

**Yeelirrie Short-Range Endemic Invertebrate Impact Assessment****Client URS Australia**; on behalf of BHP Billiton Yeelirrie Development Company Pty LtdAttention: **Kim Drummond****Keith Ashby**Date **23 February 2011****MEMO: Predicted Impacts to SRE Invertebrate Fauna**

BHP Billiton Yeelirrie Development Company Pty Ltd is preparing an Environmental Review and Management Programme (ERMP) for the Proposed Yeelirrie Development (the Project). The Project is located in the shire of Wiluna, approximately 60 km west of Mount Keith in the Midwest of Western Australia and would mine uranium mineralised ore.

A separate baseline report for invertebrate fauna has been completed that provides a habitat assessment and identifies the Short-Range Endemic (SRE) and potential SRE species occurring within the project area. The baseline report clearly outlines the project footprint and the study area assessed by ecologia and as such this memorandum should be read in conjunction with the baseline report. This accompanying memo provides a description of the threatening processes as a result of mining activities and specifically how these threatening processes may relate to the Proposed Yeelirrie Development. Additionally, it includes discussion relating to potential impacts on the habitats and species.

In summary, the baseline survey found 17 SRE or potential SRE invertebrate species (Table 1). The habitat analysis showed no significant correlation between SRE species diversity and habitat type. Hardpan Mulga habitat supported the most SRE species while the Calcrete habitat had the highest specimen abundance. Three species showed a preference for habitat type including *Anane* 'MYG170' (Calcrete), Platyarthridae/Bathytropidae (Calcrete Outwash) and *Urodacus* 'yeelirrie' (Hardpan Mulga) despite each being collected in three habitat types. No other species showed statistically significant habitat preference because of the low number of specimens collected.

**Table 1: Summary of SRE and Potential SRE Species Collected at Yeelirrie**

Taxa	Species	Collected Outside Impact Area (Y/N)	Habitat Type
Mygalomorph Spiders	<i>Aganippe</i> sp.	Yes (Wellfield Survey)	Hardpan Mulga
	<i>Aname</i> 'MYG170'	No	Calcrete Calcrete Outwash Hardpan Mulga
	<i>Aname</i> 'MYG212'	Yes (Wellfield Survey)	Calcrete Outwash Mixed Shrubs over Spinifex Sandplains
	Barychelidae	No	Calcrete Outwash
	<i>Idiosoma</i> sp.	Yes	Mixed Shrubs over Spinifex Sandplains
	<i>Kwonkan</i> 'MYG171'	No	Hardpan Mulga
	<i>Kwonkan</i> 'MYG172'	No	Calcrete Playa B
	<i>Kwonkan</i> 'MYG210'	Yes (Wellfield Survey)	Hardpan Mulga
	<i>Kwonkan</i> 'MYG211'	Yes (Wellfield Survey)	Hardpan Mulga
Scorpion	<i>Urodacus</i> 'yeelirrie'	Yes	Calcrete Calcrete Outwash Hardpan Mulga
Pseudoscorpion	Cheiridiidae	No	Calcrete Outwash
Isopods	<i>Cubaris</i> sp. 1	No	Calcrete
	<i>Cubaris</i> sp. 2	Yes	Hardpan Mulga Mixed Shrubs over Spinifex Sandplains
	Platyarthridae/Bathytropidae	No	Calcrete Calcrete Outwash Hardpan Mulga
	<i>Pseudolaureola</i> sp.	No	Calcrete Outwash
Centipede	Geophilida	No	Hardpan Mulga
Insect	<i>Pseudotetracha helmsi</i>	Yes	Yeelirrie Playa

## Threatening Processes

The primary impact to SRE species and habitats as a result of mining projects, in general, is most likely to be caused by vegetation clearing and degradation (e.g. changes in the water table, dust deposition and weed invasion, off-road driving, changes to the existing fire regime).

### 1.1 Vegetation Clearing

Impacts to native SRE invertebrate fauna arising from vegetation clearing activities can include a reduction in the amount of available fauna habitat. SRE specimens that rely on host habitat for a portion of their life cycle may be indirectly affected by reduced biomass, flowering or fruiting bodies and alteration of the litter and soil layers associated with the host vegetation. Clearing also has the potential to result in the fragmentation of habitats and lead to the inability of individuals to move between areas of habitat.

