# Preliminary Guidance document for Authorisation and Licensing of Sand Mining / Gravel Extraction, in terms of Impacts on Instream and Riparian Habitats

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## 1. Introduction

Mining is of great importance to the South African economy. It should however be recognised that the processes of prospecting, extracting, concentrating, refining and transporting minerals have great potential for disrupting the natural environment (Rabie *et al*., 1994). The environmental effects caused by the mining of sand from a river, is no exception, often causing adverse impacts to biota and their habitats.

The Department considers fresh water aquatic ecosystems to be "the base from which the [water] resource is derived" (DWAF, 1994). Because we depend on many services provided by healthy aquatic ecosystems, these ecosystems, as the resource base, must be effectively protected and managed to ensure that our water resources remain fit for the different water uses on a sustained basis (DWAF, 1996). The establishment of the Ecological Reserve is an important step in this direction since, under previous legislation, there was only limited provision to reserve a quantity of water for environmental protection purposes (DWAF, 1997).

As stated in the White Paper on a National Water Policy for South Africa (1997), effective resource protection requires two separate sets of measures. The first are resource-directed measures, which set clear objectives for the desired level of protection for each resource. The second are source-directed controls which aim to control what is done to the water resource - by way of registration of sources of impact, standards for waste discharges, best management practices, permits and impact assessments - so that the resource protection objectives are achieved.

Damage to resources, other than pollution such as habitat destruction, will be controlled by means of regulatory measures which will be introduced where appropriate (DWAF, 1997).

The objective of this document is to:

- obtain an increased understanding of the potential impacts of sand mining and gravel extraction operations on the instream and riparian habitats of streams, rivers and lotic wetlands, and

- to provide guidelines for evaluation of potential impact.

The recommendations made in this document are intended as guidance for decision-makers who are specifically involved in the review of sand mining and gravel extraction projects to:

- make more informed decisions when issuing a water use authorisation under the Water Act provisions; and

- ensure that these operations are conducted in a manner that eliminates and minimises to the greatest extent possible, any adverse impacts on both the instream and riparian components of aquatic ecosystems, including habitat and biota.

This document further intends to complement existing documentation of the Department of Minerals and Energy Affairs to ensure adequate protection of aquatic ecosystems in line with the Water Act and resource quality objectives, namely:

- Standard Environmental Management Programme for The Mining of Sand from a River, Stream, Dam or Pan (DMEA, 1998).
- Aide-Memoire for the preparation of Environmental Management Programme Reports for Prospecting and Mining (DMEA, 1992).

## 2. Impacts of sand mining / gravel EXTRACTION on riverine habitats AND BIOTA

Extraction of alluvial material from within or near a streambed has a direct impact on the stream's physical habitat characteristics. These characteristics include channel geometry, bed elevation, substrate composition and stability, instream roughness elements (large woody debris, boulders, etc.) depth, velocity, turbidity, sediment transport, stream discharge and temperature. Altering these habitat characteristics can have deleterious impacts on both instream biota and the associated riparian habitat.

The detrimental effects to biota resulting from bed material mining are caused by three main processes: (1) alteration of the flow patterns resulting from modification of the river bed, (2) an excess of suspended sediment and (3) damage to riparian vegetation and instream habitat. The disturbance activities can also disrupt the ecological continuum in many ways. Local channel changes can propagate impacts upstream or downstream and can trigger lateral changes. Alterations of the riparian zone can result in changes in channel conditions that can impact aquatic ecosystems in a similar way as some inchannel activities.

The interconnectedness of channels and riparian systems requires the simultaneous evaluation of potential disruptions of the riparian zone and channel activities. For example, aggregate mining involves the channel and boundary but requires land access and material storage that could adversely affect riparian zones e.g. construction and access roads (NMFS, 1998).

The potential impacts of sand mining and gravel extraction operations on instream and riparian habitat of riverine systems and the subsequent impact on riverine biota are summarised below (Smith & Collis, 1993).

