TIORIR '11	INTEGRISANI MEĐUNARODNI SIMPOZIJUM – ISTI, ORRE i IRSE *INTEGRATED INTERNATIONAL SYMPOSIUM – ISTI, ORRE i IRSE* **September 11 – 15, 2011., Zlatibor, Hotel Mona**

VISUAL IMPACT ASSESSMENT ON SURFACE MINES AND MEASURES OF MANAGING-NEW STEP TO SUSTAINABLE DEVELOPMENT OF MINING

VIZUELNA PROCENA UTICAJA POVRŠINSKIH KOPOVA I MERE UPRAVLJANJA-NOVI KORAK ODRŽIVOG RAZVOJA RUDARSTVA

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Abstract: *Visual resources or natural landscapes are special category of natural resources which are under extremely adverse impact on industrial development. It is specifically expressed in surface exploitation of mineral resources, occupy large areas and have expressed visibility. Mining operations should prevent and minimize negative visual impacts through consultation with local communities about potential post-closure land use, incorporating visual impact assessment into the mine reclamation process.*

The primary function of the visual impact assessment is to identify key views of which will be visible mining operation; to assess the sensitivity of these critical views; to assess the impact of visibility; to modify the design of trench in such a way to reduce potential impact to a minimum. Mitigation measures may include strategic placement of screening materials including trees and use of appropriate plant species in the reclamation phase as well as modification in the placement of ancillary facilities and access roads.

Key words*: landscape, resource, visual impact assessment, sustainable development, open pit, mitigation, recultivation*

Abstrakt: *Vizuelni resursi ili prirodni pejsaži su posebna kategorija na prirodnih resursa koji su pod izuzetno negativan uticaj industrijskog razvoja. To je posebno izraženo u površinskoj eksploataciji mineralnih sirovina, zauzimaju velike površine i imaju izrazitu vidljivost. Rudarskih operacija treba da spreči i smanjiti negativni vizuelni uticaj kroz konsultacije sa lokalnim zajednicima o potencijalnim korišćenje zemljišta, uključujući vizuelne procene uticaja rudnika u proces na reklamacija.*

Osnovna funkcija procena vizuelnih uticaja je da identifikuje ključne stavove koje će biti vidljiv rudnik, da proceni osetljivost ovih kritičnih stavova; da izmeni dizajn na površinkog kopa na takav način da se smanji potencijalni uticaja na minimum. Mere za ublažavanje uticaja mogu obuhvatiti strateški plasman skrininga materijala, uključijući drveče i upotrebu odgovarajučih biljnih vrsta u fazi melioracije, kao i modifikaciju u plasmanu pomočnih objekata i prilaznih puteva.

Klučne reči: *pejsaž, resurs, vizuelna procena uticaja, održivi razvoj, površinski kop, ublažavanje, rekultivacije*

1. INTRODUCTION

Negative visual effects, especially for quarries near urban areas, major transportation routes and tourist and recreational zones, is often expressed a limiting factor for realization of new projects, and development who has already started. Generally, the assessment of the visual impact of the proposed mining operation encompasses three types of questions: spatial, quantitative and qualitative. The spatial issue involves where the operation is seen or specifically where or who is watching. Quantitative questions include how of the operation is seen, how of the surrounding area is affected and to what degree. Qualitative questions cover the visual character of the operation and its compatibility with the environment. For some topics, such as water or air quality, it is possible to use measurable, technical international or national guidelines or legislative standards, against which potential effects can be assessed. The assessment of likely effects on a landscape resource and on visual amenity is more complex, since it is determined through a combination of quantitative and qualitative evaluations.