Vegetation clearing can cause a local loss of biodiversity and ecological function.

Proposed activities in the project footprint involve vegetation clearing, vehicle movement, excavation and other soil disturbing activities. These direct impacts to habitat types are shown in Table 2.

### 1.2 Changing the Water Table

An alteration to the water table can indirectly impact native fauna through the resultant effects on vegetation. A lowering of the water table can lead to impacts on phreatophytic vegetation that relies on deep, constant, sources of groundwater to survive, as well as carry out processes such as flowering and setting seed (Eamus et al. 2006). Phreatophytic plants provide important habitat for a variety of SRE species that live under the bark of trees, leaf litter and under rocks, including mygalomorph spiders, pseudoscorpions and some land snails.

In contrast, raising the water table may result in the drowning of plants if they become permanently inundated. However, given the low rainfall and high evaporation rates of the project area, no vegetation outside of the project footprint area would become permanently inundated as a result of the proposed Yeelirrie development. The proposed project is located in the Yeelirrie Valley floor flow path, and it is anticipated that the project would alter temporary baseline surface water regime, specifically during high rainfall events. For the purpose of the invertebrate impact assessment, it is estimated that flooding of an area for more than a three week period could be detrimental to SRE fauna in the arid dry zone.

### 1.3 Dust Deposition and Weed Invasion

Vegetation degradation can come about through the effects of dust deposition or increased weed invasion. An increase in airborne particulate matter results from vegetation clearing and vehicle movements. This dust can cause damage to vegetation primarily through abrasion of leaves, reduction in photosynthesis and in some cases intake of chemicals through the cuticle (Grantz et al. 2003). This can result in insect infestations and plant disease in addition to reduced growth and biomass, all of which may lead to increased ecosystem stress and altered species composition. A decline in vegetation quality would impact SRE assemblages by reducing habitat resources.

Disturbance and clearing of native vegetation during construction can also facilitate the colonisation of weed species already found in the area, whilst an increase in vehicle and equipment movement can introduce species from other areas. This can result in weed species dominating the understorey to the exclusion of annuals and eventually larger perennials.

### 1.4 Off-Road Driving

The main effect of off-road driving on SRE fauna would be indirect impacts through dust deposition and the potential for direct mortalities. It is also noted that habitat fragmentation is an issue for the tiger beetle species *Pseudotetracha helmsi* (located outside the project area in the Yeelirrie Playa) as this species would be highly susceptible to the use of 4-wheel-drive and other off-road vehicles and foot traffic on un-marked tracks on the Yeelirrie Playa. In the past, the continual disturbance or disruption of occupied habitats has eliminated many tiger beetle populations (Cassola et al. 2000) and therefore seemingly small disturbances to the Yeelirrie Playa by off-road driving could have negative implications for the tiger beetle population.

Considering the Yeelirrie Playa is located outside the project area and approximately 30 km south east of the project footprint, impacts from the Proposed Yeelirrie Development is not likely.

### 1.5 Fire

Increased human activity is often associated with an increased risk of fire or altered fire regimes, which may lead to temporary destruction of SRE habitats or more lasting degradation of natural vegetation if, for example, fire frequency is increased (Williams 2002). In particular, movement of vehicles, machinery and human influences have the potential to increase the frequency of spot fires. Fire within the project area, assuming it is prevented from spreading, may cause a localised loss of SRE species.

## Potential Impacts to SRE Habitats

Four habitat types were assessed for SRE species including:

- Calcrete;
- Calcrete Outwash;
- Hardpan Mulga; and
- Mixed Shrubs over Spinifex Sandplain.

There was no significant difference between SRE communities in these habitats in relation to species richness and abundance although three species show a preference for habitat type including *Aname* 'MYG170' (Calcrete), *Platyarthridae/Bathytropidae* (Calcrete Outwash) and *Urodacus* 'yeelirrie' (Hardpan Mulga). Other species did not show a habitat preference because of the low number of specimens collected.

The percentage of direct impact through vegetation clearing associated with each of the habitat types and the SRE species found in habitat is provided in Table 2.