## 2.1 Kinds of sand mining / gravel extraction operations

Many of the methods employed and principles of control in the hard rock quarries are equally applicable in sand and gravel extraction. The major differences lie in the higher rate of land use and the extent of impact, owing to the relatively shallow depths of workings and the need for more immediate environmental control and restoration. Three types of instream sand and gravel mining are addressed, namely dry-pit and wet pit mining in the active channel and bar skimming or "scalping." In addition to instream sand and gravel mining the excavation of pits on the adjacent floodplain or river terraces are also addressed.

### 2.1.1 Dry-pit mining

Dry-pit refers to pits excavated on dry ephemeral streambeds and exposed bars with conventional bulldozers, scrapers and loaders.

### 2.1.2 Wet-pit mining

Wet-pit mining involves the use of a dragline or hydraulic excavator to remove sand or gravel from below the water table or in a perennial stream channel. In wet pits dewatering or partial dewatering is frequently undertaken to allow the site to be more easily excavated. The decision to dewater or not will depend on the deposit thickness, permeability of the sand and gravel, the use of the ground water aquifer and the intended after-use and restoration requirements

### 2.1.3 Bar skimming

Bar skimming or scalping requires scraping off the top layer from a gravel bar without excavating below the summer water level.

### 2.1.4 Pits on the adjacent floodplain or river terraces

Dry pits are located above the water table. Wet pits are below, depending on the elevation of the floodplain or terrace relative to the baseflow water elevation of the

channel. The pits' isolation from an adjacent active channel may be only short term. Sudden changes in channel course during a flood, or in the gradual migration may breach small levees and the channel will shift into the sand or gravel pits. Because floodplain pits can become integrated into the active channel, they should be regarded as instream pits if considered on a time scale of decades.

## 2.2 Impacts of sand mining / gravel extraction on instream and riparian habitat

### 2.2.1 Instream habitat

**a. Extraction of bed material in excess of natural replenishment by upstream transport**

- This causes bed degradation, increases suspended sediment, sediment transport, water turbidity and sand/gravel siltation (USEPA, 1999). Gravel "armours" the bed, stabilising banks and bars, whereas removing this gravel causes excessive scour and sediment movement. High levels of sediment deposition create an unstable and continually changing environment that becomes unsuitable for many aquatic organisms (Wohl & Carline, 1996). The most likely effects of suspended sediments on fish include: reduction in light penetration and of photosynthesis in micro- and macrophytes, resulting in reduced food availability and plant biomass; reduced visibility of pelagic food; reduced availability of benthic food due to smothering; clogging of gillrakers and gill filaments (Bruton, 1985).

- Headcutting, erosion, increased velocities and concentrated flows can occur upstream of the extraction site due to a steepened river gradient. Gravel removal not only impacts the extraction site, but may also reduce gravel delivery to for example downstream fish spawning sites.

**a. Bed degradation changes the morphology of the channel.**

- Sand or gravel extraction causes a diversion or a high potential for diversion of flow through the gravel removal site. Mined areas that show decreased depth of surface flow could result in migration blockages for fish during low flows. When water does not cover much of the streambed, the amount of viable substrate for aquatic organisms is limited. In high-gradient streams, riffles and cobble substrate are exposed; in low gradient streams, the decrease in water level exposes logs and snags, thereby reducing the areas of good habitat. Even if the gravel extraction activity is conducted away from the active river channel during low water periods, substrate stability, channel morphology and channel pattern outside the excavated area's perimeter could be affected during subsequent high water events

- As active channels naturally meander, the channel may migrate into the excavated area. Also, ponded water isolated from the main channel may strand entrapped fish carried there during high water events. Fish in these ponded areas could experience higher temperatures, lower dissolved oxygen, increased predation compared to fish in the main channel, and desiccation as the area dries out (USEPA, 1999).

