Chapter 3.

Sustainable Retrofit

Syllabus LINKS:

- Geography Stages 1, 2, 3, 4 and 5.
- Curriculum Priority Sustainability – Geography – Stage 3 and 5
- Science and technology and Science Stages 1, 2, 3 and 4
- Curriculum Priority Sustainability – Science -Stages 2, and 4

Terms and concepts:

Sustainable design, WELS rating, retrofit, energy, electricity, insulation, water consumption, thermal comfort, natural ventilation, volatile compounds, recycle, reuse, fixtures, fittings.

Background Information:

The original caretakers cottage at the Coal Loader is a great example of how retrofitting can be achieved on an existing building. Retrofitting is the process of modifying something after it has been manufactured. For buildings, this means making changes to the systems inside the building or even the structure itself at some point after its initial construction and occupation. Retrofitting an existing building can save money, energy, water, and waste, and provide a more comfortable environment.

The cottage uses wind-assisted turbo ventilators to drive airflow through the building and ceiling-mounted fans increase cool air movement in summer and distribute warm air in winter. This means there is no need for air conditioners and therefore a reduced electricity bill.

The cottage is achieving a reduction of energy use of up to 55% by installing ceiling and wall insulation, utilising natural ventilation and natural lighting, using solar hot water for winter heating, and glazing windows. An electronic display measures how much solar power and recycled water the building uses which can be demonstrated in real time.

The Coal Loader has also retrofitted the bathrooms to become more sustainable. WELS stands for Water Efficiency Labelling and Standards Scheme. This is an Australian government rating system which gives stars for devices that use less water. The more stars an appliance or device receives, the less water it uses. The bathrooms include 4 star WELS rated toilets which use only 3.5L water per flush compared with 12L for a traditional toilet. The bathrooms also include 6 star WELS rated taps, using only 4.5L water per minute compared to a normal tap using up to 18L per minute.

The materials that have been used to furnish and finish the building have been selected to be as low impact on the environment as possible. For example the carpet is made from natural and recyclable materials and the paint used is low in volatile compounds (VOCs).

More than 95% of the timber used in the refurbishment is either recycled or FSC (Forestry Stewardship Council) certified, and the light-weight structural steel is 100% recycled.

Reusing and recycling building materials (up to 80%-90%) on site has resulted in the saving of energy and water used to make new products, less truck movements to transport materials and less waste to landfill.

A discussion about any recent retrofitting undertaken in the school or home environment will help frame the activities and learning to be undertaken at the Coal Loader Centre for Sustainability.

Solar vs Heat Pump Hot Water

Both types of hot water systems help to save money and lower carbon footprints, yet heat pumps offer a more convenient, low maintenance solution. Heat pumps extract renewable heat energy at any time and in any weather, are less expensive to install and free up roof space for a larger solar PV system.

Solar Electricity + Heat Pump

When paired with solar PV, and programmed to run during the day, a heat pump hot water system generates the cleanest and cheapest hot water available. Clean, renewable energy that comes from your own roof!

For More Information:

Before your visit, watch the 'Sustainable Retrofit' three minute video which will give your class an overview of what you will find at the Coal Loader.

Check out the websites *www.yourhome.gov.au* and *www.primaryconnections.org.au*

Activity 1 – Spot the Sustainable Design Features

Activity Summary:

This activity requires students to learn about sustainable retrofitting and how it has been undertaken at the Coal Loader. Students will identify sustainable retrofit features at the Coal Loader and consider if these can be carried out at school or home.

Inquiry questions:

1. What makes a feature a sustainable feature?
2. What are some sustainable retrofitted features and materials of the Coal Loader?
3. Where are the sustainable retrofitted features and materials at the Coal Loader?

Syllabus Outcomes:

Students will be able to:

- Describe processes and influences that form and transform places and environments. GE4-2
- Identifies and describes significant people, events, places and sites in the local community over time. HT1-2.
- Investigates the suitability of natural and processed materials for a range of purposes. ST2-MW-T

Materials and Preparation:

- Teachers to use the posters 'Low impact materials' and 'Keeping our cool in the caretakers cottage' for class discussion. See North Sydney Coal Loader Learning Guide.
- Students to bring a clipboard and writing equipment.
- A4 Coal Loader Map.

Background information:

The original caretakers cottage was constructed in the mid 1920s, presumably to replace the smaller sandstone block site office that survives opposite. This building was the administration hub of the site. The main office was situated in the south-western corner of the building and the site caretaker also lived there in the rooms on the north-western side. When coal-loading operations ceased in the 1990s, the whole building was used as a caretaker's residence for 15 years.

The building now features meeting facilities, a resource room, display areas, kitchen/lounge and amenities. It has been adaptively reused and retrofitted with sustainable features, appliances and devices as a learning and resource centre.