**Table 2 – Percentage of Habitat Types Predicted to be Impacted by Vegetation Clearing**

Habitat Type	SRE Species Collected	Total Area within Project Area (ha)	Estimated Area to be Impacted by Vegetation Clearing (within project footprint) (ha)	Percentage of Habitat to be Impacted (%)
Calcrete	<i>Aname</i> 'MYG170' <i>Cubaris</i> sp 1 <i>Kwonkan</i> 'MYG172' Platyarthridae/Bathytropidae <i>Urodacus</i> 'yeelirrie'	2,819	467	16.6
Calcrete Outwash	<i>Aname</i> 'MYG170' <i>Aname</i> 'MYG212' Barychelidae Cheiridiidae Platyarthridae/Bathytropidae <i>Pseudolaureola</i> sp. <i>Urodacus</i> 'yeelirrie'	3,095	615	19.9
Hardpan Mulga	<i>Aganippe</i> sp. <i>Aname</i> 'MYG170' <i>Cubaris</i> sp 2 Geophilida <i>Kwonkan</i> 'MYG171' <i>Kwonkan</i> 'MYG210' <i>Kwonkan</i> 'MYG211' Platyarthridae/Bathytropidae <i>Urodacus</i> 'yeelirrie'	21,230	835	3.9
Mixed Shrubs over Spinifex Sandplains	<i>Aname</i> 'MYG212' <i>Cubaris</i> sp 2 <i>Idiosoma</i> sp.	69,839	1,431	2.0

### Calcrete

The Calcrete habitat recorded the highest specimen abundance with 27 recorded specimens. This habitat contained five SRE species including *Aname* 'MYG170', *Cubaris* sp. 1, *Kwonkan* 'MYG172' Platyarthridae/Bathytropidae and *Urodacus* 'yeelirrie'). *Cubaris* sp. 1 and *Kwonkan* 'MYG172' have only been collected from this habitat type; however, they were only collected as single specimens and may be present elsewhere. Although *Aname* 'MYG170' was collected from other habitat types, it showed a statistically significant preference for this habitat type. Approximately 16.6 % of this habitat type is within the project footprint.

### Calcrete Outwash

Seven SRE species were found in the Calcrete Outwash habitat including *Aname* 'MYG170', *Aname* 'MYG212', Barychelidae, Cheiridiidae, Platyarthridae/Bathytropidae, *Pseudolaureola* sp. and *Urodacus* 'yeelirrie'. Of these Barychelidae, Cheiridiidae and *Pseudolaureola* sp. were collected only within this habitat although, once again, they were collected as single specimens and may be present elsewhere. Platyarthridae/Bathytropidae showed a statistically significant preference for this habitat type although it was collected in other habitats. Approximately 19.9 % of this habitat type occurs within the project footprint.

### Hardpan Mulga

The Hardpan Mulga habitat recorded the highest SRE species richness of the communities with nine species being collected within this habitat type (*Aganippe* sp., *Aname* 'MYG170', *Cubaris* sp. 2, Geophilida, *Kwonkan* 'MYG171', *Kwonkan* 'MYG210', *Kwonkan* 'MYG211', Platyarthridae/Bathytropidae and *Urodacus* 'yeelirrie'). Of these *Aganippe* sp., Geophilida, *Kwonkan* 'MYG171', *Kwonkan* 'MYG210' and *Kwonkan* 'MYG211' were only collected from this habitat type. Although collected from other habitat types, *Urodacus* 'yeelirrie' showed a statistically significant preference for the Hardpan Mulga. Only 3.9 % of this habitat type is within the project footprint.

### Mixed Shrubs over Spinifex Sandplains

The Mixed Shrubs over Spinifex Sandplains showed the least SRE species diversity and abundance. Three species (*Aname* 'MYG212', *Cubaris* sp. 2 and *Idiosoma* sp.) were found in this habitat type and only *Idiosoma* sp. was found unique to this habitat. Approximately 2 % of habitat type is expected to be cleared as a result of the project footprint.

## Potential Impacts to SRE Species

A total of 17 SRE or potential SRE species were collected during the SRE surveys of Yeelirrie. These include nine species of Mygalomorph spider, one scorpion species, one pseudoscorpion species, four isopod species, one species of centipede and one tiger beetle species (*ecologia* 2010). A summary of these results is provided in Table 3 and Table 4 and a more detailed impact analysis for each species is described below.