**b. Operation of heavy equipment in the channel bed**

- Can directly destroy spawning habitat for fish and macroinvertebrate habitat, and produce increased turbidity and suspended sediment downstream (NMFS, 1998).

**c. Altering channel hydraulics**

- Stockpiles and overburden left in the floodplain can alter channel hydraulics during high flows (NMFS, 1998).

**d. Removal or disturbance of instream roughness elements during gravel extraction activities**

- It negatively affects both quality and quantity of instream habitat. Instream roughness elements, particularly large woody debris, play a major role in providing structural integrity to the stream ecosystem. These elements are important in controlling channel morphology and stream hydraulics, in regulating the storage of sediments, gravel and particulate organic matter, and in creating and maintaining habitat diversity and complexity (Roth *et al*., 1996).

### 2.2.2 Riparian habitat

**a. Destruction of the riparian zone**

- The riparian zone includes stream banks, riparian vegetation and vegetative cover. It serves as buffer to pollutants entering a stream from runoff, controls erosion, and provides habitat and nutrient input into the stream (Osborne & Kovacic, 1993; Wohl & Carline, 1996). Destruction of the riparian zone during sand / gravel extraction operations can have multiple deleterious effects on instream habitat. Damaging any one of these elements can cause stream bank destabilisation, resulting in increased erosion, sediment and nutrient inputs, and reduced shading and bank cover leading to increased stream temperatures (Roth *et al*., 1996).

**b. Lowered floodplain groundwater because of lowered level channel water**

- Riparian vegetation reliant on the groundwater will subsequently be stressed and can result in the destruction thereof (NMFS, 1998).

**c. Permanent flooding or ponded water**

- Can occur when gravel/sand is removed to certain depths which will result in long-term loss of riparian vegetation.

- Loss of vegetation also occurs when sand/gravel removal results in a significant shift of the river channel that subsequently causes annual or frequent flooding into the disturbed site (NMFS, 1998).

**d. Destruction of riparian vegetation**

- Caused by heavy equipment, processing plants and gravel stockpiles at or near the extraction site

- Heavy equipment also causes soil compaction, thereby increasing erosion by reducing soil infiltration and causing overland flow (NMFS, 1998).

e. **Disturbing the natural hydraulics of the riparian zone during infrequent elevated flow levels (1 in 3 or 5 year events)**

- Caused by temporary bridges and mounds of soil overburden and sand. In such cases water, with important nutrient and silt loads, may be prevented from being deposited on riparian terraces downstream of the disturbance. This can significantly impact on the recruitment of certain species which are reliant on these events for their long-term persistence on these terraces. In other words a generation of recruitment may be lost causing a gap in the population structure which can be exploited by other species, commonly exotics (Warren & Pardew, 1998).

**f. Removal of large woody debris from the riparian zone**

- It negatively affects the plant community, because large woody debris is important in protecting and enhancing recovering vegetation in streamside areas (Roth *et al*., 1996).

**g. Reduced vegetative bank cover**

- Caused by portions of incised or undercut banks that may be removed during sand/gravel extraction, resulting in reduced shading and increased water temperatures.

- Can also result in rapid bed degradation which may induce bank collapse and erosion by increasing the heights of banks (NMFS, 1998).

**h. Destabilising banks and increased sediment inputs**

- Caused by banks that are scraped to remove "overburden" to reach the gravel below. Overburden is very important in that it contains a rich seed bank and organic content which is vital for germination of seedlings.

### 3. TO ALLOW SAND MINING / GRAVEL EXTRACTION OPERATIONS IN A CERTAIN ECOLOGICAL MANAGEMENT CLASS?

Based on the approach followed in the Water Act (No 36 of 1998), the level of protection of a resource will depend on the ecological management class assigned to the water resource. Criteria for assigning a class to a resource include:

- the sensitivity of a resource to impacts of water use (whether due to ecological sensitivity, or sensitivity of water users);
- the importance of the resource, in ecological, social, cultural or economic terms;
- the value of the resource, again in ecological, social, cultural or economic terms;
- what can be achieved towards improvement of resource quality, given that some past impacts or modifications may not be practically reversible (DWAF, 1999).