Landscape impact assessment, in common with any assessment of environmental effects, includes a combination of objective and subjective judgements, and it is therefore important that a structured and consistent approach is used. The aim of this paper is to develop a methodology for managing visual resources and to assess the visual impact of the whole surface mines. The visual impact assessment will identify and illustrate the changes to the visual component of the landscape experience and help to suggest appropriate mitigation measures to be integrated in to the design process. The first step is to identify the viewshed or Zone of Visual Influence of the development (sometimes called the Zone of Theoretical Visibility ZTV). This is usually established by computer software from a digital model of the terrain. Next, the key viewpoints from which the proposed change will be experienced are agreed. Their selection will be influenced primary by the most important and most sensitive visual receptors within the viewshed emphasis is given to highly frequented viewpoints, designated sites and culturally significant views: they will also relate to the landscape character areas identified as part of the project- specific landscape assessment. These visualizations are then used to identify adverse impacts, and the design refined to minimize them. The final steps in the assessment will be to describe and evaluate the remaining impacts which are considered to be significant, and incorporate mitigation measures to address them. The most common form of mitigation is to screen views by planting trees or wood lands; this is far from being universally appropriate.

2. EVALUATION OF THE VISUAL RESOURCE

Aesthetic and visual analyses are complex, as they deal with human reaction to changes in the landscape. In order to gain insight into the complexity of the Visual Resource, one needs to distinguish between that which is perceived (Visibility Criteria) from that which is perceiving (Viewing Criteria). Visibility Criteria evaluate the stimuli created by the physical environment. The criteria include the following:

2.1 Visual exposure:

The exposed object will create a viewshed. The viewshed contains all possible observation sites which would experience views of the introduced object (the proposed surface mine). The level of exposure depends on object elevation, on topography, on distance and on the presence of screening. The resulting observation sites generated through computer aided modelling are benchmarked against the indicators in table 1. These indicators have been developed in order to rate the different levels of visual exposure. Exposure is mapped in zones (corresponding to the indicators) for ease of use, although it can also be mapped as a gradient. One needs to bear in mind that visual impact diminishes exponentially as the viewing distance increases and that the bracketing of the indicators has been structured accordingly.

Table 1 Visual Exposure Indicators

Visual Exposure Indicators	Exposure Rating
Object is clearly noticeable: close proximity, large vertical variance and no vertical screening. The viewing distance is up to 100m.	Very High
Object is clearly recognizable. The viewing distance is up to 400m	High
Object is recognizable. The viewing distance is up to 2km.	Moderate
Object is barely noticeable and may not necessarily be recognizable. The viewing distance is up to 5km.	Low
Object is almost not visible: this defines the boundary region after which the object would no longer be visible. The viewing distance is 10km.	Very low

2.2 Visual Quality:

When the various environmental stimuli relate to one another and support a common theme, then a space can be referred to as having a distinctive visual quality or a strong sense of place. Spaces with a strong sense of place often involve scenic views and can usually be recalled over long periods of time. Visual

Quality Indicators have been developed for different landscapes (table 2), which in turn can be mapped as different zones.

Table 2 Visual Quality Indicators

Visual Quality Indicators	Quality Rating
The landscape represents spectacular views with a unique and harmonious visual pattern. There is a distinct absence of man-made structures.	Very high
The landscape represents spectacular views. Some infrastructure is present, yet it blends into and / or is appropriate to the landscape.	High
The landscape is relatively scenic, yet not unique.	Moderate
The landscape is void of scenic views and is encroached by visual intrusive elements.	Low
Landscape is dominated by intrusive elements and visual cluttering (industrial areas, etc)	Very low

2.3 Visual Value:

Once a landscape has obtained a value status for scenic, cultural, ecological, design, historical or other motives, it may be elevated as having visual value. Landscapes which are rare or threatened are generally valued more highly. Visual Value Indicators have been developed for different landscapes (table 3), which in turn can be mapped as different zones.