Activity 1 – Student Worksheet
Spot the Sustainable Design Features

Name .....

Location- Class to sit near the Caretakers Cottage.

a. Start with a discussion around the Inquiry question, that is,
   - What makes a feature a sustainable feature?
   - What are some sustainable retrofitted features and materials of the Coal Loader?
   - Where are the sustainable retrofitted features and materials at the Coal Loader?

b. Hand out the laminated poster titled 'Keeping our cool in the Caretakers Cottage'. Read through for background information before taking a walk around the site.

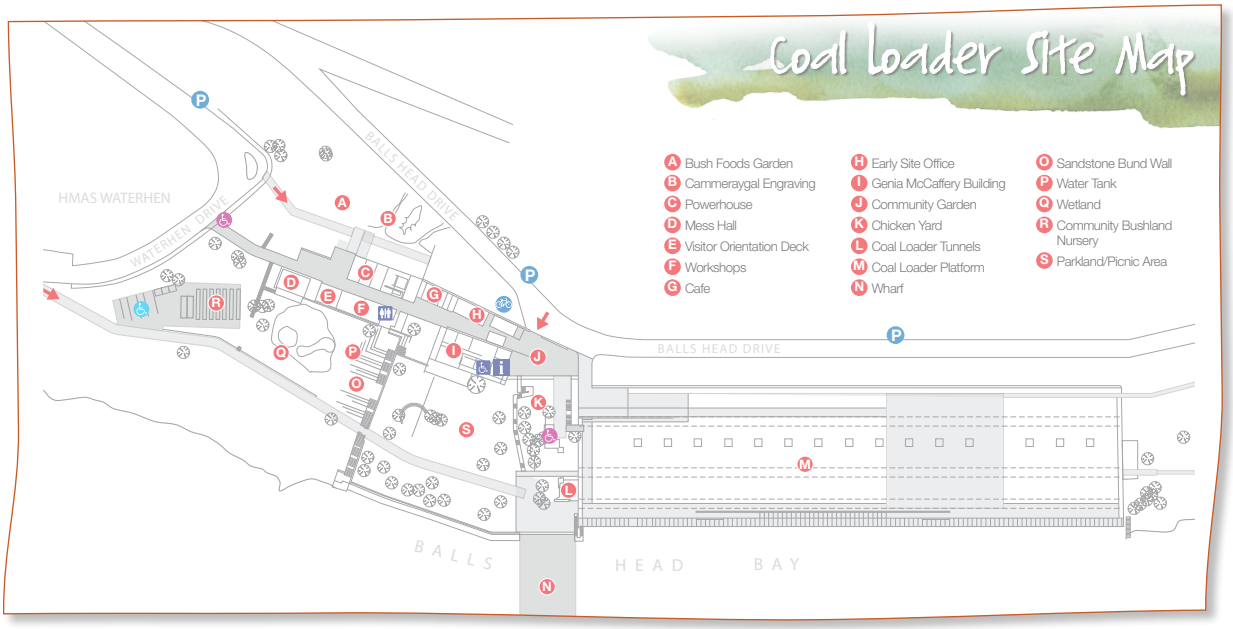
c. Hand out the A4 Coal Loader laminated maps so that students can view a larger map, and find out where they are.

d. Name some sustainability features of the Coal Loader that have been retrofitted and can be viewed from the starting location, that is,
   - Water reuse – rainwater tanks
   - Solar power generation – solar panels and photovoltaic cells
   - Recycled building materials eg, old gutters used as a vertical garden.

Activity 1 – Student Worksheet
Spot the Sustainable Design Features *continued*

Name .....

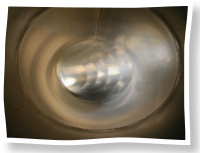
1. Let's take a walk around the Coal Loader site, find the sustainable retrofit features, tick them off ✓ and fill out the table below.
   It's best to start at the (**i**) display room in the Caretakers cottage or outside the Caretakers cottage to view the features on the roof.
   a. On the Coal Loader map below, circle or underline:
      - Wetland (at O),
      - Display room at Genia McCaffery Building (i)
      - Coal Loader tunnels (L)



   b. As you walk around the Coal Loader site, find the sustainable retrofit features, tick them off ✓ and fill out the table below.
      It's best to start at the Caretakers Cottage (B) and walk around its four sides.
      Then walk down the stairs to the wetland (O) and continue walking to tunnels at (L), before walking up the stairs, near the lift, back to Caretakers Cottage (B)

✓ the Sustainable feature	How is it sustainable? Eg, saves energy, water, reused, low toxic	Does it save money?	Use at school/ home?
1. Ceiling mounted fans 			
2. Ceiling and wall insulation 			

