International Journal on Science and Technology (IJSAT)
E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

Turning Brownfield Site into a Sustainable Urban Landscape: The Case of National Steel Corporation in Southern Philippines

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This paper investigates the sustainable redevelopment of defunct industrial sites, zooming in on the National Steel Corporation (NSC) in Iligan City, Philippines. The study aims to develop a framework for transforming post-industrial landscapes into productive, environmentally sound, and community-integrated spaces. Utilizing a mixed-methods approach, data were gathered through ocular inspection, site assessments, key informant interviews, surveys, and document analysis. Findings reveal that successful redevelopment hinges on inclusive stakeholder engagement, phased environmental remediation, and the integration of green infrastructure. The proposed framework emphasizes adaptive reuse, socio-economic integration, and long-term ecological resilience. This research contributes to the interdisciplinary field of urban planning by providing practical strategies and pathway in converting obsolete industrial land into sustainable urban landscape.

Keywords: Brownfield, Sustainability, Urban Planning, Philippines

1. Introduction

Industrial activities have long been known to cause significant environmental harm, including pollution and greenhouse gas emissions (Smith et al., 2018; Johnson & Thompson, 2019), posing substantial risks to the planet's climate and overall environmental health. As societies progress, old industrial sites are often abandoned, leaving behind environmental issues due to residual pollution and contaminated land (Williams et al., 2020). The closure of industries can also have severe social and economic impacts, leading to job losses and financial instability (Rosenblum & Cullen, 2017). Moreover, the loss of tax revenue from these closures can affect public services and infrastructure development (Rosenblum & Cullen, 2017).

Abandoned industrial sites can attract criminal activities, further harming communities (Zhu & Chen, 2021). However, transforming these sites into sustainable landscapes can have profound positive impacts. By repurposing them, environmental issues can be addressed, and economic opportunities can be created

(Zhu & Chen, 2021). In the case of the National Steel Corporation in Iligan City, its closure has significantly impacted the local economy, leading to a rise in unemployment (Iligan City Government, 2020). The post-industrial site of NSC presents ongoing challenges, requiring comprehensive interventions and redevelopment strategies to address its environmental and socio-economic consequences effectively.

2. Background

Throughout the tumultuous 20th century, Iligan City witnessed both growth and decline, alongside the ebb and flow of industrialization. The area was predominantly rural before the establishment of the National Steel Corporation (NSC), characterized by lush forests and fertile plains (Smith, 1998). Indigenous groups and locals primarily practiced subsistence farming, focusing on traditional crops like rice, corn, and fruits (Jones, 2005; Anderson, 2010). The NSC, founded in 1962, was established in Iligan City due to its proximity to rich iron ore reserves and transportation routes (Williams, 2008). This led to significant changes in land use, with some areas acquired through eminent domain and others purchased from private owners (Johnson, 1995). Displaced populations were resettled, and infrastructure was developed to support the steel plant, including blast furnaces and rolling mills (Thompson, 2007; Brown, 2012). The conversion of the NSC site had severe environmental impacts, including deforestation and pollution (Green, 2014; Gray, 2011).

Efforts were made to mitigate these effects through environmental management practices (Parker, 2013). The NSC played a crucial role in Iligan City's industrialization, shifting it from an agricultural to an industrial economy and attracting a large workforce from across the country (Sevilla, 1996). However, the NSC filed for bankruptcy in 1999, leading to economic challenges for the city (Iligan City Government, 2020). Ownership of the NSC plant was transferred to the private sector, with GSPI now responsible for its assets and financial obligations (Masigan, 2022). Government intervention may be necessary to ensure the redevelopment of these assets and protect tax revenues (Masigan, 2022).

The sustainable redevelopment of the NSC site aligns with Iligan City's urban planning objectives, as outlined in its Comprehensive Land Use Plan 2013-2022 (Iligan City Development Council City Planning & Development Office, et al., 2013). These principles emphasize orderly growth, environmental preservation, and sustainable practices, providing a framework for the transformation of the NSC site into a sustainable landscape (Iligan City Development Council City Planning & Development Office, et al., 2013). Drawing inspiration from Iligan City's planning, the thesis aims to contribute to the sustainable redevelopment of the NSC site, ensuring it becomes a model of eco-conscious urban development.

3. Methodology

This article utilizes archival records and secondary data gathered from desk research, along with insights from professional discussions, key informants' interviews, and surveys to collect relevant secondary information and primary data.

4. Results, Discussion & Analysis

4.1 Brownfield Cases: Best Practices & Strategies

Brownfield rehabilitation and sustainable urban landscape development are critical components of modern urban planning. According to Baldwin and Butler (2018), the rehabilitation of dead industrial sites provides prospects for urban rejuvenation and sustainable development. Cities can improve the ecological, social, and economic characteristics of abandoned industrial zones by using a sustainable urban landscape concept (Smith & Williams, 2020).

Bonifacio Global City (BGC), Philippines

Bonifacio Global City (BGC) in the Philippines stands out as a prime example of a sustainable urban center. Through the outposts Conversion and Development Authority Act, the Philippine government began its goal in 1992 to repurpose closed U.S. military outposts. Due to its accessibility to the city and the availability of infrastructure, Fort Bonifacio, a defunct base outside of Manila, held great potential. The former military base was transformed into the mixed-use international business center known as Bonifacio Global City through a cooperative venture with the public and private sector, owing to a host of initiatives and practices that have been woven into its fabric during its transformation from the former Bonifacio.

BGC boasts a skyline dotted with green and sustainable buildings, exemplifying its dedication to environmentally conscious construction. These structures integrate cutting-edge technologies such as solar panels, green roofs, and energy-efficient lighting and HVAC systems, setting a benchmark for sustainable architecture in the region (Gavilan, 2023). It prioritizes walkability and accessibility, recognizing the intrinsic connection between urban design and public health. Pedestrian-friendly infrastructure, including wide sidewalks, bike lanes, and verdant green spaces, not only fosters alternative modes of transportation but also fosters a healthier lifestyle among residents and visitors alike (Inquirer, 2021). Moreover, BGC's commitment to mixed-use development fosters a dynamic and inclusive community. By interweaving residential, commercial, leisure, and institutional facilities within the same area, BGC minimizes the need for lengthy commutes, mitigates urban sprawl, and cultivates a diverse urban tapestry (Philstar Global, 2020).

The proliferation of LEED-certified buildings underscores BGC's unwavering adherence to stringent environmental standards. These structures prioritize energy efficiency, water conservation, and indoor environmental quality, aligning with the city's overarching sustainability goals (Philippine Daily Inquirer, 2019). BGC champions sustainable transportation alternatives, from electric vehicles to public transit and ridesharing services. By incentivizing non-motorized transportation modes like walking and cycling through dedicated infrastructure and initiatives, reduces carbon emissions and promotes a greener urban mobility landscape (Rappler, 2022). It's commitment to green spaces and parks further enhances its sustainability credentials. These lush oases not only offer opportunities for recreation and relaxation but also contribute to biodiversity conservation and mitigate the urban heat island effect, fostering a more resilient urban ecosystem (ABS-CBN News, 2020). Lastly, BGC's comprehensive waste management and recycling programs reflect its holistic approach to sustainability. By minimizing landfill waste and promoting resource efficiency through waste segregation, recycling facilities, and public education campaigns, BGC underscores its commitment to environmental responsibility (CNN Philippines, 2021).

The Philippines' Bonifacio Global City (BGC) is notable for being the nation's first and most successful public-private partnership (PPP), which is defined by cooperation between public and private sector organizations. BGC's journey towards sustainability is characterized by a multifaceted approach that encompasses environmental, social, and economic dimensions. Through collaboration among government agencies, private developers, community stakeholders, and sustainability experts, BGC has successfully integrated sustainable design principles, technologies, and best practices into its urban planning and development processes, positioning itself as a beacon of sustainable urbanism in the Philippines and beyond. This collaboration strategy has played a key role in transforming BGC, a defunct military installation, into a thriving urban hub. The following important elements support BGC's standing as an effective PPP:

- Collaboration between Public and Private Sectors: The Bases Conversion and Development Authority (BCDA), a government agency, and private developers like Ayala Land, Inc. and Evergreen Holdings worked together in a synergistic way to make the development of BGC possible (Bonsato, 2017). The effective reconstruction of the area was made possible by this collaboration, which permitted the pooling of resources, experience, and finance from both sectors.
- Integrated Urban Planning: The development of BGC entailed thorough urban planning that took into account all facets of urban life, including as housing, transit, infrastructure, and green areas. In addition to fostering sustainability and resilience, this integrated approach made sure the development satisfied the needs of workers, residents, and tourists (Poblete, 2020).
- Infrastructure Investment: Major investments in BGC's transportation systems, utilities, and public facilities were made possible by the PPP model. The area's emergence as a thriving urban hub was largely due to the infrastructural investment that brought in businesses, inhabitants, and investors (Gavilan, 2019).
- Environmentally friendly design ideas, energy-efficient technologies, and green building standards were all incorporated into BGC's implementation of sustainable development methods. These actions not only lessened the development's negative environmental effects but also made it more appealing to renters and investors looking for sustainable urban settings (Gavilan, 2019).
- Economic Growth and Job Creation: The construction of BGC has led to a notable increase in the local economy and the creation of jobs, attracting investment and opening up work options for locals. The Philippines' overall economic prosperity has benefited from BGC's successful development as a business and commercial hub (Philippine Star, 2019).

BGC's collaborative strategy, integrated urban planning, infrastructure investment, sustainable development methods, and favorable effects on economic growth and job creation have made it the first successful public-private partnership in the Philippines.

Kisswire Steel Wire Factory, South Korea

The renovation of the defunct wire factory, formerly known as the KISWIRE steel wire producer in *Suyeong-gu, Busan*, South Korea, into one of Busan's most prominent cultural complexes is an outstanding example of adaptive reuse and sustainable urban development in Asia. H. Seong. (2022, October) highlighted the outstanding transformation of a defunct wire factory that closed in 2008 into the thriving

cultural complex known as F1963 in Busan. This adaptive reuse project has given new life to the once-abandoned industrial site, creating an environment where nature and art coexist together. The contrast is stark: whereas the previous factory produced wire, the refurbished facility now creates a cultural site, with a diverse range of events and exhibitions catering to people of all ages and interests. F1963's blend of nature and art distinguishes it as a distinct cultural destination. According to Seong (2022), the complex retains most of the original building of the previous plant, allowing visitors to learn about the site's industrial history.