Table 3 Visual Value Indicators

Visual Value Indicators	Value Rating
The landscape has an important and designated value status, which relies to a large degree on visual aspects. It is a significant iconic structure and acts as a landmark and / or as a visual cue.	Very high
The landscape is recognized and considered to be of particular importance to conserve. It is an iconic structure and acts as a visual cue.	High
The landscape is a recognized visual resource which contributes towards it having received an elevated and designated status.	Moderate
Value may be attached to the landscape by some people, although there is no broad recognition for this.	Low
No values related to visual aspects can be attributed to the landscape. There are no landmarks.	Very low

Viewing Criteria qualify the context upon which the visual stimuli have an effect. Important is to evaluate the introduced object (i.e. the potential impact) against the Visual Receptor and the location from where the introduced object would be experienced (Representative Viewpoints). The Viewing Criteria include the following:

2.4 Visual Receptor:

Viewers, also referred to as Visual Receptor, perceive, experience and value the visual environment differently. Some viewers may regard objects introduced into the landscape as intrusive or even visually obtrusive, whereas others may not. Viewers have been grouped according to their similarity. The resulting groups are motorists, tourists, residents and workers, who would inherently have different levels of sensitivity towards a particular visual intrusion. Visual Receptor Indicators have been developed for different viewer groups (table 4). According to their geographic whereabouts, these groups have been mapped as different zones.

Table 4 Visual Receptor Indicators

Visual Receptor Indicators	Sensitivity Rating
Tourists focus their attention towards their destination. They would have expectations and place importance on the destination landscape. The enjoyment of a particular landscape may be the reason for choosing it as a destination in the first place.	Very high
Residents generally place a high value on their surroundings and would be permanently affected by a change in the visual landscape.	High
Staff may also be permanently confronted with a change in the visual landscape. However, the interest in the workplace surroundings wouldn't necessarily be as strong as in the context of living and home.	Moderate
Road users tend to focus on the road rather than on the objects within the landscape. The visual experience would be fleeting. When traveling at high speeds, objects such as power lines tend to go past unnoticed. (If motorists also fall in one of the other indicator categories, then they would be covered there.)	Low
Groups of people who do not move through the area.	Very low

2.5 Representative Viewpoints:

Visual intrusions can be viewed from almost any location. The importance, however, lies in capturing the Visual Receptor's typical and significant views of the introduced object (the proposed open pit). Representative Viewpoints therefore epitomize views experienced by the majority of people residing, visiting, working or moving through the study area. Representative Viewpoint Indicators have been developed and mapped accordingly as different zones.

Table 5 Representative Viewpoint Indicators

Representative Viewpoint Indicators	Sensitivity Rating
Viewpoints towards views which will definitely be experienced by the majority of receptors for a distinct duration.	Very high
Viewpoints towards views which will very likely be experienced by the majority of receptors.	High
Viewpoints towards views which may be experienced by the some of the receptors.	Moderate
Viewpoints towards views which the minority of receptors may experience.	Low
Viewpoints towards views which will probably never be experienced.	Very low

In this paper the methodology of assessment includes observation, identification of sensitive receivers and effects, description and quantification of changes in base and evaluation of the anticipated effects, together with the criteria that are used and what measures should be taken to avoid, reduce or offset the negative effects .

Open pit mine which will be discussed in this paper is on the western part of mountain Vodno, or in the immediate area of Skopje. Near the pit is a village.

3. VISIBILITY CRITERIA

3.1 Visual exposure

The area which can be seen from a certain place is mapped using a geographic-based 3D modeling tools. In order to simplify exposure reduced the visibility of objects given the rank categories (Table 6 and 7).

Table 6 Visual exposure zones

Visual exposure zones	Exposure Rating
Zone 1:100m	Very high
Zone2:400m	High
Zone3:2 km	Moderate

Table 7 Visual quality zones

Visual quality zones	Quality Rating
Zone 1:North	Moderate
Zone 2:South	Moderate

3.2 Visual value

The region is known for its nature, mountains, and wild.

4. VIEWING CRITERIA

4.1 Visual receptors

Near the pit is a village with a few hundred residents. There are two different visual recipients: the local population and visitors (Table 8). Visitors are trying to direct their attention to their surroundings, because they want to join in that. Also among, sensitivity for the local population is high because there windows are overlooking to the site of development, in the case of open pit.

