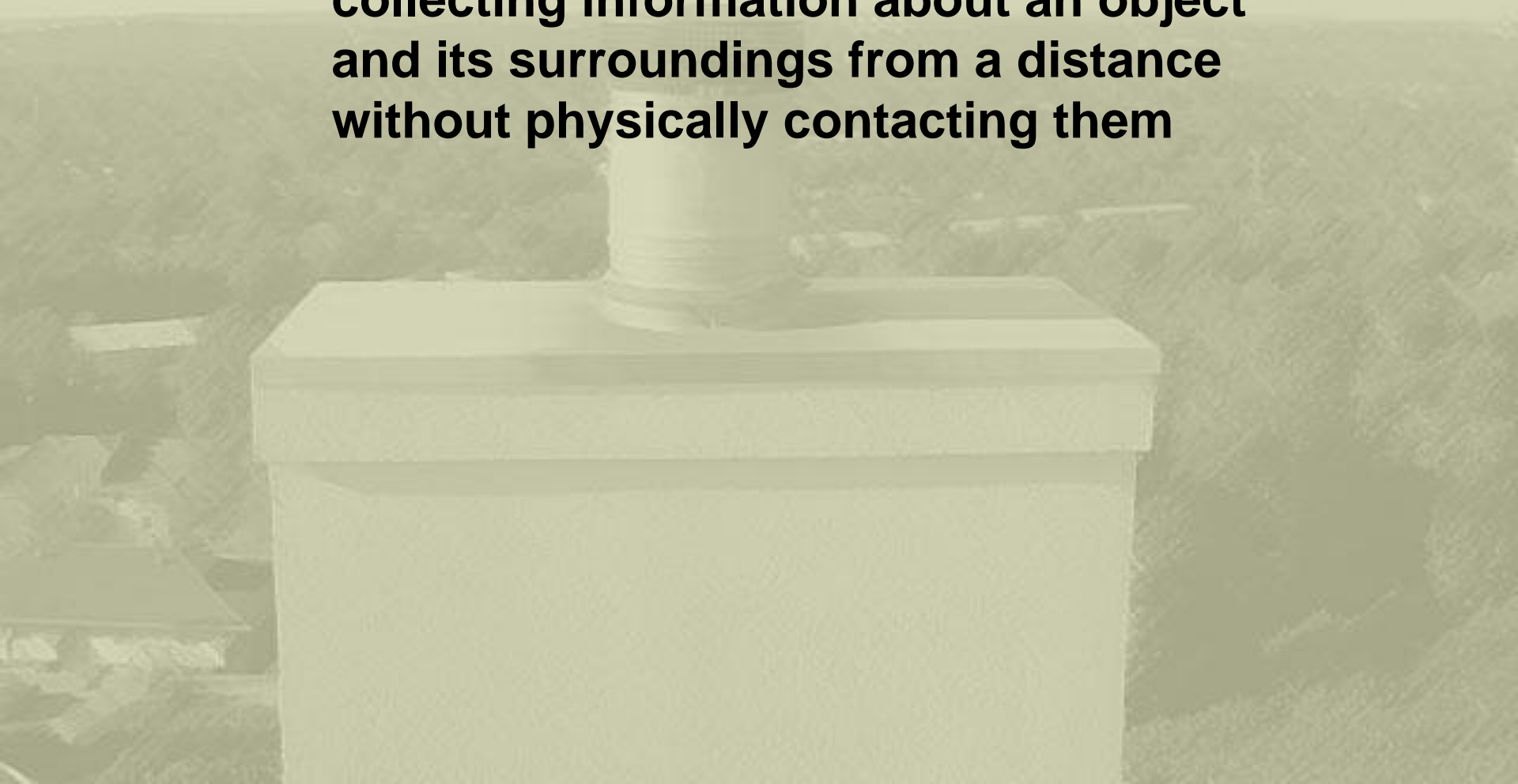


3. Sending a crew costs time and money, making the price for simple “inspection” unmarketable

# Remote Sensing as a Data Collection Tool

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- ***Remote Sensing*** – the group of techniques of collecting information about an object and its surroundings from a distance without physically contacting them



# Remote Sensing as a Data Collection Tool

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- ***Remote Sensing*** – the group of techniques of collecting information about an object and its surroundings from a distance without physically contacting them
- **The inherent physical differences of metal and rust can be utilized in remote sensing by two distinct approaches:**
  1. Examining the type of spectral reflectance of each
  2. Examining the specific spectral signature of each



# Remote Sensing as a Data Collection Tool

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## Method 1: Spectral Reflectance

- All sunlight incident upon an object is either absorbed by the object, transmitted through the object, or reflected back into the atmosphere.
- Remote sensing instruments that record in the visible and near-IR wavelengths are really recording the level of reflected sunlight
  - \* The reason we call it “visible” is because our eyes have evolved to detect light in the dominant wavelengths of the sun

# Remote Sensing as a Data Collection Tool

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## Method 1: Spectral Reflectance