Several protocols have been suggested for assigning an ecological management class which will again depend on the reserve method used (planning estimate, preliminary -, comprehensive reserve). At this stage, aquatic resources have not been classified according to a protection based classification system, neither has a comprehensive determination of the ecological importance and sensitivity (in general and in terms of specific forms of water use) of the various aquatic resources been done. It is the eventual and desirable approach that will be developed and followed as soon as all the information requirements have been met and methodologies have been developed. This will be done as the Water Act is implemented, in a phased progressive manner.

Information requirements are likely to include an assessment of the sensitivity of different rivers to particular forms of water use. In the case of sand mining / gravel extraction it means that irrespective of the ecological management class, a river will be assessed based on its sensitivity to this kind of activity. The reason being that an

impact which poses only a slight risk to a particular ecosystem in one geographical region may result in a much higher risk in another geographical region, depending on the resilience of the adapted ecosystem, the background quality of the water, and the natural flow regime.

Once the management class of the river has been decided on, an activity or impact that would change its status to a lower class may not be permitted, particularly if it is in conflict with the requirements of protection of basic human needs and ecological integrity.

### 3.1 Maintaining a river in an ecological management class

In order to determine whether a river will remain in its ecological management class if an activity like sand mining / gravel extraction takes place in a certain type of river at a certain level of intensity, the following needs to be addressed:

- The type of sand mining/gravel extraction operation as well as its intensity and extent.

- The sensitivity of the particular river type in terms of the riparian and instream habitat and biota to sand mining / gravel extraction will further be an important determinant of whether the river remains in its ecological management class. The implication here is that even if the ecological management class of a river is low (i.e. Class D), it may be very sensitive to sand mining / gravel extraction. A river in a high ecological management class (i.e. Class B) on the other hand, may be resilient to sand mining / gravel extraction at a particular scale and intensity of mining due to the characteristics of the physical habitat and the biota in that type of river.

The sensitivity of a particular river to a specific activity, i.e. sand mining / gravel extraction must be established. For this purpose a system will need to be developed to assess the sensitivity of a river to sand mining / gravel extraction.

### 3.2 Determining the sensitivity of a river or section of a river to a specific activity

Based on the results of an assessment which makes use of the procedure indicated in (a) - (e), a conclusion can be made as to the sensitivity of the particular aquatic system to sand mining / gravel extraction. This will provide an indication as to the controls that can be put in place to protect instream and riparian components of the aquatic ecosystem.

The following information requirements are necessary in such a system:

a. Ecoregion typing up to a desired level will be required.

b. Specific information on the geology, i.e. the presence of sand / gravel deposits (can be obtained from 1:250 000 geological maps).
c. Specific information on the catchment and river, such as slopes, hydrology, land cover, land use and erodability (i.e. information that relates to the fluvial geomorphology of the river)
d. A rating system for the ecological importance of the river (from which can be derived the ecological management class).
e. A rating system for the sensitivity of instream and riparian habitats and biota to the effects of sand mining.

Considering that it may take some time before methods for the above are in place, certain interim measures must in the mean while be established for determining the sensitivity of a particular river to sand mining / gravel extraction.

### 3.3 Proposed interim measures for the preliminary assessment of ecologically important and sensitive areas

The following is a proposed interim measure for the preliminary determination of ecological important and sensitive areas. It is further proposed that this interim measure be used until such time that the necessary procedures and methods have been developed and adopted.

The proposed procedure makes use of available published information which will generally indicate the ecological sensitivity of a resource. Due to the possibility that the published information is not necessarily always accurate and not specifically designed for the purpose it will be used for, such an approach can in particular cases be either under-protective or over-protective.

Areas of ecological importance and sensitivity include:

- Catchment areas listed in Schedule 1 of "Water Quality Management Policies and strategies in the RSA" (DWAF, 1991).

