



# Community Information Paper

## Determining the Physical Extent of the Floodplain



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### Key points

- Determining the physical extent of the floodplain and its alluvium helps the community understand with certainty how BHP Billiton can deliver on its commitments.
- These commitments include no mining of any description outside the targeted area, no longwall mining under the floodplains or under the deep alluvial aquifers, and no open cut mining anywhere in the Caroona Exploration Licence area.
- The physical extent of the floodplain is being determined through both geomorphology and flood modelling studies.
  - Geomorphology studies determine the location of floodplain alluvium.
  - Flood modelling studies determine the extent of present-day flooding on the alluvial plains.
- Both studies contribute to determining the physical extent of the floodplain alluvium.

### Introduction

The Caroona Exploration Licence covers an area of approximately 344 square kilometres on the Liverpool Plains.

The terrain within the exploration licence area includes near-flat farmed floodplains and sloping grazed and timbered ridge country.

## What is a floodplain?

The Macquarie Dictionary defines 'floodplain' as *"a nearly flat plain along the course of a stream that is naturally subject to flooding at high water"*.

The course of a stream (river, creek or watercourse) is formed by alluvial processes where sediment is deposited.

## Floodplains and the exploration licence

The floodplains of the Liverpool Plains sustain highly productive agriculture, including irrigated and dryland cropping and livestock production. The floodplains are composed of sediment, known as alluvium, deposited by flowing water such as creeks and rivers.

The floodplains associated with Yarraman Creek and the Mooki River/Quirindi Creek systems are a key feature of the Caroona Exploration Licence area. Aquifers under the floodplains are tapped for irrigation to provide high-quality stock water and domestic water.

Local stakeholders wish to protect alluvial aquifers and alluvial floodplains. This has been recognised by BHP Billiton and reflected in our commitments relating to this project.



Yarraman valley floodplain within the Caroona exploration licence area.

## Importance of defining the extent of the floodplain

As part of the exploration process, BHP Billiton will determine the extent of the floodplain. This will provide certainty for the community on how BHP Billiton will deliver on our commitments, including that there will be:

- no longwall mining underneath the floodplain;
- no longwall mining underneath the deep alluvial irrigation aquifers;
- no open cut mining anywhere in the exploration licence area.

BHP Billiton voluntarily committed to these principles, which the NSW Government subsequently included in amendments to the special conditions of the exploration licence.

## How is the extent of the floodplain alluvium being determined?

BHP Billiton has engaged independent specialist consultants who will determine the extent of the floodplain using two complementary approaches. The first

approach examines where floodplain alluvium is found within the exploration licence area using geomorphology studies. The second approach uses hydrological studies to determine the extent of present-day flooding on the plains. Together, these scientific studies will help determine the extent of the floodplains that BHP Billiton has committed to avoiding.

## The science of alluvium

Alluvium is sediment deposited by rivers and streams. Under many floodplains, alluvium holds valuable groundwater. Floodplain alluvium includes a range of sediment types, which vary in shape, size and size distribution depending on how they were deposited from water. Two major types of alluvium can be distinguished:

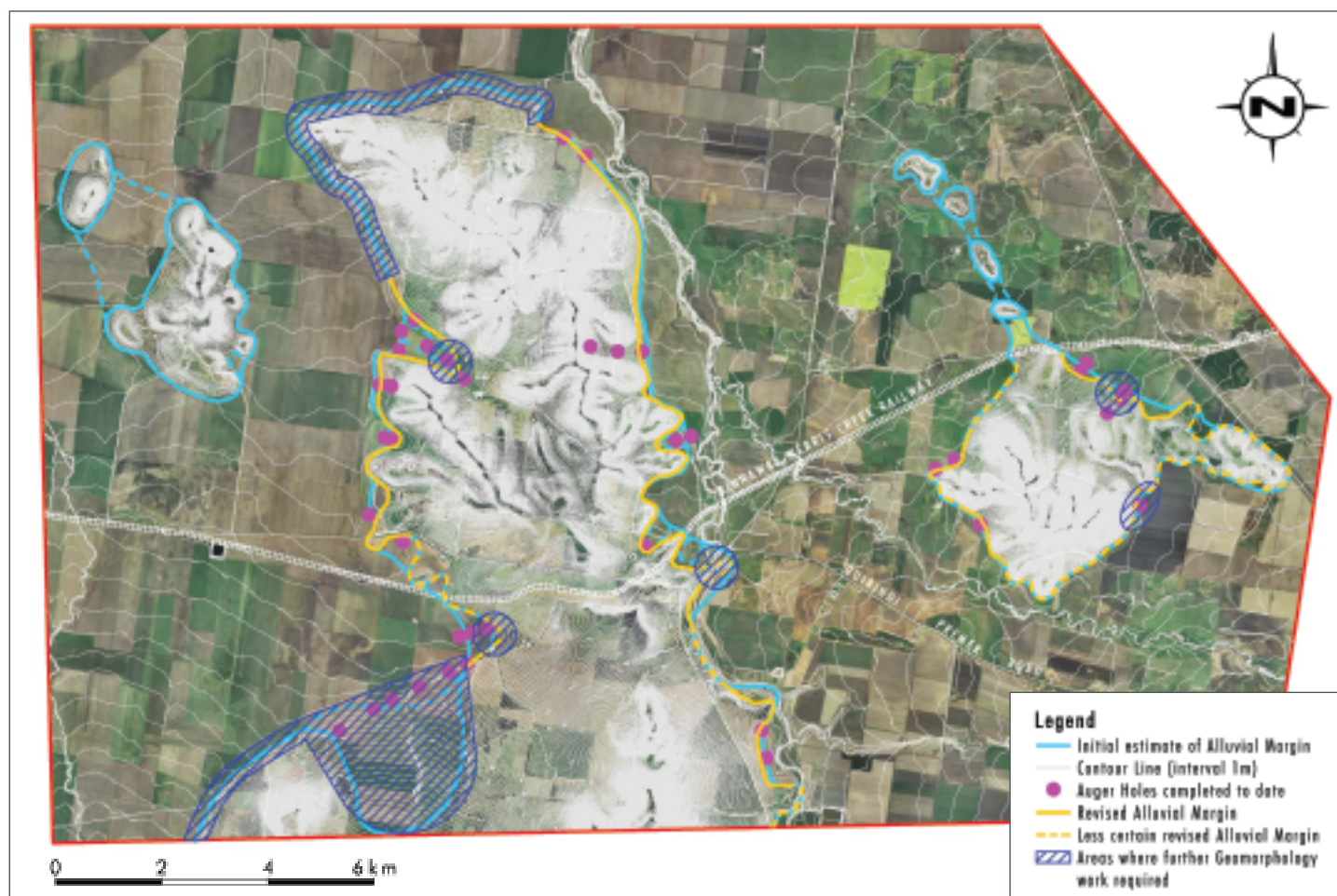
- gravel from old river beds and river banks, which was usually deposited from strongly flowing water and is usually coarse and rounded;
- flood and backwater deposits, which usually settles out from almost still water and is very fine.

At the edge of main river floodplains, other types of alluvium may be contributed to the floodplain sediments by tributary streams and by sheet water flow from neighbouring slopes. These types of alluvium include:

- tributary or gully deposits, which are often moderately coarse and more angular than main river gravels;
- slope wash, which is usually well-sorted, moderately fine and (if it is large enough) more angular.

Alluvium usually accumulates gradually on floodplains over time as rivers deposit more and more sediment into available storage areas, particularly during large floods. The original ancient bedrock valley is filled by accumulating alluvium. In the centre of the floodplain, the flat land surface usually can only have been formed by deposition of alluvium.