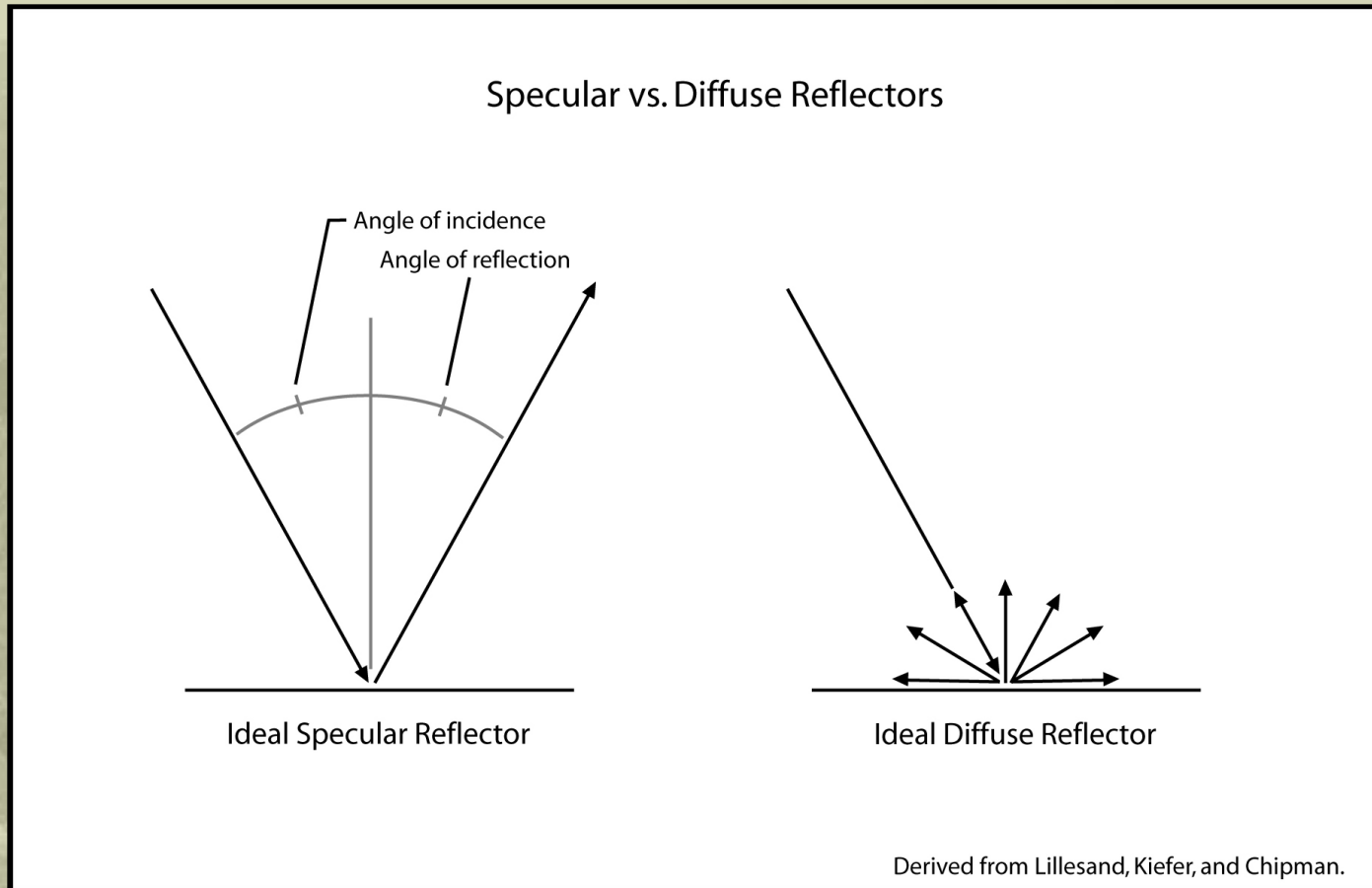
- However, not all objects reflect incident energy in the same manner

\* *Specular Reflectors* – smooth surfaces that reflect the entirety of the incident energy at a symmetric angle to the angle of incidence

\* *Lambertian/Diffuse Reflectors* – rough surfaces that reflect an equal amount of the incident energy in all angular directions