- Rivers indicated on the map, "Conservation Status of South African Rivers", as pristine (rivers in which the channel and catchments have not been significantly modified). River sites of outstanding conservation importance as indicated on this map should also be considered in this regard.

- Rivers sites where fish species listed in the "South African Red Data Book - Fishes" (Skelton, 1987) occur.

- All catchments that fall within, or are immediately upstream from a National Park, Nature Reserve, Wilderness Area, Natural Heritage Site or any similarly officially protected area (DEAT, ???).

- Wetlands listed in XXXX be considered as sensitive areas where applications for water use would be subject to licensing (DEAT??).

- Limited development areas. (Section 23 of the Environment Conservation Act, 1989 (Act 73 of 1989).

- Protected natural environments and national heritage sites.

- National, Provincial, municipal and private nature reserves.

It should however be emphasised that situations will exist where the resource may be so important or sensitive that authorisation of a particular activity or impact, may not be a viable option. In such situations, subject to the considerations of Section 27, it may be decided that no activities or operations will be allowed to take place.

## 4. Considerations and conditions when authorising sand mining / gravel extraction operations

In Chapter 4 of the National Water Act (Act 36 of 1998), general principles for regulating water use are set out. The definition of water use is a broad one and includes taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities, altering a water course, removing water found underground for certain purposes, and recreation. Of specific relevance to sand mining / gravel extraction operations, is section 21 (c) and (i): impeding or diverting the flow in a watercourse or altering the bed, banks, course or characteristics of a watercourse. In general a water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a general authorisation, or if a responsible authority waives the need for a license

According to section 29(1) of the Water Act (Act 36 of 1998), a responsible authority may attach conditions to every general authorisation or license.

### 1. Fundamental considerations

The following are fundamental considerations that must always be taken into consideration in all sand mining / gravel extraction operations:

- Abandoned stream channels on terraces and inactive floodplains should be used preferentially to active channels, their deltas and floodplains. Sand/gravel extraction sites should be situated outside the active floodplain and excavation should not take place from below the water table. Dry-pit mining is therefore preferable to other mining methods.

- Streams should not be diverted to form an inactive channel and isolated ponded areas that could cause fish entrapment should be avoided.

- Sand/gravel extraction activities for a single project should be located on the same side of the floodplain to eliminate the need for crossing active channels with heavy equipment.

- Larger rivers and streams should be used preferentially to small rivers and streams. Larger rivers and streams are preferable because they have more sand/gravel with a wider floodplain. The proportionally smaller disturbance in large systems will reduce the overall impact of sand/gravel extraction.

- Braided river systems should be used preferentially to other river systems. Other river channel types, listed in the order of sensitivity to physical changes caused by sand/gravel extraction activities, are: split, meandering, sinuous and straight. Because braided systems are dynamic and channel shifting is a frequent occurrence, theoretically, channel shifting resulting from sand/gravel extraction might have less of an overall impact because it is analogous to a naturally occurring process. Floodplain width progressively decreases in the aforementioned series of river systems and if sand/gravel extraction is to occur in the adjacent floodplain, it is likely that these four system types will experience greater environmental impacts than the braided system.

### 4.2 Standard conditions

Standard conditions that are proposed to be part of any sand mining or gravel extraction operation include:

- A Water Use Assessment Report (WUAR), management -, and monitoring program.
- Mitigation and restoration. Mitigation must occur concurrently with sand and gravel extraction activities. Restoration is therefore a part of mitigation and the aim of restoration should be to restore the biotic integrity of a riverine ecosystem, not just to repair the damaged abiotic components.

- The cumulative impacts on instream habitat caused by multiple extractions and sites along a given stream or river are compounded by other riverine impacts and land use disturbances in the catchment. These additional impacts may be caused by river diversions/impoundments, flood control projects, logging, and grazing. Individual sand/gravel extraction operations must therefore be judged from a perspective that includes their potential adverse cumulative impacts.