Table 8 Visual receptor zones

Visual Receptor Zones	Sensitivity
Zone 1: Tourist	Very High
Zone 2: Local people	High

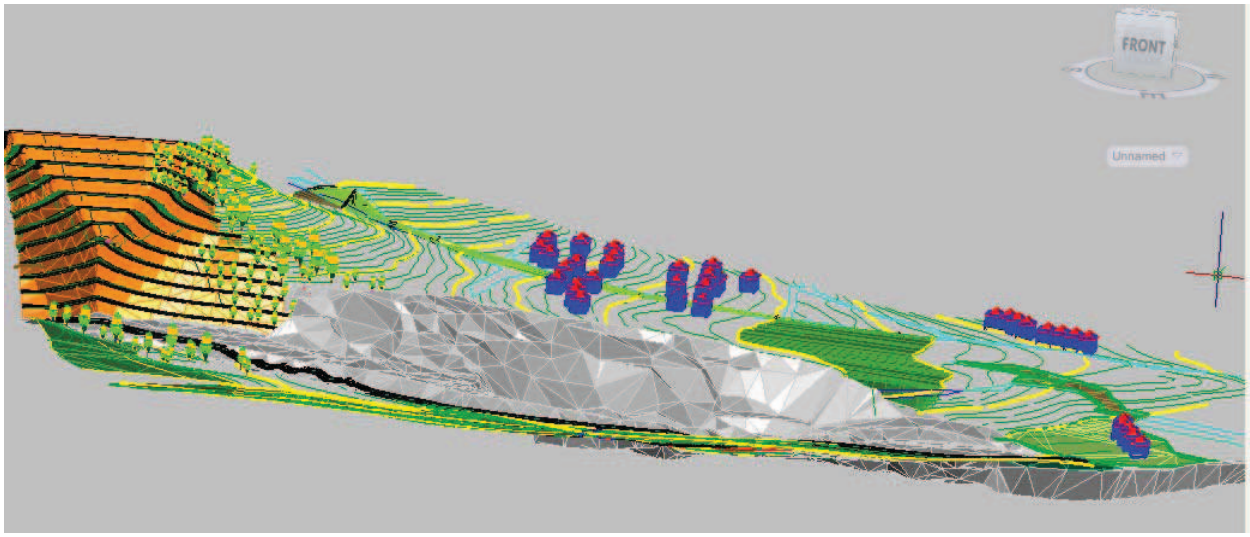

Figure 1 Visual impact from the southeast side-road across open pit
(Visual impact from smaller settlement and Visual impact from larger settlement)

Table 9 Representative viewpoint zones

Representative viewpoint zones	Sensitivity
Zone 1:Regional road	Very high
Zone 2: Smaller settlement	High
Zone 3: Bigger settlement	Low

4.2 Assessing the impact

Receptor sensitivity

It is important to set a common level between different visual recipients and representative views. This common level is classified as an area of the recipient. The complete sensitivity of the receptive zone is determined by the compilation of factors that bind to receptors as category and geographical location of the visual receptor (Table 10).

Table 10 Receptor Sensitivity

Receptor Sensitivity			
Receptor Zone	Representative Viewpoints	*Visual receptors*	*Visual sensitivity*
View from road across open pit(regional road)	Very high	High	High
View from the smaller settlement	High	Moderate	Moderate
View from the biggest settlement	Low	Very low	Very low

The views are selected to illustrate the potential worst views of the proposed mine and represent the only location where we can preserve the views of mine. The visual impact along the regional road will be very high for observers in vehicles because their attention is increased when they cross despite open pit. The visual impact of the smaller settlement is classified as a high influence because they have direct views from the windows of their residential properties to the pit. Finally, the assessment of the visual impact of a larger settlement is low or very low because of this side open pit is not seen. The assessment of visual impact can assist in avoiding or minimizing the negative effects of the development of open pit and thus a way to protection environmental.