However, at the edges of floodplains, where the plains meet the footslopes of surrounding hills, older floodplain alluvium can be overlain by slope wash or tributary alluvium. In these



**Figure 1** - Preliminary and revised estimate of the extent of the floodplain within the Caroona Exploration Licence area.

areas it is more difficult to identify the extent of this alluvium due to the overlain material washed down from the ridges.

The process of defining the floodplain alluvium is critical in identifying where alluvial aquifers may be present. This data will inform any proposed mine design and avoid impacting on the deep alluvial irrigation aquifers under the floodplain.

## Defining the edge of alluvium

The depth of material washed off the ridges and overlying floodplain alluvium may extend to several metres in places. Desktop analysis of existing data was initially used to identify the probable edge of the floodplain alluvium. Regional soil landscape mapping provided a starting point to broadly indicate

where the edge of the floodplain alluvium material may occur. This level of mapping is based largely on soil sampling to a depth of two metres. An analysis of the landscape, particularly the change of slope, also provided a good indication of the probable edge of the floodplain alluvium.

Other data sources were also used to refine the preliminary mapping of the boundary of the floodplain alluvium, including:

- site inspections;
- aerial photography;
- satellite imagery;
- topographic information (LiDAR);
- soil types and soil landscapes;
- geology maps;
- satellite imagery;
- airborne geophysical data collection.

The purpose of collecting all available data was to narrow down the areas where further on-ground field investigation and environmental study activities would be required. Figure 1 shows the preliminary estimate of the extent of the floodplain, as well as the revised floodplain margin incorporating the geomorphology studies undertaken to date. The map also shows the areas of uncertainty, based on the desktop studies, which require further auger hole drilling to accurately define the edge of the floodplain alluvium.

As identified earlier, it is difficult to determine the precise edge of the floodplain alluvium where it may be overlain by footslope material washed downhill by past rainfall events, or in gullies where gully deposits may be interlaced with floodplain material. These areas are targeted for further

investigation by drilling auger holes to a depth up to 9.5 metres. This process will provide greater certainty about the edge of the floodplain alluvium and a better understanding of the soil profile beyond two metres.

## Land use planning tools

There are a number of other planning tools, such as government land use planning tools, which define floodplains for various planning purposes.

These tools are constructed from information such as:

- 2% slope definition;
- 1980 Flood Atlas;
- extent of 50 year Average Recurrence Interval (ARI) flood;
- extent of 100 year ARI flood;
- extent of Probable Maximum Flood (PMF).

The limitations of relying on this level of information are that they are broad tools and not intended to define the physical extent of the floodplain in any particular location. As a stand-alone source of information, the flood planning related tools also only take into account the surface extent of alluvial systems based on recent flooding information, and do not identify the subsurface extent of alluvium. This means that this type of information does not account for where the water may have flowed in the past due to landscape changes, nor does it identify areas where the floodplain alluvium may be overlain by footslope material.

While these tools are useful in defining the extent of the floodplain for some planning purposes, they are not adequately definitive to assess the potential impact of any underground longwall mining developments on the deep alluvial irrigation aquifers. The major gap in the planning tools is that they do not accurately define the boundary of the floodplain alluvium.

## Where to from here?

- The definition of the floodplain boundary is not complete. Further drilling will be required in areas where access has not been able to occur to complete the studies and adequately define the boundary to provide certainty.
- Further work is required to continue to build on the existing knowledge from the geomorphology studies and enable the refinement of the floodplain alluvium boundary within the Caroona Exploration Licence. Further validation work on the flood model is also required, including further consultation with the community.

When complete the findings will:

- define the floodplain boundary and provide a basis for BHP Billiton to meet its commitments;
- be used by BHP Billiton throughout the planning process, in association with the information from the detailed groundwater, mining, geotechnical and other studies, to inform any potential mine design;
- be a key consideration of any future detailed environmental assessment process for a proposed mining development.

A report on the findings of this work will also be shared with the community and government agencies.

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