### 4.3 Specific conditions for instream and riparian habitat

Control measures specifically associated with the instream habitat, adjacent floodplain or terraces and riparian zone that have to be taken into consideration when considering an authorisation for sand mining or gravel extraction are briefly discussed below (NMFS, 1998).

### 4.3.1 Instream habitat

**a) Gravel bar skimming**

Gravel bar skimming or "scalping" should only be allowed under restricted conditions:

- Sand/gravel should be removed only during low flows and from above the low-flow water level.
- Berms and buffer strips must be used to control stream flow away from the site.
- The final grading of the gravel bar should not significantly alter the flow characteristics of the river during periods of high flows.
- Bar skimming operations need to be monitored to ensure that they are not adversely affecting gravel recruitment downstream or stream morphology either upstream or downstream of the site
- If the stream or river has a recent history of rapidly eroding bars or streambed lowering, bar skimming should not be allowed.

**b) Floodplain pits to be considered as instream pits**

Because the active channel can shift into the floodplain pits, it is recommended that the pits be considered as potentially instream when viewed on a time scale of decades.

- Pit excavations located on adjacent floodplain or terraces should be separated from the active channel by a buffer designed to maintain this separation for two more decades.
- Buffers or levees that separate the pits from the active channel must consequently be designed to withstand long-term flooding or inundation by the channel.
- Mining pits located on adjacent floodplain should not be excavated below the water table.

- Berms and buffer strips in the floodplain that keep active channels in their original -locations or configurations should be maintained for two or more decades.

**c) Limitation to quantities of sand or gravel removal**

Quantities should be strictly limited so that gravel recruitment and accumulation rates are sufficient to avoid extended impacts on channel morphology and instream

habitat. Although conceptually simple, annual sand/gravel recruitment to a particular site is highly variable and not well understood.

- Flow and sediment transport for most rivers and streams is highly variable from year-to-year, thus an annual average rate may be meaningless.
- An "annual average deposition rate" could bear little relation to the sediment transport regimes in a river in any given year.

**d) Removal or disturbance of instream roughness elements**

Instream roughness elements, particularly large woody debris, are critical to stream ecosystem functioning:

- The removal or disturbance of instream roughness elements during gravel extraction activities should be avoided.
- Those that are disturbed should be replaced or restored.

**e) Potential toxic sediment contaminants**

- Prior to sand or gravel removal, a thorough review should be undertaken of potentially toxic sediment contaminants in or near the streambed where these types of operations are proposed or where bed sediments may be disturbed (upstream and downstream) by the operation.
- Extracted aggregates and sediments should not be washed directly in the stream or river or within the riparian zone.
- Turbidity levels should be monitored

### 4.3.2 Riparian habitat

**a) Minimise or avoid damage to stream/river banks and riparian habitats**

Sand/Gravel extraction operations should be managed to avoid or minimise damage to stream/river banks and riparian habitats

- Sand/gravel extraction in vegetated riparian areas should be avoided.
- Undercut and incised vegetated banks should not be altered.
- Large woody debris in the riparian zone should be left undisturbed or replaced when moved and not be burnt.
- All support operations (e.g. gravel washing) should be done outside the riparian zone.
- Sand/gravel stockpiles, overburden and/or vegetative debris should not be stored within the riparian zone.
- It is essential that overburden is evenly redistributed over exposed areas as soon as possible after the operation has been completed for faster revegetation.
- Operation and storage of heavy equipment within riparian habitat should be restricted.
- Access roads should not encroach into the riparian zones

## 5. STATUATORY REQUIREMENTS

It is accepted that effective resource management cannot be done in isolation – a fact which is acknowledged by the Department. The Department therefore pursues approaches towards coordination and integration where possible, which has led to coordinated regulatory systems.