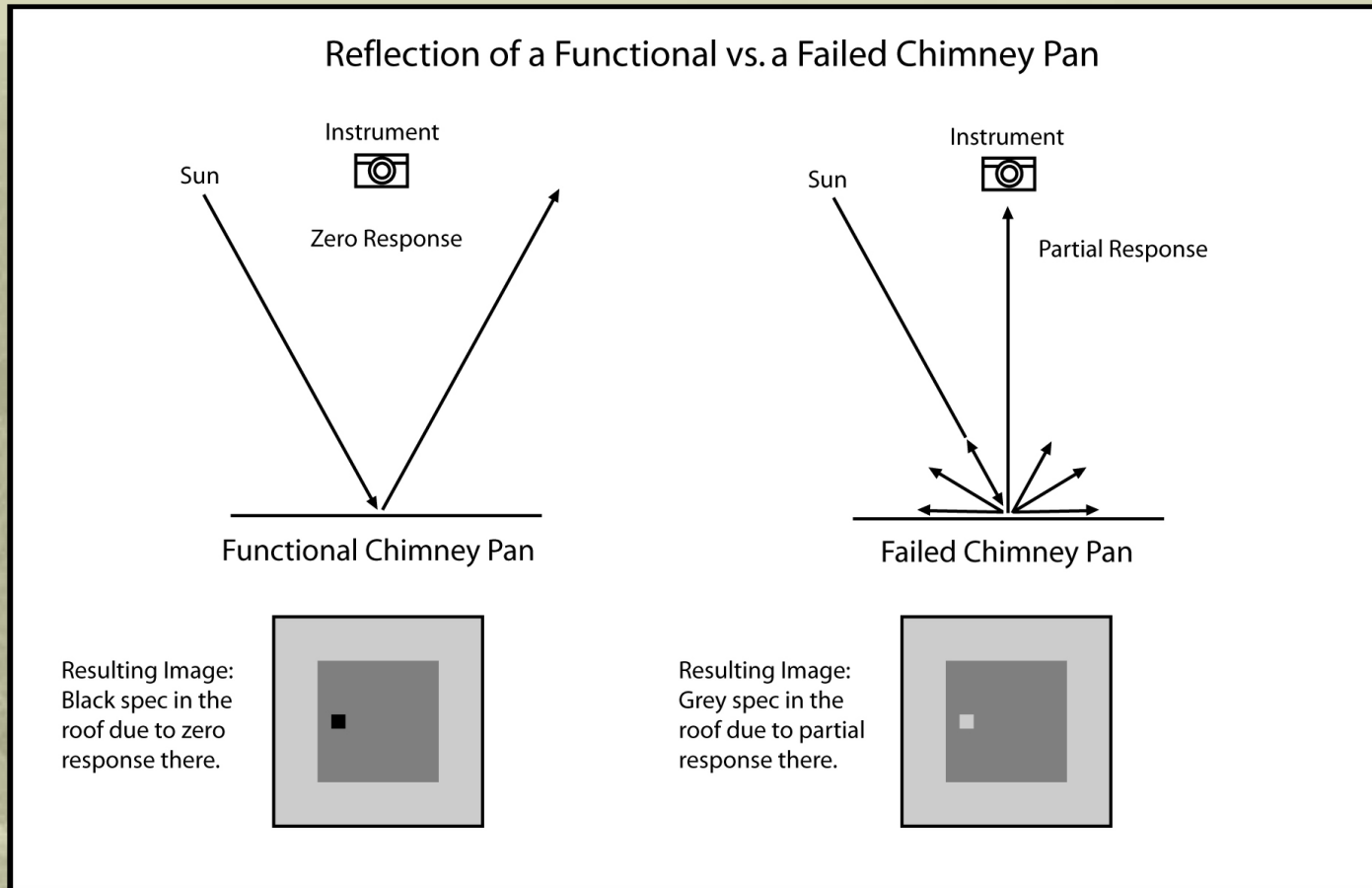
# Remote Sensing as a Data Collection Tool

## Method 1: Spectral Reflectance



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# Remote Sensing as a Data Collection Tool

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## Method 1: Spectral Reflectance

- **Still some key problems with this approach**
- **The largest is that there is a non-uniform source of incident energy across the image as well as from image to image**

\* can't be completely automated – still reliant on visual interpretation

# Remote Sensing as a Data Collection Tool

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## Method 2: Spectral Signature

**- Instead, it may be best to look at the amount of absorbed energy**

\* It is the amount of absorbed energy that gives non-living or non-radioactive objects its internal heat, or *kinetic temperature*

# Remote Sensing as a Data Collection Tool

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## Method 2: Spectral Signature

- **Instead, it may be best to look at the amount of absorbed energy**

- \* It is the amount of absorbed energy that gives non-living or non-radioactive objects its internal heat, or *kinetic temperature*

- **All objects that have a kinetic temperature over absolute zero emit energy as radiation**

- \* This energy can also be collected via remote sensing as well as the energy reflected from the sun

# Remote Sensing as a Data Collection Tool

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## Method 2: Spectral Signature