However, the inclusion of natural elements such as the Moonlight Garden and the Bamboo Sori Trail creates a tranquil and scenic atmosphere in which visitors may escape the rush and bustle of the city and immerse themselves in nature. The project's decision to repurpose existing structures rather than demolish them considerably decreased the environmental impact of construction waste while preserving the site's historical and industrial past (Yun 2018). Energy consumption in the refurbished complex was reduced with the use of energy-saving technology and design principles such high-performance insulation, energy-efficient lighting, and efficient HVAC systems (Kang et al., 2020). Incorporating green areas and landscaping improved the site's environmental quality, supported biodiversity, and lessened the impact of the urban heat island effect (Yang & Lee, 2017). Aligning with more general urban sustainability aims, giving public transportation priority for accessibility decreased dependency on private vehicles and encouraged sustainable mobility options (Kim & Kim, 2019). The goal of the makeover was to restore the site's historical and cultural relevance while envisioning it as a thriving community hub (Lee & Park, 2016). The project aimed to promote economic growth and development in the region by drawing tourists, enterprises, and investment (Kang & Choi, 2018). The initiative sought to promote sustainable development by striking a balance between environmental conservation and economic growth by incorporating environmentally friendly behaviors and technologies (Park et al., 2021).

F1963 has developed a dynamic and engaging environment by mixing elements of nature and art, honoring the site's industrial legacy while embracing its current position as a cultural production hub. F1963's varied selection of concerts, exhibitions, and educational events caters to everyone, making it a genuinely unique and valuable addition to Busan's cultural environment. The effective conversion of the former wire factory into a cultural complex was made feasible by a collaborative effort that included government agencies, business developers, community stakeholders, and sustainability specialists (Choi and Jung, 2019). This collaborative effort, marked by meticulous planning, inventive design, and a commitment to sustainable methods, not only conserved the site's industrial legacy but also established a new cultural monument in Busan. The transformation of the former wire factory into a cultural complex exemplifies the possibilities of adaptive reuse in sustainable urban development, demonstrating how existing structures may be adapted to revitalize old industrial sites while respecting historical relevance.

The High Line In New York City, Usa

The High Line in New York City, USA is an outstanding example of adaptive reuse and revitalization. This project converted an elevated railway track into a public park, improving urban green space, conserving industrial history, and accelerating economic growth while encouraging sustainability and community involvement (Ghersi, Troglio, & La Greca, 2017). The detailed best practices and strategies employed in repurposing the High Line in New York City include community engagement and stakeholder

involvement, preservation and adaptive reuse, ecological sustainability, arts, culture, and programming, economic revitalization, and tourism. Collaboration between many stakeholders and community involvement were crucial to the High Line's successful repurposing. The involvement of the community ensured that the project met their needs and objectives (Choi, 2011).

To obtain community opinion, open forums, seminars, and polls were organized, encouraging a sense of ownership and having a beneficial social impact (Sturges, 2017). A nonprofit organization called Friends of the High Line played a key role in organizing and promoting community engagement programs (Friends of the High Line, n.d.). Maintaining the High Line's historic charm while modernizing it was one of the key goals. The design accomplished a distinctive fusion of historical and contemporary by preserving and reusing vintage railway elements, such as steel structures and tracks. While honoring the site's industrial legacy, this adaptive reuse strategy reduced demolition waste (Moss, 2014).
Sustainable design ideas, with an emphasis on ecological restoration and biodiversity, were included into the High Line's repurposing. In order to create green areas, native plants were selected, which required less watering and upkeep (Chan, 2016). To control stormwater runoff and lessen the impact of the urban heat island, permeable pavement and rainwater collecting technologies were used (Lehman, 2019). In addition to improving the park's resilience, these tactics helped New York City achieve its larger sustainability goals (Hou, 2012). Integration of the arts, culture, and programming was crucial to the High Line's viability as a public area.

A variety of people were drawn to the temporary and permanent art displays, performances, and educational events, which helped to create a feeling of place (Schneider, 2020). Collaborations with regional cultural organizations and artists improved the site's cultural value and consolidated local relationships (Richards, 2019). The High Line's transformation significantly influenced the nearby communities, spurring tourist and economic revival. New investments and the creation of mixed-use developments were a result of rising property prices (Barry, 2012). Local businesses benefited from more foot traffic and consumer spending, which helped the region's economy grow overall and create jobs (Bode, 2017).

The High Line in New York City stands out for its innovative approach to urban renewal, sustainable practices, and successful achievement of key goals. The High Line repurposed an old railway structure, preserving its historic value and reducing the environmental impact of demolition and construction (David & Schmidt, 2017). The project introduced extensive greenery, including native plantings, which not only beautify the area but also promote biodiversity and improve air quality (Grunewald & Ehrenfeucht, 2011). Sustainable drainage systems were integrated into the design to manage stormwater runoff, reducing the burden on the city's sewer system (David & Schmidt, 2017). It also features energy-efficient lighting, reducing electricity consumption and contributing to the park's sustainability (Grunewald & Ehrenfeucht, 2011).

One of the primary goals of the High Line was to revitalize a neglected urban area, transforming it into a vibrant public space (Grunewald & Ehrenfeucht, 2011). The project aimed to engage the local community and create a sense of ownership over the park, fostering social cohesion and pride in the neighborhood (David & Schmidt, 2017). It has become a major tourist attraction, attracting millions of visitors annually

and stimulating economic growth in the surrounding area (Grunewald & Ehrenfeucht, 2011). By preserving and repurposing a historic railway structure, the High Line honors the area's industrial past while adapting it for contemporary use (David & Schmidt, 2017). The success of the High Line can be attributed to careful planning, community engagement, and a commitment to sustainability. By repurposing existing infrastructure, integrating green spaces, and achieving key goals such as urban revitalization and community engagement, the High Line has become a model for adaptive reuse and revitalization projects worldwide.

Zollverein Industrial Complex in Essen Germany

Then we have the Zollverein Industrial Complex in Essen Germany which exemplifies successful brownfield rehabilitation demonstrating an incredible change from a former coal mining and coking plant to a flourishing cultural and commercial hub. This project exhibits new sustainable practices and initiatives that have rejuvenated the area while preserving its industrial heritage and fostering environmental sustainability. The rehabilitation of Zollverein centered on utilizing existing industrial buildings while conserving their historical and architectural significance (Schneider, 2014). This strategy reduced demolition waste and embodied energy, adding to the project's overall sustainability. The integration of cultural and educational institutions, as well as sustainable design principles, were critical to the success of this project, which has been designated a UNESCO World Heritage Site (Czarnowski, Baran, & Komiski, 2019).

Preservation and adaptive reuse, cultural and educational applications, adaptive design and architecture, and sustainable development are among the comprehensive best practices and initiatives used in repurposing the Zollverein Industrial Complex in Essen, Germany. Preservation and adaptive reuse were critical objectives in the Zollverein Industrial Complex's repurposing. The industrial infrastructure, including the coal mine and coking factory, were conserved and converted into cultural and educational institutions (Steinhäuser, 2012). This strategy preserved the site's historical relevance while introducing new activities and objectives (Gravari-Barbas & Grabowiecki, 2018). The Zollverein Industrial Complex was repurposed with an emphasis on cultural and educational applications to increase its status as a historic asset. Within the complex, museums, exhibition spaces, and educational institutions were constructed, allowing visitors to connect with its history and industrial legacy (Thielemann, 2009). These cultural and educational applications helped to the region's economic growth and boosted tourism (Russo & van der Borg, 2002).

The Zollverein Industrial Complex's adaptive design and architecture centered on balancing the preservation of old structures with contemporary modifications. The makeover preserved the industrial appearance while allowing for additional purposes and activities (Novy & Colomb, 2014). The use of modern architectural components and inventive design improved the tourist experience while remaining sensitive to the historical environment (Bravo & Pulla, 2015). The Complex was repurposed in accordance with sustainable development principles. The facility was renovated and maintained using energy-efficient technology, renewable energy sources, and environmentally friendly materials (Kliemt, 2018). Sustainable transportation choices and infrastructure were also considered in order to reduce environmental impacts and enhance accessibility (Khan, 2017). Zollverein also features extensive green spaces and landscaping, integrating nature into the industrial setting. These green areas not only enhance the aesthetic appeal of

the complex but also promote biodiversity and improve the local microclimate (Höller, 2010). The property is easily accessible via public transportation, decreasing dependency on private vehicles and encouraging sustainable mobility options (Meyer, 2006). This accessibility makes the place more appealing to both visitors and inhabitants.

The Zollverein Industrial Complex was successfully rehabilitated thanks to a collaborative effort by government authorities, business developers, and community partners (Meyer, 2006). This teamwork meant that the project satisfied all of the stakeholders' goals and expectations, culminating in the brownfield site's successful transformation. Zollverein has become a symbol of successful brownfield rehabilitation thanks to meticulous planning, the preservation of industrial legacy, and a dedication to environmental sustainability.

Olympic Park, London, Uk

The regeneration of the Olympic Park, London, UK, showcased the integration of ecological restoration and green infrastructure. The extensive wetland system within the park mitigated flood risks, enhanced biodiversity, and created recreational spaces for local communities (Bulkeley & Whiteside, 2015). Following the 2012 Olympic Games, the Olympic Park in London, UK, experienced a successful redevelopment, becoming an exceptional model of post-event reuse. Legacy planning and sustainability were important factors in the Olympic Park's redevelopment. The planning process was centered on assuring the host city's long-term social, economic, and environmental advantages (Horne & Manzenreiter, 2012). The park's design and operation incorporated sustainable development ideas such as energy efficiency, waste management, and ecological restoration (Manley & Jago, 2014).