Each species was assigned an impact ranking based on the criteria defined in Chapter 7 of the ERMP (see Table 7.1). Species that were found to have a statistically significant preference for habitat type were analysed separately to species with unknown habitat preference. Many species were collected in very low numbers and therefore it is not possible to accurately assign an impact ranking. However, for the purpose of the impact assessment, these species have been identified with a note 'insufficient data' and have been categorised using the same % habitat loss impact ranking.

**Table 3 – Predicted Impacts for Species with Statistically Significant Habitat Preference**

Species	Collected Outside the Project Footprint (Y/N)	Habitat Outside the Project Footprint (Y/N)	Preferred Habitat	Potential Impacts to Species at Known Locations				Impact Ranking <sup>1</sup>
				Direct	Indirect			
				Habitat Clearing	Ponding	Drying	Dust Deposition	
<i>Aname</i> 'MYG170'	No	Yes	Calcrete	✓	✓	-	✓	Low
Platyarthridae/Bathytropidae	No	Yes	Calcrete Outwash	✓	✓	-	✓	Moderate
<i>Urodacus</i> 'yeelirrie'	Yes	Yes	Hardpan Mulga	✓	-	✓	✓	Low

<sup>1</sup> As per Table 7.1 of the ERMP (Chapter 7, Impact and Risk Assessment Approach)

**Table 4 – Predicted Impacts for Species with Unknown Habitat Preference**

Species	Collected Outside the Project Footprint (Y/N)	Habitat Outside the Project Footprint (Y/N)	Habitat	Potential Impacts to Species at Known Locations				Impact Ranking <sup>1</sup>
				Direct	Indirect			
				Habitat Clearing	Ponding	Drying	Dust Deposition	
<i>Aganippe</i> sp.	Yes	Yes	Hardpan Mulga	-	-	-	✓	Negligible
<i>Aname</i> 'MYG212'	Yes	Yes	Calcrete Outwash Mixed Shrubs over Spinifex Sandplains	✓	-	✓	✓	Low
Barychelidae	No	Yes	Calcrete Outwash	✓	-	-	✓	Insufficient Data (Moderate) <sup>3</sup>
Cheiridiidae	No	Yes	Calcrete Outwash	✓	✓	-	✓	Insufficient Data (Moderate) <sup>3</sup>
<i>Cubaris</i> sp. 1	No	Yes	Calcrete	✓	-	-	✓	Insufficient Data (Low) <sup>2</sup>
<i>Cubaris</i> sp. 2	Yes	Yes	Hardpan Mulga Mixed Shrubs over Spinifex Sandplains	-	-	-	✓	Negligible
Geophilida	No	Yes	Hardpan Mulga	✓	✓	-	✓	Insufficient Data (Low) <sup>2</sup>
<i>Idiosoma</i> sp.	Yes	Yes	Mixed Shrubs over Spinifex Sandplains	-	-	-	✓	Negligible
<i>Kwonkan</i> 'MYG171'	No	Yes	Hardpan Mulga	✓	✓	-	✓	Insufficient Data (Low) <sup>2</sup>
<i>Kwonkan</i> 'MYG172'	No	Yes	Calcrete	✓	✓	-	✓	Insufficient Data (Low) <sup>2</sup>
<i>Kwonkan</i> 'MYG210'	Yes	Yes	Hardpan Mulga	-	-	-	✓	Negligible
<i>Kwonkan</i> 'MYG211'	Yes	Yes	Hardpan Mulga	-	-	-	✓	Negligible
<i>Pseudolaureola</i> sp.	No	Yes	Calcrete Outwash	✓	✓	-	✓	Insufficient Data (Moderate) <sup>2</sup>
<i>Pseudotetracha helmsi</i>	Yes	Yes	Yeelirrie Playa	-	-	-	-	Negligible

<sup>1</sup> As per Table 7.1 of the ERMP (Chapter 7, Impact and Risk Assessment Approach)

<sup>2</sup> Low collection numbers and poor habitat correlation result in the inability to accurately determine the level of impact, however, given that it is reasonable to expect other individuals of these species to occur in the same habitat, species recorded from habitat types with good habitat connectivity to outside the project footprint and <30% habitat clearance would have a 'Low' impact

<sup>3</sup> Low collection numbers and poor habitat correlation result in the inability to accurately determine the level of impact, however, although <30% habitat clearance is expected for Calcrete Outwash habitat, habitat connectivity between inside and outside the project footprint is poor and therefore species only occurring within this habitat are assigned 'Moderate' impact

#### *Aganippe* sp.

*Aganippe* sp. was collected from within the prospective Wellfield area and is considered to be located outside the project footprint. This species was collected from the Hardpan Mulga habitat and the site where it was found is expected to only be indirectly impacted by dust from potential nearby activities.