Activity 1 – Student Worksheet
Spot the Sustainable Design Features *continued*

✓ the Sustainable feature	How is it sustainable? Eg, saves energy, water, reused, low toxic	Does it save money?	Use at school/ home?
3. Natural ventilation 			
4. Natural lighting eg, windows/light tubes 			
5. Low energy lighting 			
6. Rooftop solar panels 			
7. Glazed windows			
8. Smart metering of solar power 			
9. 4 star WELS rated toilets 			
10. 6 star WELS rated taps			

Activity 1 – Student Worksheet
Spot the Sustainable Design Features *continued*

✓ the Sustainable feature	How is it sustainable? Eg, saves energy, water, reused, low toxic	Does it save money?	Use at school/ home?
11. Natural and recyclable fixtures and fittings eg carpet			
12. New recycled or FSC timber (Forestry Stewardship Council) 			
13. New recycled steel 			
14. Reused/recycled Building materials  			
15. Water recycling and reuse  			
16. Solar power generation 			

Activity 1 – Student Worksheet
Spot the Sustainable Design Features *continued*

✓ the Sustainable feature	How is it sustainable? Eg, saves energy, water, reused, low toxic	Does it save money?	Use at school/ home?
17. Tesla battery energy storage 			
18. Plants, trees and bushes for shade 			
19. Reuse old buildings such as Caretakers cottage and tunnels  			

Activity 2 – Sourcing Sustainable Fixtures and Fittings

Activity Summary:

This activity requires students to learn about the sustainable fixtures and fittings at the Coal Loader. Students will identify sustainable retrofitted fixtures and fittings features at the Coal Loader and consider if these can be carried out at school or home.

Inquiry questions:

1. What is the difference between a fixture and a fitting?
2. What makes a fixture or a fitting sustainable?
3. What are some sustainable retrofitted fixtures at the Coal Loader?
4. Where are the sustainable retrofitted fixtures and fittings at the Coal Loader?

Outcomes:

Students will be able to:

- Describe processes and influences that form and transform places and environments. GE4-2
- Identifies and describes significant people, events, places and sites in the local community over time. HT1-2.
- Investigates the suitability of natural and processed materials for a range of purposes. ST2-7MW-T

Materials and Preparation:

- Teachers to use the background information below and the posters ‘Low impact materials’ and ‘Keeping our cool in the caretakers cottage’ for class discussion.
- Students to bring a clipboard and writing equipment.
- A4 Coal Loader Map.

Background Information:

The life cycle of a product is often thought of as the journey of materials from cradle to grave. Many of the fixtures and fittings have been retained or retrofitted at the Coal Loader in order to save resources and reduce the environmental impact. Fixtures are items that are secured or bolted to the walls or floor eg light fixtures, kitchen units and bathroom suites and ‘fittings’ are free standing items eg carpets, fridge and furniture.

Retrofitting is the process of making changes to an already existing building to improve its appearance, thermal comfort, amenities and sustainability.

The managers at the Coal Loader retrofitted the old caretakers Cottage with new sustainable fixtures and fittings. For example, the carpet in the former caretakers cottage is made from natural and recyclable materials. Other materials that have been used for retrofitting include hand basins in the public amenities, windows in the cottage, rainwater tanks, solar panels and recycled timber for balconies.

Activity 2 – Student Worksheet
Spot the sustainable fixtures and fittings

Name .....

Location – Class to sit near the Caretakers Cottage.

1. Class to reread background material and discuss and write the answers to:

a. What is a fixture?

_____

b. What is a fitting?

_____

2. Hand out the laminated reference poster titled 'Low impact materials'. Read through for background information and answer these questions.

a. During renovation of the Coal Loader Centre, how much of the demolition waste was reused?

_____

b. Give two examples of the demolition materials being reused.

_____

_____

c. Why is this a sustainable practice?

_____

d. Some of the fittings eg, electrical equipment are low impact and sustainable.
Write down how these features are sustainable: (hint: read the poster)

- The lamp in the projector _____
- Computers in the resource room _____
- Carpet _____
- Chairs _____

e. Some of the fixtures are low impact and sustainable.
Write down how these features are sustainable: (hint: read the poster)

- Structural steel _____
- The paint used on the walls _____
- Floorboards _____
- Plasterboard and horse hair ceilings _____
- New ceilings _____

f. Hand out the A4 Coal Loader laminated maps so that students can view a larger map, and find out where they are.

Activity 2 – Student Worksheet
Spot the sustainable fixtures and fittings *continued*

3. Let's take a walk around the Coal Loader site, find the sustainable fixtures and fittings, tick them off ✓ and fill out the questions below.

It's best to start at the (**i**) outside the Caretakers cottage. Walk through community garden and down the stairs, past the chickens to the tunnels.