The Olympic Park's repurposing relied heavily on adaptive reuse and the development of multi-purpose amenities. Existing facilities and infrastructure were converted for a range of purposes, including sports, recreation, cultural events, and community activities (Henry, 2014). This technique increased resource consumption, decreased expenses, and improved the park's incorporation into the neighboring neighborhood (Gratton & Henry, 2012). The provision of high-quality public areas and landscape design was prioritized throughout the Olympic Park redevelopment. The park was created to be accessible, inclusive, and visually appealing, with options for leisure, relaxation, and social contact (Chatterjee & Tewdwr-Jones, 2012). The park contained significant wetlands and green spaces, which not only increased biodiversity but also served to decrease flood hazards in the area (Bulkeley & Whiteside, 2015). These ecological characteristics were incorporated into the park's design to provide a sustainable environment for both wildlife and humans. The park's design included green roofs, permeable surfaces, and sustainable drainage technologies to manage stormwater runoff and mitigate the heat island effect (Manley & Jago, 2014).

These green infrastructure elements contributed to the park's environmental performance and overall sustainability. Existing Olympic Games buildings and infrastructure were converted for a variety of purposes, including sports, entertainment, cultural events, and community activities (Henry 2014). This technique lowered resource consumption and expenses while boosting the park's integration into the surrounding community (Gratton & Henry, 2012). The redevelopment of the Olympic Park was led by a long-term vision of providing long-term social, economic, and environmental advantages to the host city

(Horne & Manzenreiter, 2012). The park's design and operations were meant to help the city achieve its sustainable development goals while also providing long-term benefits to the local population. The park aims to illustrate sustainable development principles by promoting energy efficiency, waste management, and natural restoration (Manley & Jago, 2014). These methods were included into the park's design to reduce environmental impact and encourage sustainable living. The redevelopment process prioritized community involvement and the generation of local benefits (Horne & Manzenreiter, 2012). In the repurposing process, community participation and the production of local benefits were critical. Local communities participated in decision-making and planning, ensuring that the park matched their requirements and improved their well-being. The Olympic Park's redevelopment achieved its ecological restoration, green infrastructure integration, and sustainable development objectives. The park's design and management have set a precedent for future urban developments, illustrating how large-scale events may leave a good and long-term impact in host communities (Chatterjee & Tewdwr-Jones, 2012). The restoration of the park created job possibilities, skill training, and socioeconomic advantages for the neighboring communities, so contributing to social inclusion and urban regeneration (Henry & Tomlinson, 2017). The Olympic Park in London, UK, exemplifies how ecological restoration and green infrastructure may be successfully integrated into urban redevelopment projects. Through creative sustainable methods and community engagement, the park has become a model for sustainable urban development, demonstrating how brownfield lands may be converted into vibrant and sustainable spaces for all to enjoy.

Landschaftspark Duisburg-Nord, Duisburg, Germany.

Landschaftspark Duisburg-Nord, Duisburg, Germany, a former steelworks site, exemplifies strong community participation and social inclusion. The restoration of the property into a park provided chances for recreation, cultural events, and educational activities, enhancing the relationship between inhabitants and their surroundings (Hill, 2006). The conversion of the Landschaftspark Duisburg-Nord relied heavily on preservation and adaptive reuse. The industrial legacy of the site was conserved by preserving existing structures and machinery while adapting them for new uses (Papa et al., 2015). Visitors may experience the industrial history while also enjoying the altered environment using this method (Budde et al., 2017).

The Landschaftspark Duisburg-Nord was repurposed with a focus on cultural and recreational applications. The property was renovated into a multipurpose venue that could host a variety of activities such as art exhibitions, concerts, and outdoor leisure activities (Grimm et al., 2018). This combination of cultural and recreational components draws a wide spectrum of people, generating a feeling of place and community (Georgiadis et al., 2016). The repurposing of the Landschaftspark Duisburg-Nord relied heavily on adaptive design and architecture. New buildings and interventions were constructed to the site to supplement the existing industrial aspects while also offering usable spaces for a variety of activities (Papa et al., 2015).

The design strategy used energy-efficient technologies and materials, according to sustainability principles (Rakotonirainy et al., 2019). The repurposing of the Landschaftspark Duisburg-Nord prioritized environmental sustainability. The property integrates ecological rehabilitation, with previous industrial areas being converted into green spaces, ponds, and gardens (Papa et al., 2015). The landscape design incorporates sustainable stormwater management practices, which promote biodiversity while also improving water quality (Schmidt et al., 2018). These case studies demonstrate the possibilities of merging

historical preservation, green infrastructure, and community-driven design to create attractive and sustainable urban environments.

Addressing environmental contamination is one of the most difficult difficulties in redeveloping abandoned industrial facilities. Bioremediation (Gottschall et al., 2018), phytoremediation (Hernandez et al., 2019), and soil washing (Lay et al., 2017) have all shown promise in reducing soil and groundwater pollution. Implementing these measures during the National Steel Corporation site's transformation will be critical to safeguarding the site's ecological integrity and public safety. Any redevelopment project's success is heavily reliant on good stakeholder engagement and community participation. Involving the local community in decision-making provides a sense of ownership and inclusive development. Klemmer et al. (2018) underline the necessity of participatory planning in urban redevelopment projects, taking into account the viewpoints of residents, business owners, and community organizations.

4.2 NSC's Physical & Environmental Landscape Today

The National Steel Corporation site stands as a stark reminder of its once industrious past, now shadowed by neglect and decay. The physical condition and status of its equipment paint a vivid picture of abandonment and disrepair. Upon entering the premises, the first notable observation is the overgrown vegetation that has taken over much of the plant site. The dense undergrowth has reclaimed the area, creating a wild, almost untamed landscape. The only exceptions to this verdant takeover are the Administration building and the immediate entrance area, which still bear semblances of maintenance. Wildlife has found refuge within the premises, with sightings of snakes and other reptiles becoming increasingly common.

This resurgence of nature further underscores the extent of human absence and neglect. The extensive pilfering, coupled with environmental exposure and lack of maintenance, has led to a severe deterioration of both facilities and equipment. While some mechanical equipment holds a glimmer of potential for rehabilitation, the overall outlook is bleak, with most systems, particularly the electrical ones, rendered obsolete and beyond repair. The overgrown vegetation and presence of wildlife further highlight the absence of human intervention, turning the once-bustling industrial hub into a relic of the past, overrun by nature.

Today, the physical and environmental landscape of the NSC site reflects decades of abandonment and unregulated ecological succession. Thick layers of soil and plant debris cover what used to be paved roads and open service areas, while rusted pipelines and skeletal frames of machinery protrude from the underbrush. Several buildings are in various stages of structural decay—roofs collapsed, windows shattered, and walls overtaken by climbing vines and moss. Drainage canals and access paths are blocked or barely visible, having been swallowed by vegetation and erosion. The air carries the stillness of isolation, broken only by the sounds of insects and the occasional animal movement. Despite the evident decline, the landscape reveals a slow but persistent transformation—an organic reclamation of space that hints at both ecological resilience and the possibility of adaptive reuse.

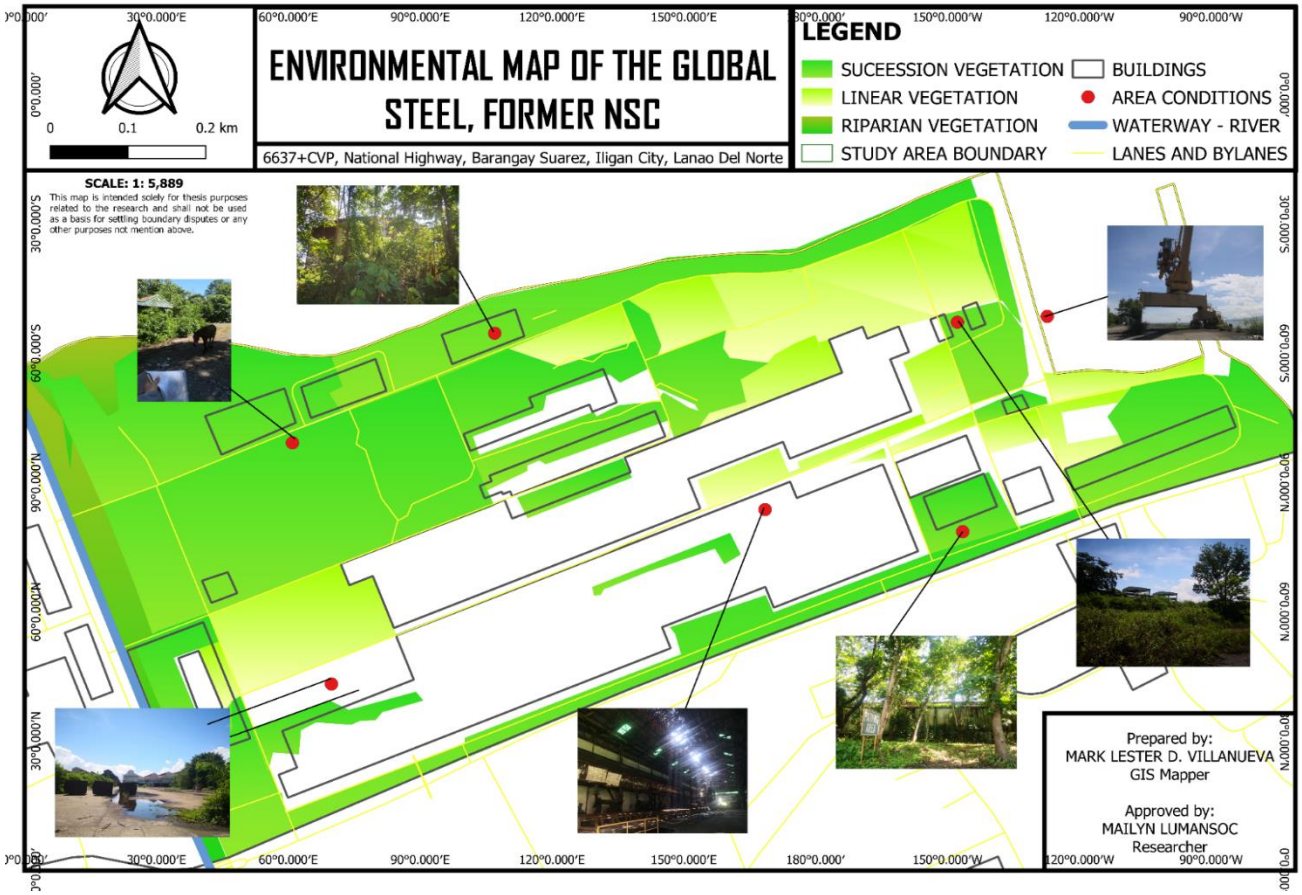


Figure 1. Environmental Map of the Global Steel, Former National Steel Corporation of Iligan City

The environmental map illustrates the current ecological and structural conditions within the study area. The map shows the distribution of succession vegetation, linear vegetation, and riparian vegetation, highlighting the natural regeneration occurring across the site. The white zones indicate existing buildings, while blue lines represent the waterway/river bordering the area. Yellow lines depict lanes and bylanes, crucial for accessibility and redevelopment planning. Red dots with corresponding photos pinpoint key area conditions, showcasing examples such as regrown forest areas, existing infrastructure, overgrowth, and river conditions. This environmental assessment serves as a baseline for analyzing land use potential, ecological restoration, and infrastructure integration for sustainable redevelopment.

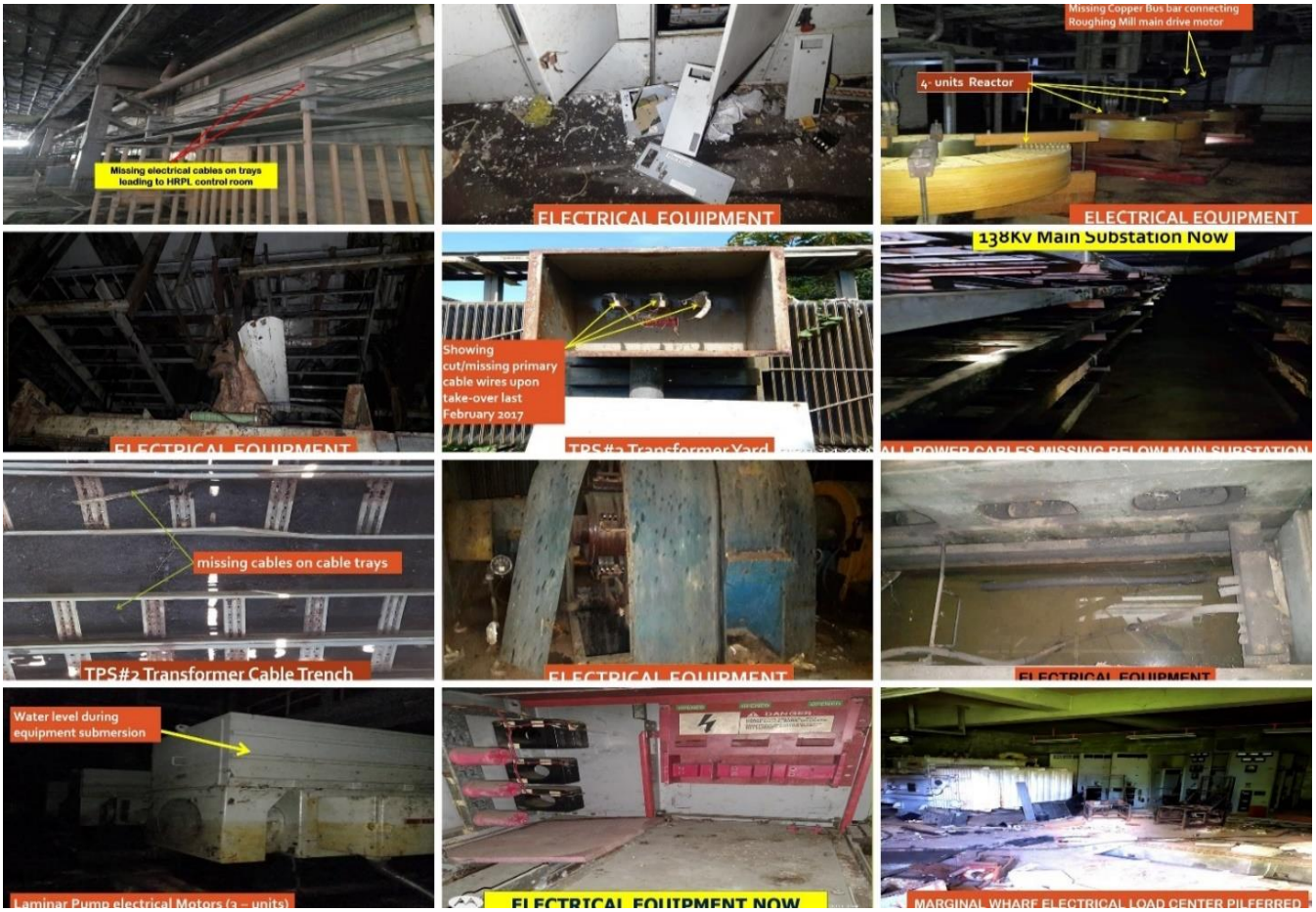


Figure 2. Condition of Motor Rooms and Electrical Machineries. (Photo by NSC Preservation Team)

Figure 3. Condition of the Mechanical Machinery. (Photo by NSC Preservation Team)

Figure 4. Condition of the Support Facilities. (Photo by NSC Preservation Team)

Figure 5. Condition of Other Facilities. (Photo by NSC Preservation Team)

Table 1. Assessment Summary of Major Facilities. (Source: NSC Preservation Team)

Assessment Summary			
	Facility	**% Scrap**	**% Rehab**
1	Hot Mill #1	60%	40%
2	Hot Mill #2	20%	80%
3	HRPL	60%	40%
4	Picking Line 1	100%	-
5	Picking Line 2	85%	15%
6	4-Stand Mill	65%	35%
7	5-Stand Mill	60%	40%
8	Recoiler Line	45%	55%
9	HCD Line	65%	35%
10	Alkali Cleaning Line	100%	-
11	Batch Annealing Line	45%	55%
12	1-Stand Temper Mill	55%	45%
13	2-Stand Temper Mill	45%	55%
14	Coil Preparation Line #1	100%	-
15	Coil Preparation Line #2	35%	65%
16	Electrolytic Tinning Line (ETL)	45%	55%
	Overall Assessment	55%	45%

Based on the inventory records obtained from the NSC preservation team through Global Steel Philippines, Inc. (Internal Document, 2024), the assessment of existing industrial facilities within the former National Steel Corporation site reveals a significant degree of deterioration, with most structures and equipment leaning toward obsolescence. Among the nine key facilities evaluated, Pickling Line 1 shows the most severe decline, marked by a 100% scrap rating, indicating it is entirely beyond rehabilitation. Similarly, Pickling Line 2 and the 4-Stand Mill also reflect advanced degradation, with 85% and 65% scrap ratings, respectively, and only minor portions deemed salvageable. Conversely, Hot Mill #2 stands out as the most viable for rehabilitation, with 80% of its components assessed as restorable, suggesting this facility may serve as a strategic anchor for potential redevelopment. The Recoiler Line also shows relatively strong recovery potential, with 55% of its structure and equipment deemed suitable for rehabilitation. The rest of the facilities, including Hot Mill #1, HRPL, 5-Stand Mill, and HCD Line, exhibit mixed conditions, each with 40–60% scrap proportions, reflecting the toll of prolonged abandonment, environmental exposure, and lack of maintenance. The Alkali Cleaning Line and Coil Preparation Line #1 have both been assessed as 100% scrap, indicating complete structural and functional degradation, and offering no potential for reuse. This emphasizes the harsh impact of prolonged inactivity and environmental exposure on specific chemical and preparatory systems. On a more positive note, several facilities demonstrate promising rehabilitation potential. The Batch Annealing Line, 2-Stand Temper Mill, and Electrolytic Tinning Line (ETL) each report 55% rehab rates, suggesting that over half of their systems or components remain functionally intact and may be restored with moderate investment. Similarly, the Coil Preparation Line #2 exhibits the highest rehabilitation potential (65%) among this

group, underscoring its value as a strategic asset for future redevelopment. In contrast, the 1-Stand Temper Mill reflects a more modest outlook with 45% rehab potential, but still offers a basis for selective restoration depending on redevelopment priorities and cost-efficiency analyses. The overall assessment of this set places the scrap rate at 55% and the rehabilitation potential at 45%, echoing the trend seen in the first summary. This points to a clear need for a hybrid redevelopment strategy—one that combines dismantling of irreparable systems with focused investment in facilities that maintain structural integrity and operational relevance. In general, the table underscores the strategic need for a selective redevelopment approach—prioritizing the retention and adaptive reuse of components like Hot Mill #2 and the Recoiler Line while planning for the safe dismantling and environmental management of facilities with high scrap values.

4.3 Environmental Contaminations

Despite the encroaching greenery, numerous remnants of NSC's industrial era remain. As observed through transect walk, steel slags, by-products of the steel manufacturing process, are prevalent throughout the premises, particularly near the old production areas. These black, glassy residues are a stark reminder of the site's industrial history and highlight the need for environmental remediation. Rust scales, indicative of corroding metal, can be observed beneath unmaintained equipment both indoors and outdoors. These rust flakes are products of prolonged exposure to the elements and the lack of maintenance, contributing to the ongoing decay of the industrial infrastructure. The site's coastal areas exhibit signs of scouring along the seashore, a process where waves and tides erode the shoreline. However, the waters around the pier and wharf area remain notably clear, with no visible oil spills. This absence of oil pollution is likely due to the passage of time, allowing natural processes to cleanse the marine environment. The clarity of the water contrasts with the industrial debris found on land, including boulder slags scattered around the site. These large, solidified masses of slag serve as tangible evidence of the plant's once-vigorous operations and the substantial industrial output that characterized NSC's active years.

Aside from the aforementioned contaminants marked by bustling industrialization of the past, based on the inventory records obtained from the NSC preservation team through Global Steel Philippines, Inc. (Internal Document, 2024), Polychlorinated Biphenyl (PCB) were found last December 2006 through an electrical incident that forced the decommissioning of Utilities' Steam Generating Plant's Power Transformer #T-6007 for boilers. The particular unit of Westinghouse power transformer contained 1,380 liters (approximately 6.6 drums) of Insuldor (Inerteen) Transformer Oil. Inerteen is one of the brands or trade names for Polychlorinated Biphenyl (PCB) Oil classified as highly toxic/hazardous and carcinogenic substance, of which the manufacturer has been totally banned throughout the world. In addition to the documented Polychlorinated Biphenyls (PCB), Radioactive Materials are also present to this day, as extracted through a review of documents provided by the current NSC preservation team employed by Global Steel Philippines, Inc. from the inventory of the Philippine Nuclear Research Institute Nuclear Regulatory Division. The following radioactive materials were observed at the following locations: Cesium-137 at the Old Oxygen Plant Stock Room; Americium-241 at the 5-Stand Tandem Mill (Cold Mill), Coil Preparation Line 1, 4-Stand Tandem Mill, Electronic Tinning Line No. 3, 5-Stand Tandem Entry Cold Mill, Recoiler Line (Cold Mill), and Sea Van; Cobalt-60 at the Old Oxygen Plant Stock Room; Lead-210 (6 units) at the Hot Rolled Preparation Line (Cold Mill); and Lead-210 (12 units) at the Sleckel Mill Motor Room (Hot Mill).

Table 2. Specific locations of Polychlorinated Biphenyl (PCB) contaminated Transformers.

Location	No. of Units	Total Estimated Volume of PCB Oil
1. Cold Mill	16	22,748 liters (approx. 109 drums)
2. Hot Mill #1	09	13,900 liters (approx. 67 drums
3. Foundry Shop	06	8,200 liters (aprox. 39 drums)
4. Admin #2	01	1,040 liters (approx. 05 drums)
5. RC Pier	01	840 liters (approx. 4 drums)
6. Marginal Wharf	01	1,900 liters (approx. 09 drums)
7. SB Pier	03	3,844 liters (approx. 18 drums)
8. Machine Shop	02	1,600 liters (approx. 08 drums)
9. Mobile Equipment Section	01	800 liters (approx. 04 drums)
10. CCAP	03	10,960 liters (approx. 53 drums)
11. ASP	02	5,660 liters (approx. 27 drums)
12. Steam Gen. Plant	01	1,380 liters (approx. 07 drums)
13. Admin 1/Blue House	02	2,080 liters (approx. 10 drums)

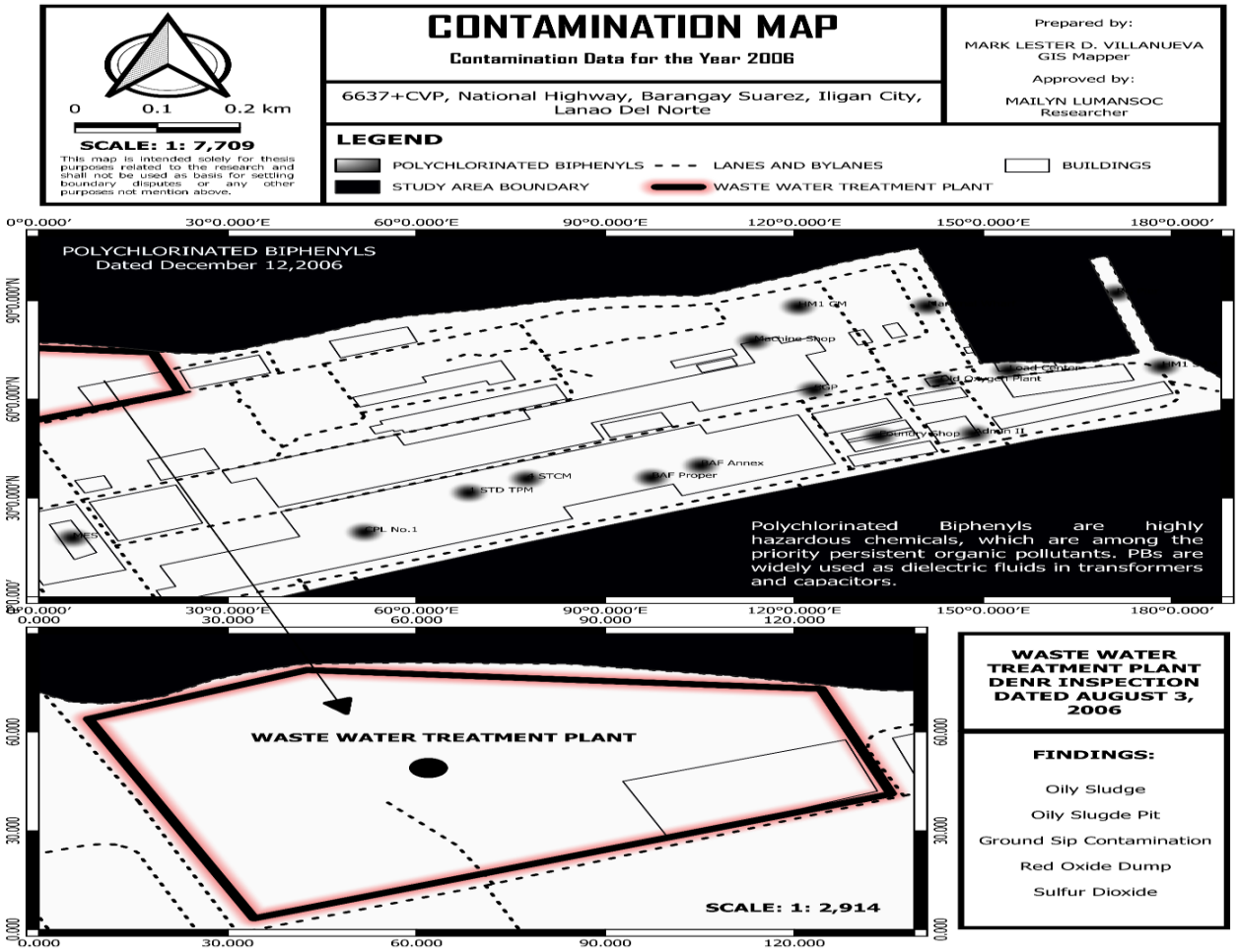
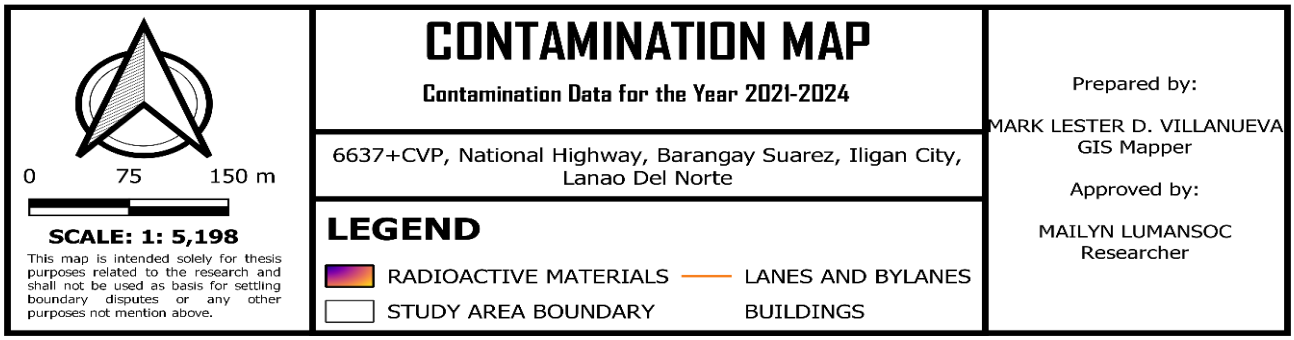
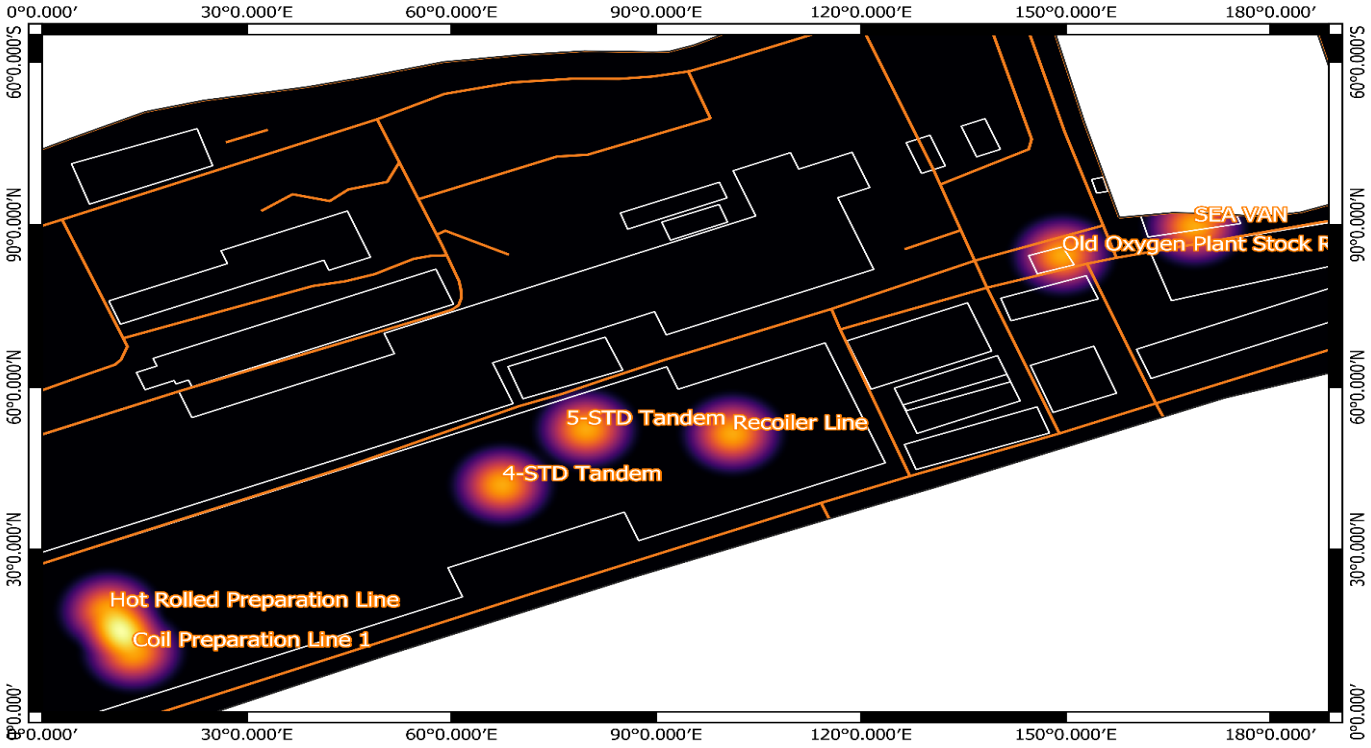


Figure 6. Polychlorinated Biphenyl (PCB) Contamination Map.