Impact Ranking: Negligible

#### *Aname* 'MYG170'

*Aname* 'MYG170' was collected from seven sites within three habitat types (Calcrete, Calcrete Outwash and Hardpan Mulga), however this species demonstrated a preference for the Calcrete habitat. The proposed percentage habitat clearance to the Calcrete habitat type is 16.6 % and some of the sites where this species was found may also be indirectly impacted by dust deposition and surface ponding. This species has not been collected outside the project footprint.

Impact Ranking: Low

#### *Aname* 'MYG212'

*Aname* 'MYG212' was collected both within the project footprint and the prospective Wellfield area. It was located in two diverse habitats – Calcrete Outwash and Mixed Shrubs over Spinifex Sandplains and the combined percentage impact is estimated at 3 %. As the species has been collected outside the impact area and percentage impact is estimated at 3 %, the impact is considered to be low.

Impact Ranking: Low

#### Barychelidae

A single Barychelid specimen was collected at a site in Calcrete Outwash habitat. Spiders of the family Barychelidae are known from across Western Australia including the Pilbara, Midwest and Great Victoria Desert, however many species are known to have restricted distribution (Raven 1994). The specimen collected at Yeelirrie was juvenile and could not be identified to genus and therefore the SRE status is unknown. The precautionary principle was adhered to and the species is considered a potential SRE.

The proposed percentage clearance of the Calcrete Outwash habitat is 19.9 % however habitat connectivity between areas inside and outside the project footprint is poor. The site where this species was collected would be directly impacted by habitat clearing and indirectly impacted through dust deposition. This species has not been collected outside the project footprint, however the habitat exists outside the project footprint and indirect impacts to these areas is low.

Impact Ranking: Moderate

#### Cheiridiidae

A single Cheiridiid pseudoscorpion was collected from site T18 within Calcrete Outwash habitat. The proposed percentage clearance of this habitat is 19.9 % however habitat connectivity between areas inside and outside the project footprint is poor. The site where this species was collected would be directly impacted by habitat clearing and indirectly impacted through dust deposition. This species has not been collected outside the project footprint, however the habitat exists outside the project footprint and indirect impacts to these areas is low.

Impact Ranking: Moderate



### Cubaris sp. 1

A single specimen of *Cubaris* sp. 1 was collected from site T07 in Calcrete habitat, of which 16.6 % is proposed to be cleared by the Proposed Yeelirrie Development. This species has not been collected outside the project footprint, however the habitat extends outside the project footprint.

Impact Ranking: Low

### Cubaris sp. 2

*Cubaris* sp. 2 was collected at four sites outside the project footprint including one site within a prospective Wellfield. These sites were located in Hardpan Mulga and Mixed Shrubs over Spinifex Sandplain habitats and the proposed percentage vegetation clearance is only 3 %. These sites would be indirectly impacted by dust caused by vehicle traffic. Potential activities within the prospective Wellfield may also indirectly impact the fourth site if unmitigated.

Impact Ranking: Negligible

### Geophilida

Geophilid centipedes were collected at two sites (F25 and T11) within Hardpan Mulga habitat. The proposed clearing of this habitat is 3.9 %. Both of these sites are located within the project footprint and would be directly impacted by vegetation clearing. This species has not been collected outside the project footprint, however this habitat extends outside the project footprint.

Impact Ranking: Low

### Idiosoma sp.

A total of 15 *Idiosoma* sp. burrows have been found within the project area. These were found in Mixed Shrubs over Spinifex Sandplains, of which only 2 % is proposed to be cleared. This species has only been found outside the project footprint and some sites may be indirectly impacted by dust from vehicle movement. As this species appears to exist in very low numbers the impact is considered to be minor.

Risk Ranking: Negligible

### Kwonkan 'MYG171'

A single specimen of *Kwonkan* 'MYG171' was collected site T11 within the Hardpan Mulga habitat. This community is proposed to be only 3.9 % cleared, however site T11 would be directly impacted by vegetation clearing. This species has not been collected outside the project footprint however the Hardpan Mulga habitat extends outside the project footprint.