A regulatory system consists of both statutory and non-statutory components. In the Sectoral-specific strategy for prospecting and mining, the Department participates within an integrated environmental management system which is administered in terms of the Minerals Act, 1991 (Act 50 of 1991). This approach enables the Department, *inter alia*, to gain insight into and control mines that could adversely affect the water environment which is not possible within the Department's regulatory system (DWAF, 1996b).

Other Acts dealing with matters relating to the conservation and protection of the environment and which a holder of a mining authorisation must also take cognisance of, include *inter alia*, the following:

- The Environment Conservation Act, 1989 (act 73 of 1989)
- The Conservation of Agricultural Resources Act 1983 (Act 43 of 1983)
- The Water Act, 1956 (Act 54 of 1956) [*]. Government Notice R287
- Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965)
- Nuclear Energy Act, 1993 (Act 131 of 1993)[**].

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**Present Status**

[*] Water Act, 1998 (Act 36, 1998)

[**] Draft Bill has been approved

**6. CONCLUSION**

Little is known internationally about the environmental impacts of aggregate mining in rivers. The mere nature however of these mining operations, namely the extraction of alluvial material from within or near a streambed, has a direct impact on the stream's physical habitat characteristics and consequently the biota. Obtaining an increased understanding of the potential impacts of these mining activities on aquatic resources, will allow water quality managers and decision-makers to make more informed decisions when issuing water use authorisations.

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â€žSand miningâ€Ÿ is a practice that is used to extract sand, from various environments, such as beaches, inland dunes and dredged from ocean beds, and river beds of deltaic regions. The mining is in operation in all the continents of the Globe. Environmental problems occur when the rate of extraction of sand, gravel and other materials exceeds the rate of deposition. Sand budget of a particular environment shall be observed before sand mining. Specific hydrologic and hydraulic information are necessary. The three major components of mining (exploration, mining, and processing) overlap somewhat. After a mineral deposit has been identified through exploration, the industry must make a considerable investment in mine development before production begins. Further exploration near the deposit and further development drilling within the deposit are done while the mining is ongoing. Comminution (i.e., the breaking of rock to facilitate the separation of ore minerals from waste) combines blasting (a unit process of mining) with crushing and grinding (processing steps). In-situ mining, which is treate Instream sand mining is one of them to hindrance on riverine biota. Hence, an attempt is made in this study to assess three tier habitat degradation or alteration caused by instream sand mining from channel bed to riparian and bank site in upper, middle and lower segments of Kangsabati River. Habitat Suitability Index (HSI) is applied to detect geo referenced ecological information on two different condition i.e. habitat suitability of two dominating species of Koeleria macrantha and Cynodon dactylon (pre mining) and degraded or altered habitat incorporated with mining responses (post mining). 4. Examine the adverse impacts of excessive sand mining on the river ecosystem. à¤¨à¤¦à¥€ à¤ªà¤¾à¤°à¤¿à¤¸à¥à¤¥à¤¿à¤¤à¤¿à¤• à¤¤à¤¥à¤¾ à¤ªà¤°à¤¿à¤¸à¤° à¤…à¤¨à¥à¤¯à¤¤à¤§à¤¿à¤• à¤°à¥‡à¤¤ à¤–à¤¨à¤¨ à¤•à¥‡ à¤ªà¥à¤°à¤¤à¤¿à¤•à¥‚à¤² à¤ªà¥à¤°à¤à¤¾à¤µà¥‹à¤‚ à¤•à¥€ à¤œà¤¾à¤‚à¤š à¤•à¤°à¥‡à¤‚à¥¤ IntroductionÂ  Moreover, the effects of instream sand mining may not be visible immediately because it requires continuous monitoring and takes a decade or more to surface and propagate the effects along the river channel in measurable units. Mining which leads to the removal of channel substrate, resuspension of streambed sediment, clearance of vegetation, and stockpiling on the streambed, will have ecological impacts.Â  Sand-and-gravel mining in stream channels can damage public and private property. Channel incision caused by gravel mining can undermine bridge piers and expose buried pipelines and other infrastructure.