INVENTORY OF RADIOACTIVE SOURCES AND ASSOCIATED EQUIPMENT, AND RADIATION MONITORING

RADIOACTIVE SOURCE	LOCATION
Cesium-137	Old Oxygen Plant Stock Room
Amerecium-241	5-Stand Tandem Mill (Cold Mill)
Amerecium-241	Coil Preparation Line 1
Amerecium-241	4-Stand Tandem Mill
Amerecium-241	Electronic Tinning Line No.3
Amerecium-241	5-Stand Tandem Entry Cold Mill
Amerecium-241	Recoiler Line (Cold Mill)
Amerecium-241	Sea Van
Cobal-60	Old Oxygen Plant Stock Room
Lead-210 (6 units)	Hot Rolled Preparation Line (Cold Mill)
Lead-210 (12 units)	Sleckel Mill Motor Room (Hot Mill)

Figure 7. Map of Radioactive Contamination.

4.4 Socio-cultural and Economic Profile

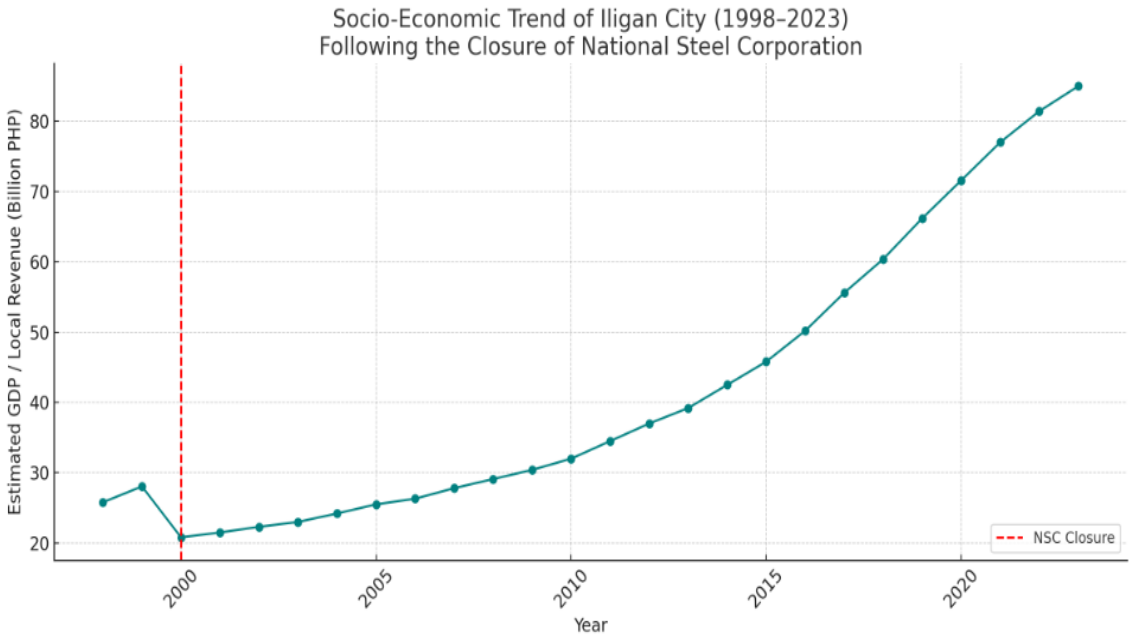


Figure 8. Socio-Economic Trend of Iligan City (1998-2023) following the Closure of National Steel Corporation.

The graph shows the socio-economic trend of Iligan City from 1998 to 2023. The red dashed line marks the closure of the National Steel Corporation in 2000, highlighting the economic downturn that followed, and the gradual recovery and growth in the years after.

Socio-Economic Trend of Iligan City (1998–2023): A Post-Industrial Transition

The graph illustrates the socio-economic trajectory of Iligan City from 1998 to 2023, focusing on the economic consequences following the closure of the National Steel Corporation (NSC) around the year 2000. NSC was once considered the industrial backbone of Iligan City and one of the largest steel producers in Southeast Asia. Its shutdown marked a critical juncture in the city's development, triggering economic challenges that spanned years before signs of recovery and diversification emerged.

Immediate Economic Decline (1998–2005)

In the years leading up to its closure, NSC contributed significantly to Iligan City's local economy, providing thousands of jobs and comprising up to 75% of the city's tax revenue (Philippine Star, 2004). In 1999, the city collected ₱280.5 million in local revenues. However, following NSC's collapse, revenue fell to ₱208.1 million in 2000, indicating a loss of over ₱72 million in just one year. Simultaneously, unemployment rose from 14,000 in 1997 to 18,000 by 2000, highlighting the devastating socio-economic impact on households reliant on the steel industry (Philippine Star, 2004).

Stagnation and Gradual Recovery (2006–2016)

The years following the closure were marked by economic stagnation. With the loss of a major industrial employer, the city had to reconfigure its economic base. Though revenues and economic output slowly

increased, the pace of recovery was limited by the absence of large-scale industry and the lack of investment in alternative economic drivers during the early 2000s.

Economic Diversification and Resurgence (2017–2023)

From the mid-2010s onward, Iligan City began to show signs of economic revitalization through diversification and investment in non-industrial sectors. According to the Philippine Statistics Authority (2024), the city's Gross Domestic Product (GDP) grew to ₱71.6 billion in 2021, ₱77.02 billion in 2022, and ₱81.44 billion in 2023. This upward trend reflects a transition toward a service-oriented economy. By 2022, services accounted for 49.5% of Iligan's GDP, with the accommodation and food service sector alone growing by 40.5% (Philippine Statistics Authority, 2023).

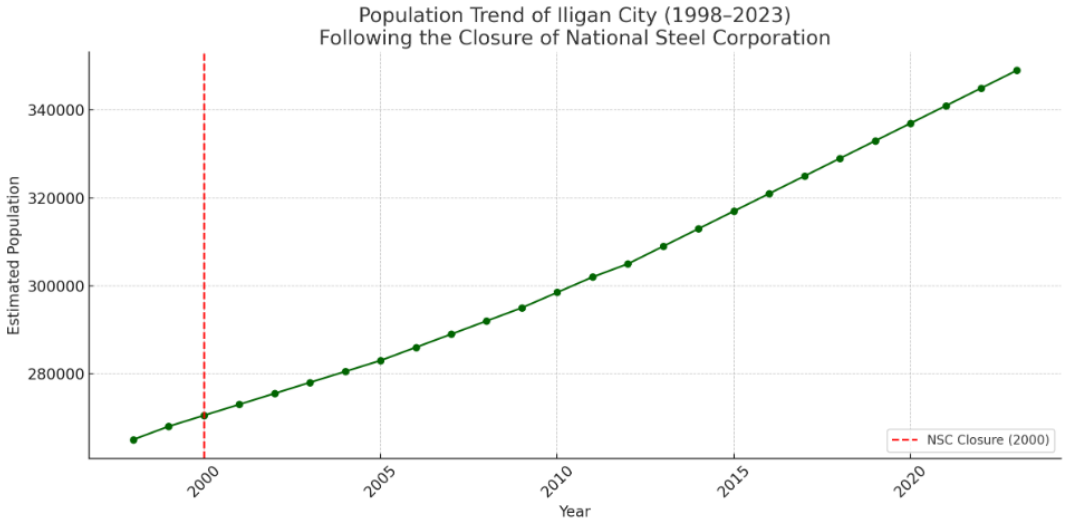


Figure 9: Population Trend of Iligan City (1998-2023)

The red dashed line marks the year 2000, when the National Steel Corporation closed. Despite the economic downturn, the population steadily increased, suggesting urban resilience and long-term demographic growth.

Population Trend of Iligan City (1998–2023) Following the Closure of the National Steel Corporation

According to the study by Reyes, Teatro, Dimantaga, and Ochea (2014), the closure of the National Steel Corporation (NSC) significantly contributed to the outmigration of residents from Steeltown, a community originally developed to house NSC employees. The researchers observed that the economic collapse following NSC's shutdown prompted many former employees and their families to leave Iligan City in search of employment opportunities elsewhere. As financial resources dwindled, families who once relied on NSC's stable wages could no longer sustain their livelihood within the city, leading to a noticeable demographic shift in the area. The once exclusive and relatively affluent Steeltown transformed into a more common and heterogeneous settlement, as the exodus of its original residents made way for in-migrants from nearby rural areas seeking affordable housing. This demographic turnover not only altered

the socio-economic profile of the community but also reflected the broader consequences of deindustrialization on urban migration patterns (Reyes et al., 2014).

Despite the economic shock triggered by the closure of the National Steel Corporation (NSC) in 2000, the population trend of Iligan City from 1998 to 2023, as illustrated in the graph, indicates a steady growth. This seemingly contradictory pattern can be attributed to internal demographic dynamics and in-migration from surrounding rural areas, which offset the outmigration of displaced NSC workers and their families. As noted by Reyes et al. (2014), communities such as Steeltown experienced a significant exodus of former employees following the collapse of NSC; however, these vacancies were gradually filled by in-migrants seeking affordable housing and urban opportunities, contributing to the city's overall population increase.

NSC was a major industrial player and once considered the backbone of Iligan's economy, employing thousands and contributing significantly to the city's revenue. In 2000, shortly after its collapse, the city's income dropped from ₱280.5 million to ₱208.1 million, and unemployment rose from 14,000 in 1997 to 18,000 in 2000 (Philippine Star, 2004). One might expect that such a major economic event would have triggered population decline or stagnation, but Iligan City defied that trend.

Despite the industrial collapse, Iligan City's population continued to increase. According to Macrotrends (n.d.), the estimated population in 1998 was about 265,000, and by 2000, it had grown to around 270,500. The upward trend continued steadily through the years, reaching approximately 349,000 by 2023. This growth is indicative of the city's capacity to retain and attract residents, even in the face of economic adversity (Macrotrends, n.d.). This pattern suggests that the city's population growth was sustained through natural increase and internal migration rather than economic opportunity alone.
Part of the reason for Iligan's population resilience can be attributed to its evolving role as a regional hub for education, health services, and trade. While industrial activity declined, the city's service sector gradually expanded. By 2022, services accounted for nearly 49.5% of Iligan's economy, including a 40.5% growth in the accommodation and food services sector, showing a shift toward urban economic diversification (Philippine Statistics Authority [PSA], 2023). This transformation created new livelihood opportunities, which may have helped retain residents and even attract individuals from nearby rural areas seeking better access to essential services and infrastructure.

Furthermore, like many cities in the Philippines, Iligan has also experienced natural population growth. Factors such as a young population structure and relatively high birth rates have contributed to steady demographic expansion, regardless of economic setbacks (PSA, 2024). The city's ability to sustain its population growth amidst such challenges reflects a form of urban resilience—where social, demographic, and institutional systems adapt to shocks and maintain functionality.

In conclusion, the closure of the National Steel Corporation in 2000 marked a turning point in Iligan City's economic history, but not in its demographic trajectory. Despite the industrial loss and its accompanying economic strain, Iligan continued to grow, evolve, and adapt over the next two decades. The population trend from 1998 to 2023 exemplifies the city's capacity for resilience and transformation in the face of structural change (Philippine Star, 2004; PSA, 2024; Macrotrends, n.d.).

4.5 Community Aspirations for the Sustainable Redevelopment of NSC

The evaluation of community aspirations for the sustainable redevelopment of the National Steel Corporation (NSC) site reveals a clear and consistent vision centered on sustainability, inclusivity, and holistic urban development. The use of a 5-point Likert scale allowed respondents to express their level of agreement with various proposed redevelopment elements. The overwhelmingly high percentage of ratings at the maximum level (5) across all components signals a strong and unified public consensus.

Healthcare and wellness facilities emerged as a critical need, with 88.4% of respondents strongly agreeing on their inclusion. This indicates that accessible healthcare infrastructure is not only a public demand but a foundational expectation for any redevelopment effort. Similarly, the near-unanimous support for green spaces and environmental rehabilitation (97% rating 5 in both categories) highlights the community's heightened awareness of environmental issues, as well as a desire to restore the natural ecosystem damaged by industrial operations. The emphasis on renewable energy sources (92.6% strongly agree) reflects a forward-thinking mindset, albeit with some respondents possibly needing more information or familiarity with the technologies involved.

The strong preference for amusement and recreational areas (94.5%) and cultural venues (95.1%) underscores the community's value on quality of life, leisure, and cultural identity. These spaces are seen not only as amenities but as tools for tourism promotion, social interaction, and mental well-being. The data also points to a proactive interest in education and training (89%)—a foundation for long-term socio-economic mobility and capacity building. Remarkably high support was also given to corporate offices and co-working spaces (94.5%), and commercial establishments (98.8%), indicating that the community envisions the area as a vibrant economic hub that attracts investments while providing employment and business opportunities. This is strongly reinforced by the 98.2% support for job creation and 98.8% support for MSMEs, which affirms that economic empowerment is a central priority—especially for communities affected by the NSC closure.

The call for affordable and inclusive housing (92.7%) reflects the community's demand for equitable urban development that avoids displacement and supports stable, diverse residential options. The inclusion of safety measures and public lighting (97.5%) as well as emergency services (99.4%) further indicates that functional resilience and disaster preparedness are critical to the redevelopment's success. Overall, the community envisions a redevelopment that restores environmental balance, fosters social equity, and revitalizes the local economy. The high agreement across all categories demonstrates a mature, cohesive understanding of the interconnected elements necessary for sustainable urban transformation. For planners, stakeholders, and policymakers, these insights offer a concrete, community-backed roadmap for designing a post-industrial landscape that is not only livable and inclusive but also resilient and future-ready.

4.1.1 Sustainable Redevelopment Framework

Environmental Rehabilitation & Risk Mitigation

Objective: Restore ecological balance and ensure public safety from contamination.

Strategies:

- Site Decontamination: Collaborate with DENR-EMB and PNRI to assess and remediate hazardous materials (PCBs, radioactive elements, steel slags).
- Soil and Groundwater Testing: Conduct Environmental Site Assessments (ESAs) and implement phytoremediation where applicable.
- Green Buffer Zones: Establish greenbelts using native vegetation around contaminated or high-risk areas to prevent encroachment.
- Coastal Restoration: Reinforce the shoreline with soft engineering (e.g., mangrove reforestation, bioengineering) to address scouring and support biodiversity.

Spatial Zoning & Land Use Integration

Objective: Balance mixed-use development while respecting ecological and cultural heritage.
Zones to be Developed:

- Eco-Industrial Heritage Park: Adaptive reuse of iconic NSC structures as museums, learning centers, or industrial art spaces.
- Green Innovation District: Co-working spaces, renewable energy R&D, and business incubators to attract green technology firms.
- Community Health & Resilience Hub: Integrated facilities for health, wellness, emergency response, and public safety.
- Cultural and Recreational Spine: Amphitheaters, museums, parks, and open spaces for cultural expression and leisure.
- Waterfront Development: Promenade and eco-tourism boardwalks, integrating commerce with sustainable design and zero-waste tourism.
- Residential Clusters: Affordable, inclusive housing prioritizing displaced workers and low-income families with access to services and transit.

Green Infrastructure & Climate Resilience

Objective: Reduce the site's carbon footprint and improve resilience to climate-related risks.
Strategies:

- Sustainable Building Design: Enforce green building codes (e.g., BERDE, LEED); use passive cooling, green roofs, and rainwater harvesting.
- Energy Transition: Deploy solar farms and integrate microgrid systems using renewables to power zones.
- Nature-Based Solutions: Bioswales, retention ponds, and urban forests to manage stormwater, reduce heat, and improve biodiversity.
- Mobility & Accessibility: Introduce EV charging stations, bike lanes, pedestrian zones, and shuttle systems to reduce vehicle use.

Socio-Economic Revitalization

Objective: Stimulate inclusive economic growth through local employment and MSME support.
Strategies:

- MSME Accelerator Hubs: Provide training, financing, and mentorship spaces to incubate small businesses.
- Job Creation Schemes: Prioritize employment for former NSC workers and marginalized sectors through public-private employment agreements.
- Skills Upgrading Centers: Establish vocational and technical schools in partnership with TESDA, focusing on green jobs and circular economy roles.
- Cooperative and Social Enterprise Models: Encourage worker-owned enterprises and community-driven development initiatives.

Governance, Partnerships & Policy Alignment

Objective: Ensure inclusive, accountable, and well-coordinated implementation.
Strategies:

- Multisectoral Redevelopment Council (MRC): Composed of LGU, civil society, private sector, academia, and former NSC stakeholders.
- Public-Private Partnerships (PPP): Attract sustainable investors with clear ESG compliance requirements.
- Regulatory Framework: Develop local ordinances and align with national plans (e.g., Philippine Development Plan, SDGs).
- Participatory Monitoring: Institutionalize citizen-led monitoring platforms (like SubayBayan) for project transparency and feedback.

Cultural Preservation & Community Well-Being

Objective: Reclaim NSC's legacy and foster a vibrant, inclusive urban identity.
Strategies:

- Industrial Heritage Trail: Document and design historical trails with AR/VR storytelling of NSC's history.
- Community Art Programs: Engage local artists in mural projects, performance spaces, and exhibits in reused buildings.
- Healing and Wellness Centers: Prioritize trauma-informed urban design, green therapy spaces, and community gardens.
- Inclusive Public Design: Ensure universal access, gender-responsive amenities, and safe public spaces with lighting and surveillance.

This proposed Sustainable Redevelopment Framework for the sustainable redevelopment of the National Steel Corporation (NSC) site in Iligan City presents a comprehensive and integrated strategy for converting a defunct industrial zone into a vibrant, resilient, and inclusive urban landscape.

Rooted in principles of sustainability, social equity, and cultural preservation, the framework is structured into six interdependent pillars, each addressing critical dimensions of the site's revitalization while aligning with national development goals and international sustainability agendas.

1. Environmental Rehabilitation & Risk Mitigation initiates the redevelopment by addressing the site's ecological damage and potential hazards. By collaborating with key agencies such as DENR-EMB and PNRI, the framework emphasizes thorough site decontamination, soil and groundwater testing, and coastal restoration using soft engineering methods. The introduction of green buffer zones and phytoremediation techniques not only restores natural systems but also enhances public safety and climate resilience.
2. Spatial Zoning & Land Use Integration ensures that land use is optimized to support economic productivity, environmental conservation, and social inclusivity. It proposes distinct development zones, including an Eco-Industrial Heritage Park, a Green Innovation District, a Community Health & Resilience Hub, and inclusive Residential Clusters. These zones are designed to accommodate diverse functions—heritage preservation, technological advancement, public service, eco-tourism, recreation, and affordable housing—while maintaining ecological balance and cultural identity.

3. Green Infrastructure & Climate Resilience incorporates low-carbon, adaptive design principles to future-proof the redevelopment. The plan mandates green building practices, renewable energy installations such as solar farms and microgrids, and nature-based solutions like bioswales and retention ponds. Mobility is reimagined through active transport systems, EV-ready infrastructure, and walkable environments, reducing the site's ecological footprint and enhancing livability.

4. Socio-Economic Revitalization focuses on inclusive economic regeneration. It outlines strategies to create jobs, support micro, small, and medium enterprises (MSMEs), and upskill local workers—especially former NSC employees—through partnerships with TESDA and the establishment of training centers. Cooperative models and community-driven enterprises are encouraged to foster shared ownership, local innovation, and sustained economic empowerment.

5. Governance, Partnerships & Policy Alignment anchors the framework in transparent, collaborative, and policy-driven implementation. The establishment of a Multisectoral Redevelopment Council ensures diverse stakeholder participation, while Public-Private Partnerships (PPP) attract ESG-compliant investors. The framework aligns with national strategies like the Philippine Development Plan, AmBisyon Natin 2040, and the Sustainable Development Goals (SDGs), ensuring legitimacy, funding alignment, and scalability. Mechanisms like SubayBayan will support citizen-led monitoring and accountability.

6. Cultural Preservation & Community Well-being reclaims the site's historical legacy and repositions it as a space for collective healing, expression, and inclusion. Through the creation of an Industrial Heritage Trail, immersive art programs, and wellness-focused urban design, the framework fosters a renewed sense of place and identity. The promotion of universal access and gender-responsive, child- and senior-friendly spaces ensures that the redeveloped NSC site becomes truly inclusive.

Together, these six pillars create a step-by-step strategic pathway toward a sustainable and regenerative future for the NSC site. By integrating ecological rehabilitation, equitable development, cultural revitalization, and participatory governance, the framework aspires to serve as a model for sustainable post-industrial redevelopment not only in Iligan City but across similarly challenged urban landscapes in the Philippines.'

4.1.2 Sustainable Redevelopment Pathway

Building on the foundation of the proposed Sustainable Redevelopment Framework, this Redevelopment Pathway offers a sequenced, actionable, and context-sensitive roadmap for transforming the defunct National Steel Corporation (NSC) site in Iligan City into a sustainable and inclusive urban landscape. While the framework outlines the overarching pillars and thematic strategies, the pathway translates these strategic components into a logical and implementable flow—from environmental assessment to long-term governance. This step-by-step pathway integrates the ecological, spatial, social, and economic priorities identified through stakeholder consultations, field observations, and case study analyses. It is designed not only to guide technical interventions and policy actions but also to serve as a practical tool for decision-makers, local authorities, investors, and community members. Each phase is informed by both best practices in sustainable post-industrial redevelopment and the unique socio-environmental realities of the NSC site. Moreover, the pathway emphasizes systems thinking, multisectoral coordination, and adaptive management—recognizing that successful redevelopment requires not just physical transformation but also inclusive governance, community empowerment, and cultural reclamation. The integration of monitoring mechanisms and feedback loops further ensures that the pathway remains dynamic, participatory, and accountable. Ultimately, this Sustainable Redevelopment Pathway operationalizes the vision of a just, resilient, and regenerative transformation of the NSC site—honoring its industrial legacy while embracing a future rooted in sustainability and shared prosperity.

4.1.3 Redevelopment Pathway for the Sustainable Redevelopment of National Steel Corporation (NSC)

Phase 1: Foundational Preparation

Objective: Establish legal, institutional, and environmental groundwork.

Step Action Item Key Outcomes:

1.1 Legal & Institutional Audit Determine land ownership, liabilities, and coordinate with national agencies (e.g., DTI, DENR, LGU).

1.2 Stakeholder Engagement Conduct inclusive consultations with displaced workers, local communities, business groups, and LGUs.

1.3 Environmental Site Assessment (ESA) Identify contamination levels, ecological degradation, and hazard zones. Basis for ecological restoration.

1.4 Establish Redevelopment Authority or Task Force Ensure dedicated oversight and inter-agency coordination. Secure Funding & Partnerships Explore PPPs, LGU-NGA collaboration, green grants, and international aid for brownfield regeneration.

This phase addresses critical governance and transparency issues, ensuring that redevelopment is just, legal, and environmentally sound. Early inclusion of the community builds long-term trust and accountability.

Phase 2: Site Reclamation & Environmental Rehabilitation
Objective: Restore ecological health, stabilize land for multi-use potential.

Step Action Item Key Outcomes:

2.1 Soil Remediation & Hazard Removal Apply phytoremediation, bioremediation, and waste cleanup.
2.2 Revegetation & Greening Introduce buffer zones, native plant species, and urban forestry.
2.3 Waterway & Drainage Restoration Rehabilitate rivers and drainage canals to support flood resilience.
2.4 Green Space Pre-Zoning Reserve spaces for future parks, eco-corridors, and biodiversity sanctuaries.

This is a transitional environmental stage, necessary to regenerate the damaged landscape. It serves as a symbol of healing for a post-industrial city and lays the groundwork for later urban functions.

Phase 3: Strategic Zoning & Planning
Objective: Develop a land use framework that ensures balance among economy, environment, and equity.

Step Action Item Key Outcomes:

3.1 Integrated Masterplan Development Adopt a mixed-use, climate-resilient, transit-oriented framework.
3.2 Urban Design for Accessibility Ensure walkability, universal design, and public transport integration.
3.3 Climate Resilience Design Standards Mandate green building codes, permeable surfaces, and solar orientation.
3.4 Inclusive Housing Allotment Identify areas for affordable housing to prevent gentrification.

Zoning isn't just technical—it reflects social values. The NSC redevelopment should prioritize inclusivity, cultural preservation, and climate readiness, in line with the community's aspirations.

Phase 4: Social Infrastructure & Livelihood Development
Objective: Build foundational services that improve quality of life and economic mobility.

Step Action Item Key Outcomes:

4.6 Construct Health & Wellness Centers Respond to 88.4% demand for accessible healthcare.
4.7 Build Educational & Vocational Facilities Support skill development tied to green economy jobs.
4.8 Create Cultural & Recreational Spaces Support identity, mental well-being, and local tourism.
4.9 MSME Hubs & Co-working Zones Nurture innovation, entrepreneurship, and job creation.

Social infrastructure ensures that redevelopment serves people, not just investors. The inclusion of culture, wellness, and education empowers citizens to participate meaningfully in their city's future.

Phase 5: Economic Zone & Green Enterprise Launch
Objective: Catalyze long-term economic revitalization through sustainable industry.

Step Action Item Key Outcomes:

5.1 Launch Renewable Energy Facilities Transition to solar, hydro, and wind energy zones.
5.2 Develop Green Industrial Parks Attract clean-tech, agro-industrial, and circular economy businesses.
5.3 Retail & Mixed-Use Commercial Zones Align with 98.8% community preference for MSME inclusion.
5.4 Tourism Development Initiatives Promote heritage tours, eco-recreation, and cultural events.

Unlike past industrial mono-dependence, this phase introduces economic diversification with green and blue economy alignment. Iligan's new economy must be both inclusive and future-proof.

Phase 6: Governance, Monitoring & Continuous Improvement (Ongoing)
Objective: Ensure long-term sustainability, safety, and participatory governance.

Step Action Item Key Outcomes:

6.1 Establish Community Advisory Councils Maintain feedback loops between government and residents.
6.2 Deploy Smart Monitoring Systems Use data to track energy use, emissions, safety, and land use.
6.3 Institutionalize Resilience Plans Prepare for disasters, pandemics, and climate impacts.
6.4 Regular Plan Review & Policy Updates Keep the redevelopment strategy adaptive and relevant.

This final phase ensures that what is built endures and evolves. It makes the transformation accountable, data-informed, and responsive to future challenges.

5. CONCLUSION

The sustainable transformation of the National Steel Corporation (NSC) site in Iligan City represents both a critical challenge and a profound opportunity. Once hailed as the industrial backbone of the city and a major contributor to the national steel economy, NSC's closure in the early 2000s triggered a cascade of socio-economic and environmental consequences. This study has sought to understand the multifaceted implications of that closure and explore a pathway forward through a sustainable redevelopment framework grounded in physical realities, historical context, and community aspirations.

Physically, the site today is characterized by a juxtaposition of decaying industrial infrastructure and encroaching greenery. Key structures remain, though heavily corroded, exposing steel frameworks and rusting machinery. The absence of consistent maintenance and the natural wear of time have left the once-vibrant industrial complex in a state of arrested decay. The spatial layout still reflects the site's past function, but many of its buildings, equipment, and utility areas are either structurally compromised or

deteriorated. However, this same physical openness and structural emptiness present latent opportunities for adaptive reuse and urban regeneration. Environmentally, the site bears clear markers of its industrial legacy. Steel slags and rust scales are widespread, particularly in areas where steel production once thrived. While the coastal waters surrounding the site now appear clear, natural elements like scouring and erosion are reshaping the shoreline. More significantly, the presence of toxic and hazardous materials such as Polychlorinated Biphenyls (PCBs) and radioactive elements—including Cesium-137, Americium-241, Cobalt-60, and Lead-210—indicates serious environmental risks that must be addressed through rigorous remediation and monitoring efforts. These contaminants pose ongoing threats not only to the site's usability but also to public health and ecological integrity.

Socio-economically, Iligan City suffered a pronounced downturn following NSC's closure. Local revenue dropped sharply, unemployment surged, and economic stagnation persisted throughout the early 2000s. Yet, despite these hardships, the city demonstrated remarkable demographic resilience. Population growth continued steadily from 1998 to 2023, driven by natural increase and internal migration. This endurance is partly due to Iligan's evolution into a regional hub for education, health services, and commerce. In recent years, the city's economic profile has diversified, with the services sector, particularly accommodation and food services, taking on a more prominent role in supporting livelihoods and urban development.

Community aspirations strongly reflect a collective vision for sustainable, inclusive, and forward-looking redevelopment. Based on the results of a 5-point Likert scale assessment, overwhelming support was shown for key components such as green spaces (97%), environmental rehabilitation (97%), job creation (98.2%), MSME support (98.8%), healthcare facilities (88.4%), cultural and recreational spaces (95%+), and safety measures (97.5%). These findings reveal a mature, well-informed, and unified community perspective. Residents are not merely seeking redevelopment in the form of commercial revival—they are envisioning a holistic transformation that restores environmental balance, promotes economic opportunity, safeguards social equity, and enhances quality of life.

In synthesis, this study concludes that the NSC site embodies the complexities of post-industrial urban landscapes: ecological degradation, economic dislocation, and physical obsolescence—yet it also holds potential as a canvas for regenerative urbanism. The convergence of community aspirations, demographic resilience, and evolving urban functions provides a solid foundation for a redevelopment strategy that is inclusive, ecologically sound, and economically viable. For policymakers, planners, and stakeholders, the task ahead is to translate this collective vision into action—through comprehensive planning, cross-sector collaboration, and adherence to sustainability principles.

The redevelopment of the NSC site is not just a matter of land reuse; it is a test of Iligan City's commitment to transformation, innovation, and resilience. With strategic planning and genuine community engagement, this defunct industrial zone can become a beacon of sustainable urban regeneration in the Philippines.

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