Impact Ranking: Low

### Kwonkan 'MYG172'

Two specimens of *Kwonkan* 'MYG172' were collected during the survey with one specimen collected from Calcrete habitat (16.6 % proposed clearance) and one specimen from Playa B. Both of these sites would be directly impacted either through vegetation clearing or surface water ponding (Playa B is naturally seasonally inundated). As the sites where *K.* 'MYG172' were found represent very different habitats, this may indicate that the species is found in other areas. Both Calcrete habitat and playa landscapes occur elsewhere outside the project footprint.

Impact Ranking: Low

#### Kwonkan 'MYG210'

*Kwonkan 'MYG210'* was collected from within the prospective Wellfield survey and is considered to be located outside the project footprint. This species was collected from the Hardpan Mulga habitat and the site where it was found is expected to only be indirectly impacted by dust from vehicle movement associated with Wellfield activities.

Impact Ranking: Negligible

#### Kwonkan 'MYG211'

*Kwonkan 'MYG211'* was collected from within the prospective Wellfield survey and is considered to be located outside the project footprint. This species was collected from the Hardpan Mulga habitat and the site where it was found is expected to only be indirectly impacted by dust from vehicle movement associated with Wellfield activities.

Impact Ranking: Negligible

#### Platyarthridae/Bathytropidae

Isopods from the family Platyarthridae/Bathytropidae were found at seven sites within the project footprint. The species collected at Yeelirrie has unusual morphology for isopods of this area and species with similar morphology are known to be SREs (Judd 2010).

This species was collected within Calcrete, Calcrete Outwash and Hardpan Mulga habitats however, it demonstrated a preference for the Calcrete Outwash habitat. The proposed percentage clearance of this habitat is 19.9 % however habitat connectivity between areas inside and outside the project footprint is poor. All sites where this species has been collected would be directly impacted from vegetation clearing, however all of the habitats where the species was collected exist beyond the project footprint.

Impact Ranking: Moderate

#### *Pseudolaureola* sp.

One specimen of *Pseudolaureola* sp. was collected from Yeelirrie within the project footprint. Species of this genus are more common in the wetter areas of the south-west and all species are known to be SREs (Judd 2010).

This species was collected within the Calcrete Outwash habitat and would be directly impacted by habitat clearing. The proposed percentage clearance of this habitat is 19.9 % however habitat connectivity between areas inside and outside the project footprint is poor. The Calcrete Outwash habitat exists beyond the project footprint so there is the potential for this species to be found in areas that would not be impacted.

Impact Ranking: Moderate

#### *Pseudotetracha helmsi*

*Pseudotetracha helmsi* was collected from three sites within the Yeelirrie Playa (located outside the project area) and is restricted in distribution even within connected areas of the playa. The Yeelirrie Playa population represents a new discovered population of this species.

The restricted distribution of the Yeelirrie Playa population may be caused by the tracks that run through the playa, preventing the beetles from moving to other areas. Field observations (sites 3, 5, 6, 7 and 10) indicate that disturbance from the nearby road may inhibit the species habitat selection as species were not found in these areas. According to Cassola *et al.* (2000) small disturbances and disruption of occupied habitats may eliminate tiger beetle populations making it difficult for the species to recover from population declines.

As the Yeelirrie Playa is outside the project area, and approximately 30 km southeast of the project footprint, disturbances caused by the proposed Yeelirrie Development are expected to be minor.

Impact Ranking: Negligible

*Urodacus 'yeelirrie'*

*Urodacus 'yeelirrie'* was collected from 10 sites within three habitat types (Hardpan Mulga, Calcrete and Calcrete Outwash), however this species demonstrated a preference for the Hardpan Mulga habitat. The total proposed percentage clearing of these habitats is only 7 %. Four of the sites where this species was collected are proposed to be cleared and all of the sites are expected to be indirectly impacted by dust either from the mine or vehicle traffic. Based on the distances between collection sites and the variety of habitats where this species was found, it is considered likely that this species is widely distributed within the project area and its surrounds.

Impact Ranking: Low

Best regards,  
Dr Lazaro Roque-Albelo  
*Principal Zoologist*

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