5. MEASURES OF PROTECT

The perception of surface mines is always negative, due to large negative environmental impacts, lack of sanitation and illegal use so they are often perceived as devastation. The purpose of mitigation is to avoid, reduce and where possible remedy or offset, any significant negative (adverse) effects on the environment arising from the proposed development. Mitigation measures are generally more effective if they are designed as an integral part of an iterative process of project planning and design. The *ideal* strategy for each identifiable negative effect is one of avoidance. If this is not possible, alternative strategies of reduction, remediation and compensation may each be explored. If the consideration of mitigation measures for negative landscape or visual effects is left to the later stages of scheme design, this can result in increased mitigation costs, because early opportunities for avoidance of negative effects are missed. The proposed open pit mine is protected primarily from the view of nearby receptors due to the natural topography. The planting of seedlings will create a forest area which will conceal the view to the pit and the proposed measures to protect pit will not be visible and will have extremely limited visibility.

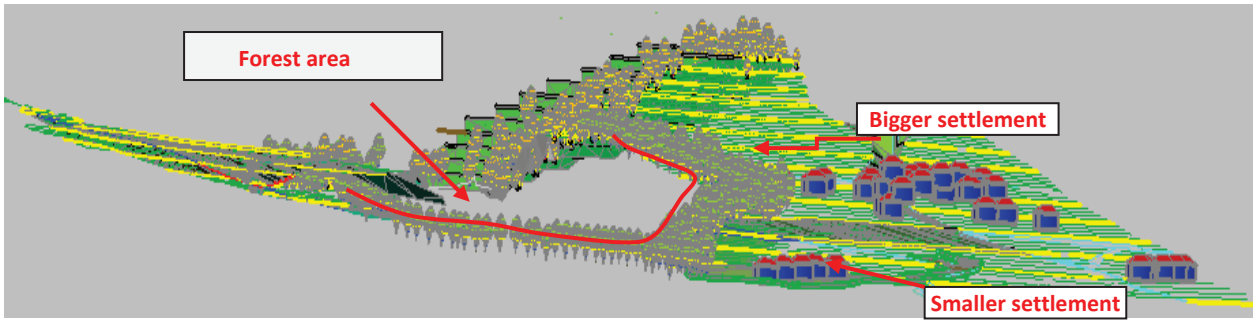

Table 11 Table Impact severity

Impact Severity					
Receptor Zone	Visual Exposure	Visual Discord	Visual Quality	Visual Value	Impact Severity
View from the regional road	Moderate	Moderate	Moderate	Moderate	Severe
View from the smaller settlement	Moderate	Moderate	Moderate	Moderate	Severe
View from the bigger settlement	Moderate	None	Low	Little	Slight to no effect.

6. CONCLUSION

The results of the assessment are presented by giving a short description of the existing view from each perspective, followed by a description of changes in the view of the landscape as well as analysis of the size and nature of effects. With the planting of seedlings will be create a forest area which will conceal the view to pit and proposed measures to protect pit will not be visible and will have extremely limited visibility. The assessment in this case helped in avoiding or minimizing the negative effects of the development, and thus finds a way to improve the visual view of the local population to the pit. In market economic conditions mining experts cannot allow their own dehumanization, not leaving behind a huge hill of waste and fields with no life and vegetation, but must fight for such a technological process that will be in function of overall socio - economic and environmental efforts. Project arrangement of the landscape need to be developed simultaneously with the major mining project, and it makes mining engineer together in collaboration with biologist and geologist. With the eventual entry to the European Union, mining companies will have to respect environment all standards and legislation regulative to the environment, thus residents of mining areas will be protected from existing sources of pollution in the process of exploitation. The process of production and measures of environmental protection are implemented and controlled in accordance with the procedures of ISO 9001 and ISO 14001.

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