Look at the poster 'Low impact materials' for photos / clues of what you are looking for.

a. On the Coal Loader map below, circle or underline:
- Community Garden (at J),
- Caretakers Cottage /Genia McCaffery Building (i)
- Coal Loader tunnels (L)

On a walk outside (✓) when you see these materials, and name what they are reused for (The poster – Low impact materials – will also help you answer these questions)

1. old corrugated roofing was used for?

_____

2. old bricks were used for?

_____

3. old plastic and steel were used for?

_____

4. old crushed tiles and concrete were used for?

_____

5. Old or recycled timbers were used for?

_____

6. Streetsigns were used for?

_____

Pre and post excursion – Investigation and research activities

Activity 1:

The following table summarises the properties of three different types of lightbulbs, each providing the same amount of light. Look at the information provided and answer the following questions:

1. Which type of light bulb
   - Lasts the longest? _____
   - Is the most expensive per bulb? _____
   - Uses the least amount of electricity over 50,000 hours? _____
2. You will notice that both LED and CFL light bulbs save a similar amount of money compared to incandescent light bulbs. Considering the fact that CFL bulbs contain mercury (which is harmful to the environment), and LED contain no mercury, which would you choose for your own use?

   _____

Light Bulb Comparison Table*

	LED Light-emitting Diode	**CFL** Compact Fluoroescent Lamp	**Incandescent**
			
Light bulb projected lifespan	50,000 hours	10,000 hours	1,200 hours
Watts per bulb (equiv. 60 watts)	10	14	60
Cost per bulb	$35.95	$3.95	$1.25
KWh of electricity used over 50,000 hours	400	700	3000
Cost of electricity (@ 0.10per KWh)	$50	$70	$300
Bulbs needed for 50,000 hours use	1	5	42
Equivalent 50,000 hours bulb expense	$35.95	$19.75	$52.50
Total cost for 50,000 hours	**$85.75**	**$89.75**	**$352.50**

Energy Savings over 50,000 hours, assuming 25 bulbs per household:

Total cost for 25 bulbs	$2143.75	$2243.75	$8812.50
Savings to household by switching from incandescents	$6668.75	$6568.75	0

*Source: www.eartheasy.com/live_led_bulbs_comparison.html

Activity 3 – Design your own sustainable home or school

Activity Summary:

This activity will inspire students to use technology to redesign their own home to incorporate more sustainable features. Google SketchUp *www.sketchup.com* (free to download) or other design software can be used to replicate a 3D model of an existing building. Markers can be added to point out the sustainable design features.

Inquiry questions:

1. What makes a feature a sustainable feature?
2. What are some sustainable retrofitted features and materials of the Coal Loader that could be used elsewhere?
3. Can you redesign or retrofit your home or school to become more sustainable?

Syllabus Outcomes:

- Investigates the suitability of natural and processed materials for a range of purposes. ST2-7MW-T
- Explains how the properties of materials determines their use for a range of purposes. ST3-7MW-T

Materials Needed

- Floor plan of students' home or school or other building (or a tape measure to estimate).
- Google SketchUp free design program (or a scale ruler if you don't have access to a computer).

Preparation

- Before the students begin this activity, the teacher should engage the class in a discussion on sustainable design and retrofitting. Use examples of sustainable retrofitting at the Coal Loader to prompt students into thinking about their own homes and what could be done to make them more sustainable.
- Ask students to measure the rooms within their own homes or locate an existing floor plan.
- Ask students to download Google SketchUp *www.sketchup.com* or another design software package.
- If students don't have access to a computer they can use a scale rule to do a technical drawing.

Activity 3 – Student Worksheet
Design your own sustainable home or school

Introduction:

This activity will allow you to imagine you are modifying your existing home or school to become more sustainable. You will use online software to help create a model of your retrofitted home. This could be presented to your parents or Principal as a plan for a sustainable retrofit or the beginnings of a future design project!

Activity:

1. Locate a floor plan of your home or school or measure it yourself using a tape measure.
2. Use actual dimensions and orientation to recreate your existing layout on Google SketchUp or another software program.
3. Add design elements that you think would make it more sustainable.
4. Retrofit existing fixtures and fittings to save money and reduce your environmental impact.
5. Clearly label those features that you consider most important and highlight why they are a sustainable alternative.

Extension Activity:

- Research The Coal Loader Centre's 'Plants for rooftop gardens.'
  How much roof space do you have available?

- Do you need to modify the existing roof to accommodate growing plants?

- Now calculate how much soil you will need (10cm height max)

- What plants eg natives, edible plants, flowers would you plant and why?

- What water system would you use? Can you use recycled water?

Sustainable scavenger search

Walk around the Coal Loader site and find these features: