# ENGINEERING HERITAGE AUSTRALIA

## ENGINEERING HERITAGE GUIDELINES

ENGINEERS AUSTRALIA

## PRACTICE NOTE No. 8

## CONSERVING A WHEELED STEAM ENGINE

### Purpose

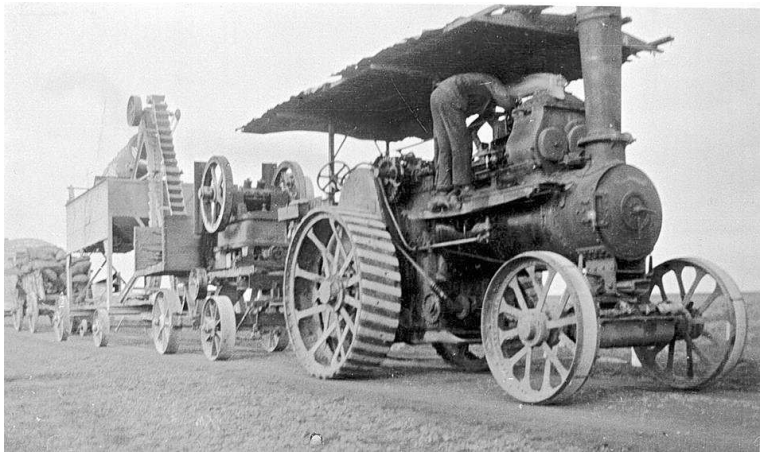
The purpose of this practice note is to provide engineers and others with essential background information on the appropriate process for conserving a wheeled steam engine.

### Preamble

Previous Practice Notes 1 to 3 have defined conservation and have provided information on the principles and procedures to be followed in order to give an understanding of what to do and how to do it in an overall approach. They are the foundation on which all conservation is built and are essential to achieving the right end result.
Practice Notes 5 and 7, using the overall approach, have dealt with machinery as an item of Industrial Heritage and as an item of Movable Heritage.
This Note is aimed at conserving an Item which has its individual place in both Industrial and Movable Heritage and builds on them in more specific detail.
Adequately conserving a wheeled steam engine requires a great deal of knowledge of the engineering behind the machine including its technical development and place in the timeline of that development.
This Practice Note calls for and assumes that an engineer knowledgeable in steam will be involved in the work and concentrates on guiding that engineer through the Heritage process.
Appendix A provides an introduction to steam powered machines as an aid to non engineers.

### What is a Wheeled Steam Engine?

Wheeled Steam Engines are divided into two groups, self-propelled steam powered traction machines and steam powered machines with wheels, capable of being towed but not self-propelled.
The self- propelled group includes railway steam locomotives and steam road vehicles such as traction engines and road rollers, with traction engines often doubling up as stationary belt drivers for powering farm machinery.



*Traction Engine, Grenville, Victoria. Traction engine towing belt driven farm machinery.*

The non self- propelled wheeled engines were developed as a readily moved power supply and were a common agricultural, civil engineering, drilling and mining machine.

## Conservation Reasons

It is useful to first examine the reasons for conservation as an aid to using the Notes.

The Notes refer to the community benefit of handing on significant items to future generations and require assessment of –

- Whether it is an example of a technological advance.
- The history of the item. Its materials, design, construction, usage.
- The influence of it on our society.
- The criteria to be used.

The Notes require the determination of significance by-

- Investigating the history including the people involved in design and construction.
- Determining where the item fits in the development of engineering.
- Rating the engineering importance- exceptional, high, low, none.
- Rating the social importance - exceptional, high, low, none.
- Rating the item's heritage significance- exceptional, high, low, none.

The criteria need consideration of the fact that steam engine development went hand in hand with developments in metallurgy and saw changes in fabrication with casting and machining of parts and in construction with progression from bolts to rivets to welding.
Brittle fatigue investigations into steam engine failures was a major influence in the progression of metallurgical knowledge generally and had a large impact on the design and construction of steam engines and the wheeled machines containing them.
The criteria have special importance when dealing with a wheeled steam engine particularly with unique features as –
Many parts may be handmade and may be a good example of their kind.
It may demonstrate a feature to minimise or avoid a fatigue failure.
The machine may be elegant.
It may be linked to an early activity or ancillary development such as a railway or agriculture forming a strong community interest link between machine, its use and the people involved.
It may have special meaning to a group of enthusiasts.
It may have tourism potential.
It may be capable of operation.
It may have a spectacular operation or appearance.
It may be a good example of its type or demonstrate a development in design, construction or use.

## The Assessment Procedure

Wheeled steam engines are uniquely related to their function as distinct from other movable heritage items.

They are related more strongly to their function than to a place but may gain significance from their use at a specific place.

An example is an engine that started life on drilling bores and ended up on a farm powering shearing equipment.

It is important to first determine the most significant function period of the machine and then relate it to the most significant place at which it operated.

The continuing use of a wheeled steam engine is a powerful factor in demonstrating its design principles and its development history and will relate very strongly to observers on a personal level if linked to their forebears or to past practices of the area in which they live but operation and public safety requirements may require unacceptable alterations to materials, structure and appearance. If this is the case then a museum situation is likely to be the only viable option.

The assessment procedure of Practice Note 7 should be followed and the requirement for engineering expertise cannot be over emphasised.

The assessment procedure must include the criteria outlined above and it should be recognised that consideration of a specific machine may throw up other or extra criteria.

## The Conservation Procedure

The procedure applies the assessment to obtain the available options enabling a best choice decision to be made.

The assessment procedure of Practice Note 7 should be followed and the requirement for engineering expertise cannot be over emphasised.

## Interpretation and Presentation

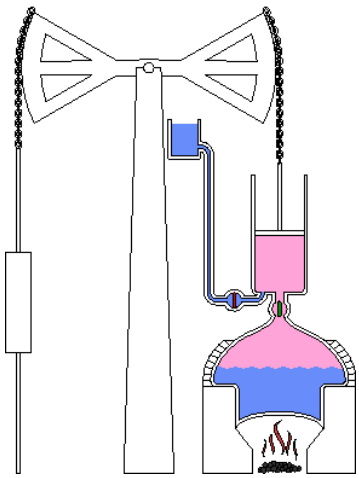
The story of the development of the machine, its usage, the places where it was used, the people involved and their activities provide the opportunity for a wide ranging and effective communication with observers not possible with most other heritage items, buildings or places.

Telling the story and involving the observer is a major part of successful conservation.

## Appendix A

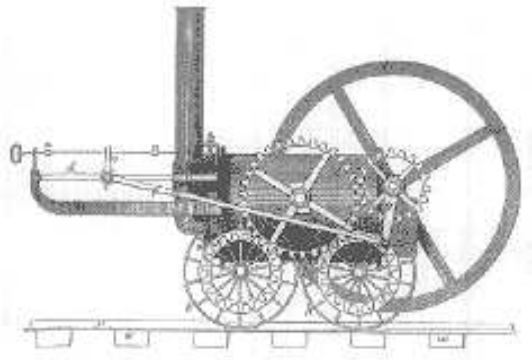
### The Development of Steam Engines

A knowledge of the development of steam engines is essential to understanding how to conserve them.
Steam engines are a classic example of engineers making practical use of a basic science phenomena to construct a useful machine and to then continually improve on it.
The steam engine was initially developed over a period of about 100 years by four major engineers with continuing development to the present day with contributions from many others.
The story starts in 1698 with Savery using steam to pump water out of coalmines in England by opening and closing valves in a pipe to cyclically prevent and allow steam into a large cylinder. There were no moving parts and large amounts of coal were used in pumping small quantities of water.



The next development was Newcomen using steam to push a piston in the cylinder. The engine relied on gravity to create a seesaw action on a beam to initiate the pumping action of the steam. Steam let into the cylinder pushes the piston up and condensing water then let into the cylinder pulls the piston down.

Watt and Murdoch improved on Newcomen by developing a method to push the piston both ways in the cylinder and a way of turning the seesaw beam action into a circular rotation of a wheel.
A further major development was installing a steam condenser cylinder separate to the power cylinder.
Steam pressures remained low at near atmospheric pressure and the next major development was high temperature high pressure steam to give more power with less fuel.
The compound engine with two power cylinders with a high pressure cylinder discharging to a low pressure cylinder with work from Trevithick, Woolf, Corliss and Allen in England and Evans in America, developed greater efficiencies, power and speed together with speed governors and safety devices.
The high pressure engines were simpler than the early condensing engines, were cheaper to build and maintain and did not require large volumes of water.
Their development led to wheeled steam engines of which the largest subset is railway locomotives.



*World's first steam locomotive by Trevithick 1804*

*Stephenson's Rocket. 1829 American Reproduction*

Railway engines saw the development of tube boilers starting with the Rocket and culminating in the modern steam locomotive with its double acting engine working directly on the drive wheels and with a water tube boiler with spiral formed tubes and slide gate regulator enabling the engine to run forward or backward.


*Last steam engine built in Australia. Ipswich, Qld.*

The development of the steam engine was only made possible with developments in metallurgy from cast to wrought iron to steel concurrent with developments in fabrication, machining and construction using, progressively, bolts, rivets and welding.
The phenomenon of brittle fatigue was investigated by Rankine with the failure of railway axles in 1842 and became a major factor in the use of materials in steam engines where subject to stress reversals.