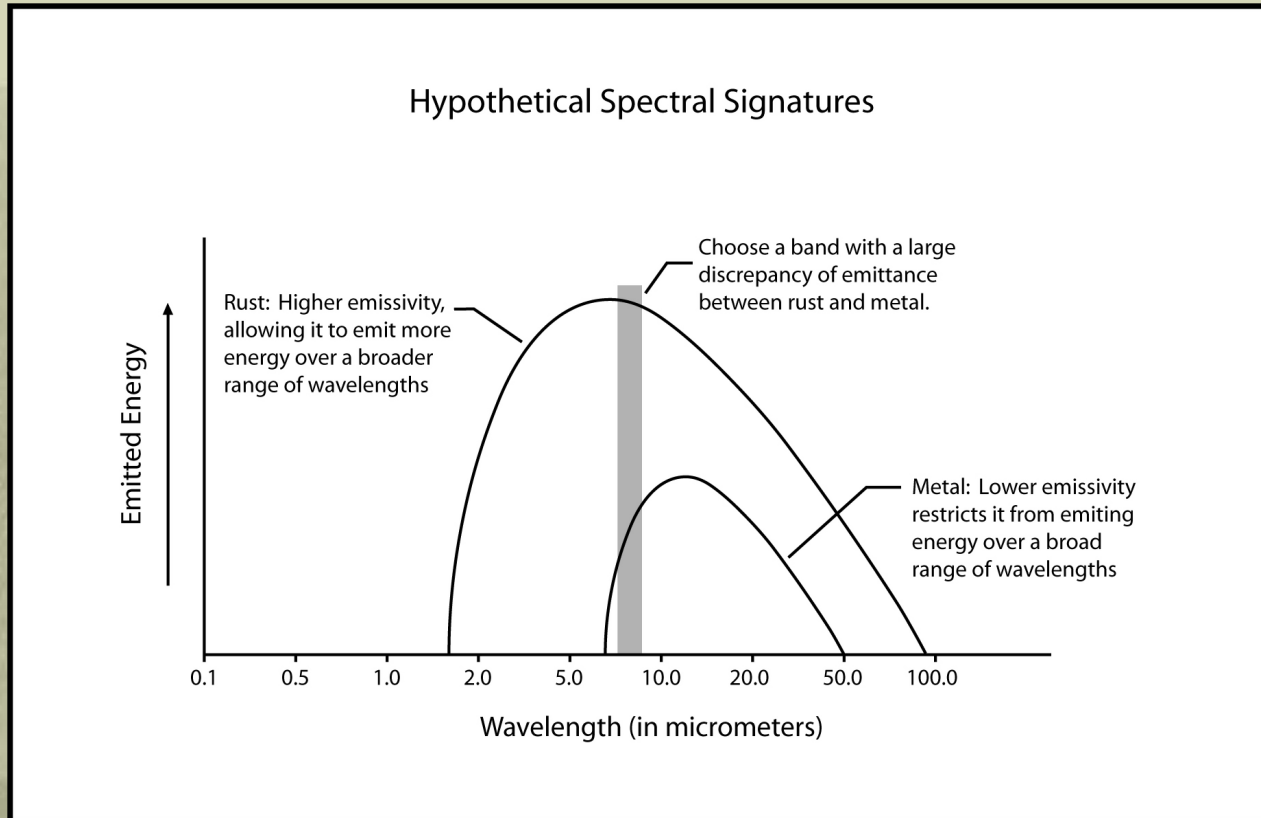
- **The amount of radiated energy, or *exitance*, is directly related to the *emmissivity*, or the percentage of energy that is absorbed and then radiated**

\* Thus, the amount of radiated energy recorded by a remote sensing instrument can serve as a proxy for the percentage of incident energy that is absorbed by the material



# Remote Sensing as a Data Collection Tool

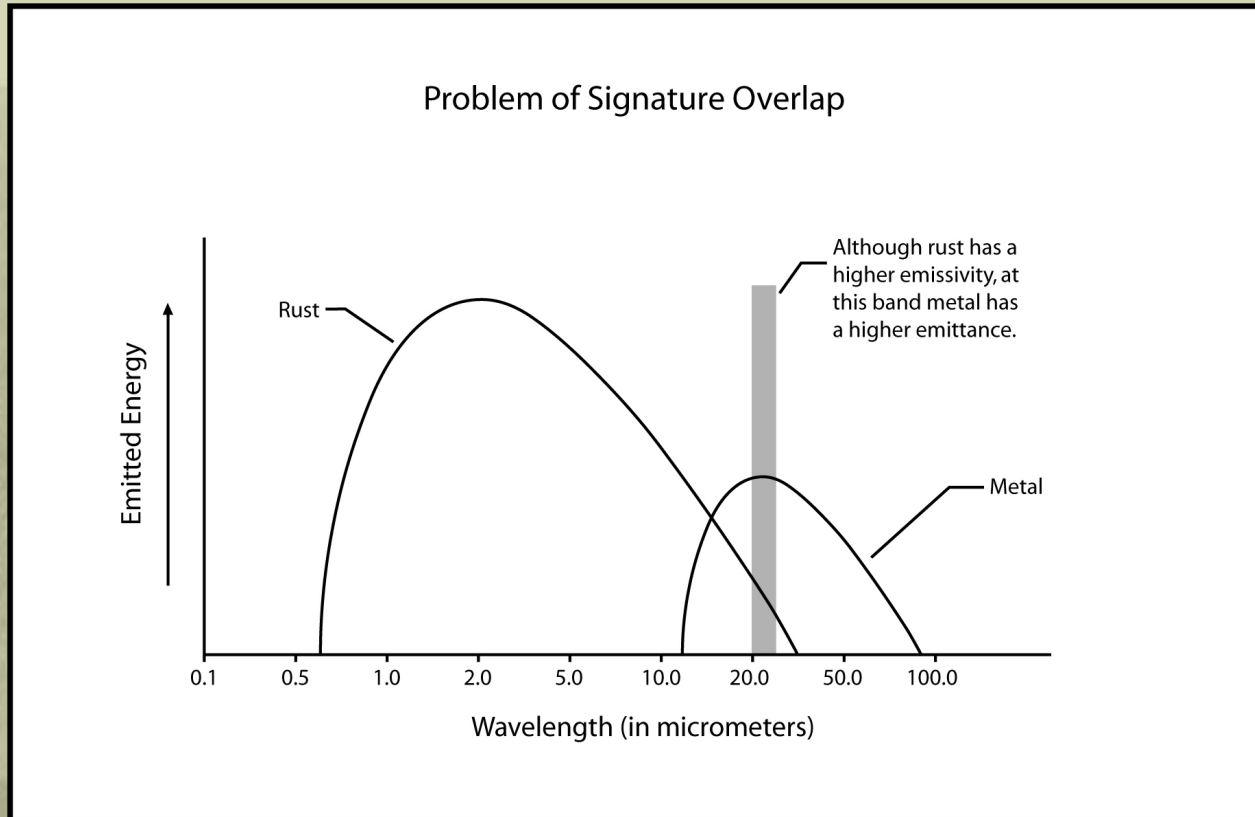
## Method 2: Spectral Signature



- **Metal has a distinctive spectral signature because of its low emissivity**

# Remote Sensing as a Data Collection Tool

## Method 2: Spectral Signature



- It is important to select a proper band that clearly separates the rusted pan from the functional pan

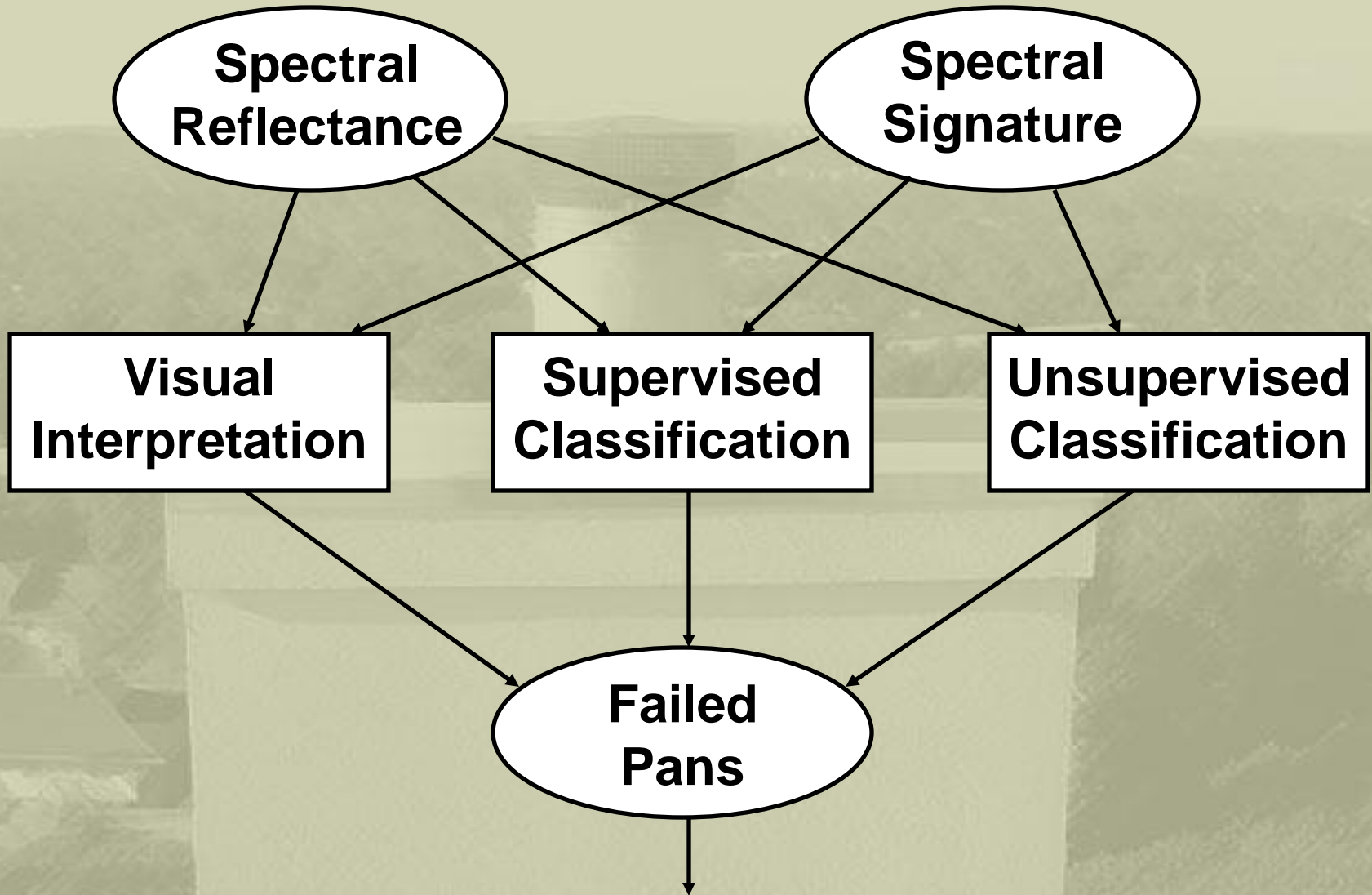
# GIS and Profitability

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- ***GIS*** – a computer based system for the efficient input, storage, manipulation, analysis, representation, and retrieval of all forms of spatially indexed and related descriptive data
- We want to now take what we know about the spectral properties of the failed and functional chimney pans and spatially analyze them so that we know which areas to infiltrate with our marketing

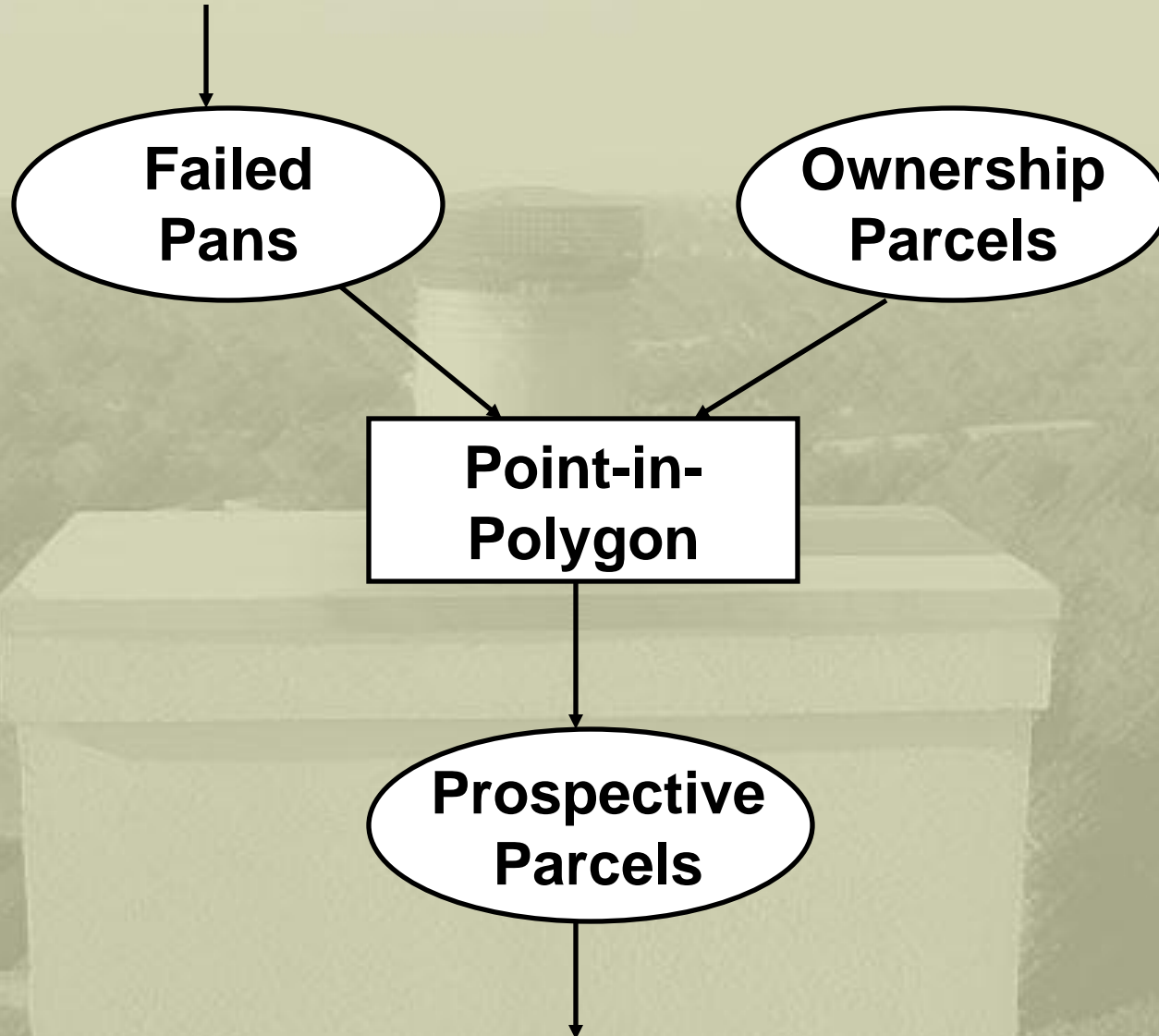
# GIS and Profitability

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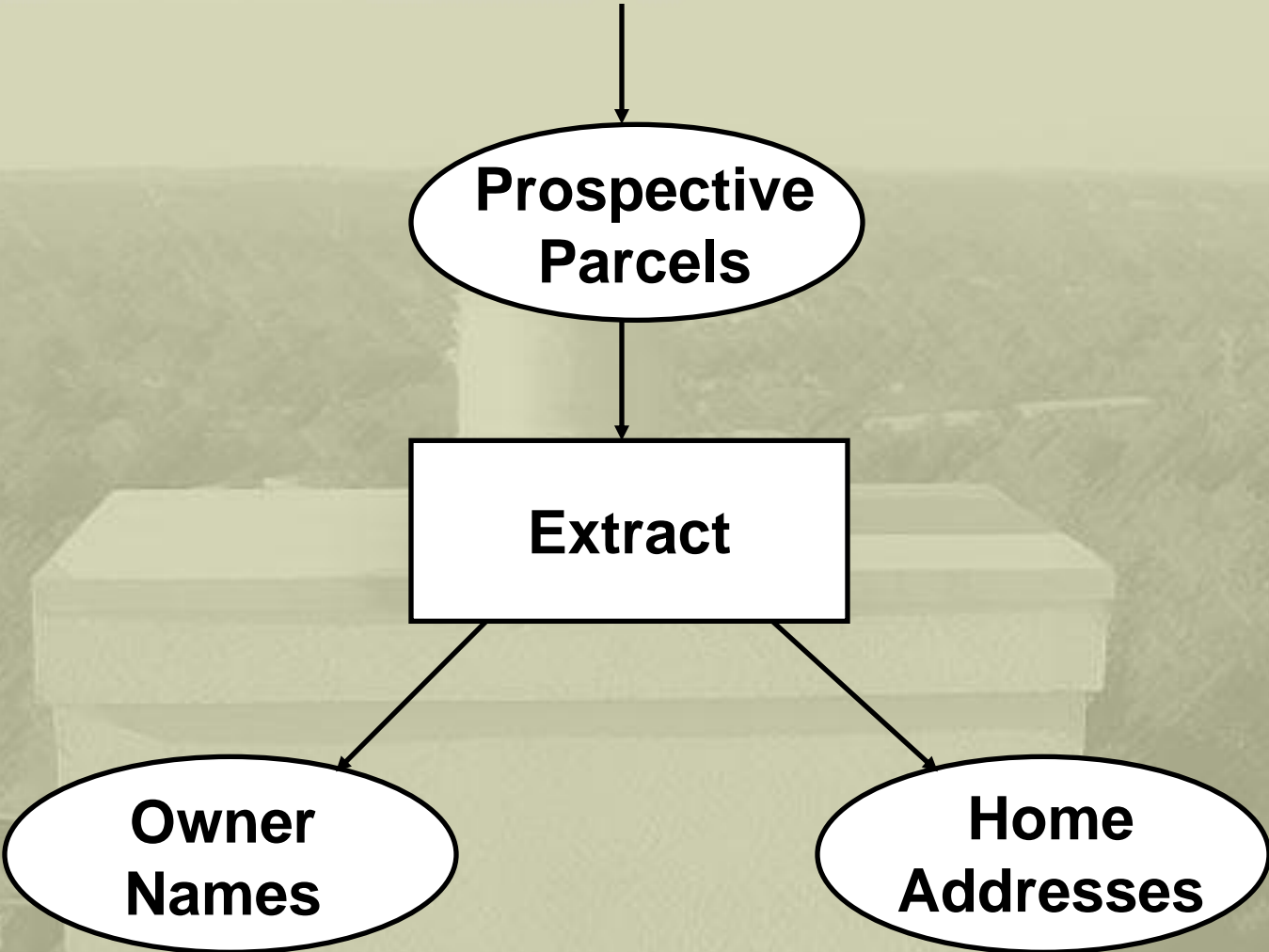
# GIS and Profitability

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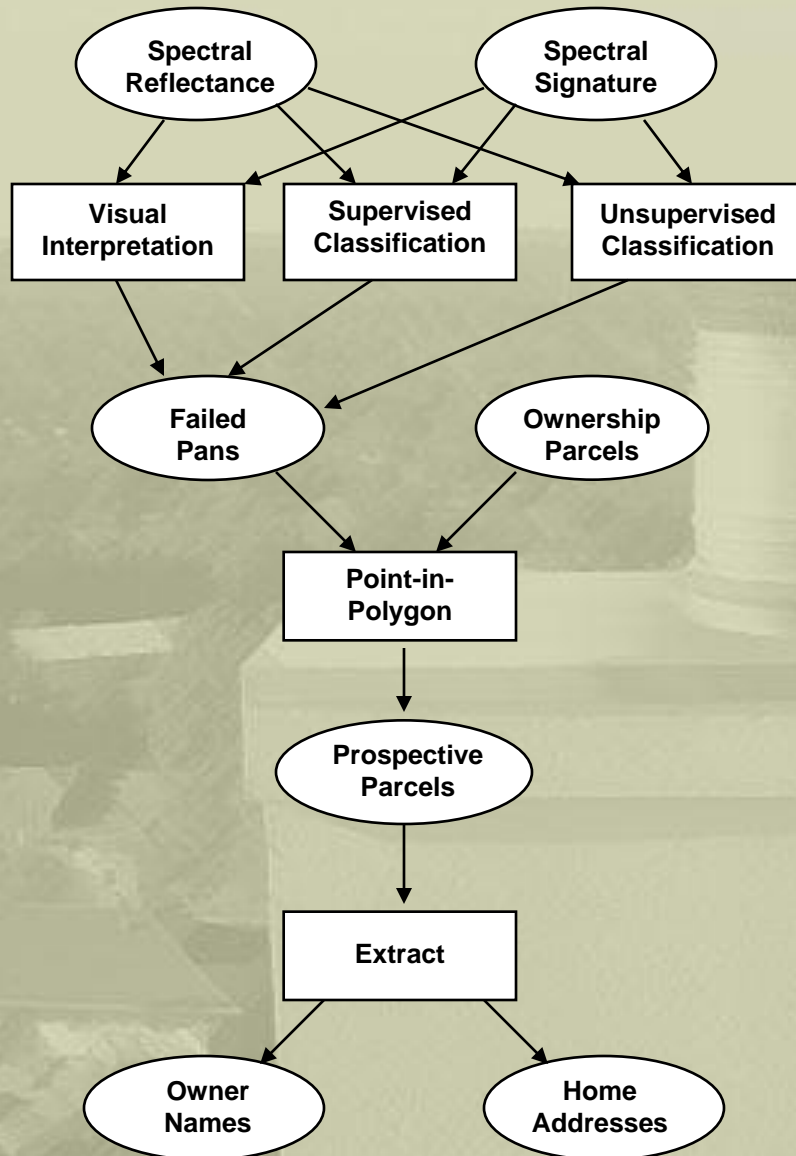


# GIS and Profitability

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# GIS and Profitability



- The end result provides both the name and address of clients that we KNOW require our service

- Last marketing step is to send out brochures and wait for responses

# GIS and Profitability

<b>Gross Profit (off of one image)</b>			
	Charge Per House		\$500
	# of Houses in Image		1000 homes
	# of Houses w/ a failed pan	10% of 1000 homes	100 homes
	# of Houses getting the service	25% of 100 homes	25 homes
	Gross Profit	25 homes @ \$500 ea.	\$12,500
<b>Gross Expenditure (off of one image)</b>			
	Imagery Acquisition and Processing		\$1,000
	Wholesale Pans	25 pans @ \$200 ea.	\$5,000
	Brochure Cost	1000 copies @ \$0.25 ea.	\$250
	Labor Costs	25 pans @ \$30 ea.	\$750
	Miscellaneous and Unforseen Costs		\$500
	Gross Expenditure		\$7,500
<b>Net Returns</b>			
	Net Profit (one image in two weeks)	\$12,500 - \$7,500	\$5,000
	Net Profit (52-week span)	\$2,500 for 52 weeks	\$130,000



# GIS and Profitability

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- ***“The Subdivision Effect”*** – because homes of a subdivision are often built all at once, it is likely that most of the pans within that subdivision will fail at relatively the same time

\* Selecting subdivisions that are 7-10 years old should increase the success rate of our marketing

# Potential Problems

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- Unfortunately, the entire process has yet to be fully implemented
- The potential problems can be broken into two different categories:
  1. Technical
  2. Ethical

# Potential Problems

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## Technical Issues

- *Technical Issues* – problems that occur during the data collection and processing that reduce the quality of the analysis

1. Non-Uniform Energy Source
2. Atmospheric Effects
3. Ambiguous Signatures
4. Sensor Limitations

# Potential Problems

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## Technical Issues: Non-uniform Energy Source

- **A non-uniform energy source will affect the spectral reflection recorded by the remote sensing instrument**
  - \* Will cause rusted pans to have a range of grayscale values instead of a distinct cluster of values
  - \* Reason that manual visual interpretation may be required
- **A normalized ratio between visible bands may help with this problem**

# Potential Problems

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## Technical Issues: Atmospheric Effects

- **Atmospheric absorption and scattering will affect the recorded reading from the instrument**
- **The theoretical spectral signatures shown early are blackbodies that do not reflect the present of atmospheric walls**
  - \* This will affect the band choice

# Potential Problems

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## Technical Issues: Ambiguous Signatures

- **Pans are made of numerous kinds of metals, each with numerous types of gauges**

- **The amount of rust on a failed pan varies**

  - \* A pan with 10% rust is considered just as “failed” as a pan that is 100% rust

# Potential Problems

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## Technical Issues: Sensor Limitations

- **LIMITED SPATIAL RESOLUTION!!!**
- ***Mixed Pixels*** – a pixel that includes several different features in its spatial coverage
- **The best resolution available will adequately cover our interests in the visible spectrum, but will not cover our interests in the infrared.**

\* We may be limited to only the spectral reflection approach to data because of the sensor limitations

# Potential Problems

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## Ethical Issues

- ***Ethical Issues*** – problems deriving from the very fundamental and moral appropriateness of the service

- **Do we have a right to monitor and mail individuals without their consent?**

\* What is private?



# Potential Problems

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## Ethical Issues: Privacy

- **Privacy of the home is protected by the 4<sup>th</sup> amendment**
  - \* Affirmed by *Griswold v. Connecticut* in 1965
  - \* Later expanded upon in the Privacy Act of 1974
- **So is remote surveillance of chimney pans from above a violation of one's constitutionally protected right to privacy?**

# Potential Problems

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## Ethical Issues: Privacy

- The issue of the legality in remote sensing addressed in *Dow Chemical Company v. United States*

- From this emerged the *open field doctrine*:

\* “whatever can be seen from above is fair game for official and unofficial snooping”

- Legality does not confirm ethicality

# Questions?

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**Thank you kindly for your time!**  
**~Robert**