Pipeline Route Selection Class location

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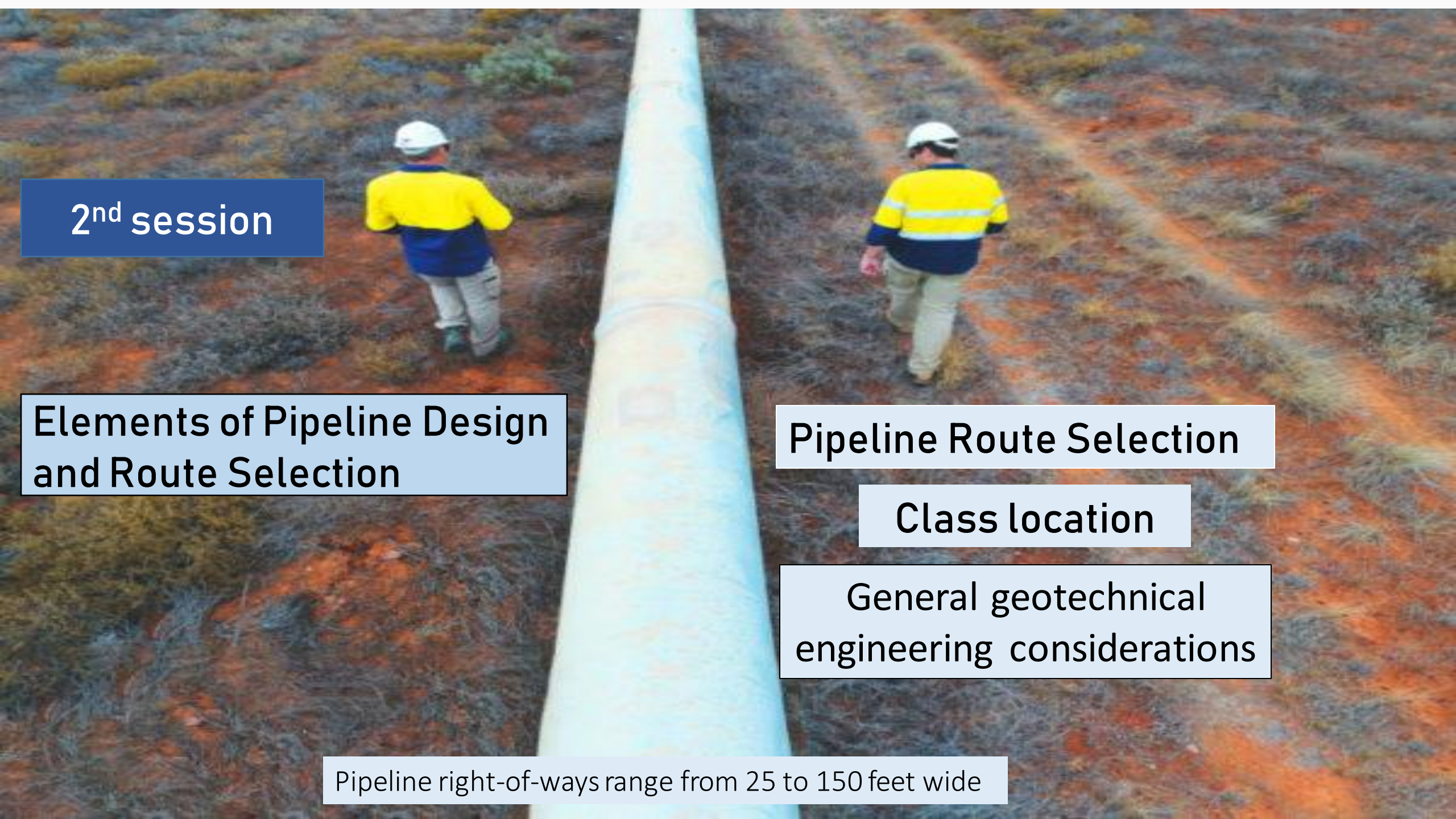


2nd session

Elements of Pipeline Design and Route Selection

Pipeline Route Selection

Class location

General geotechnical engineering considerations

Pipeline right-of-ways range from 25 to 150 feet wide

1. Pipeline Route Selection

- Many factors go into determining the route a pipeline will travel.
- Listening to stakeholders, understanding issues, and balancing all of the factors is part of the selection process.
- During the planning for a new pipeline, pipeline operators map out potential routes to :

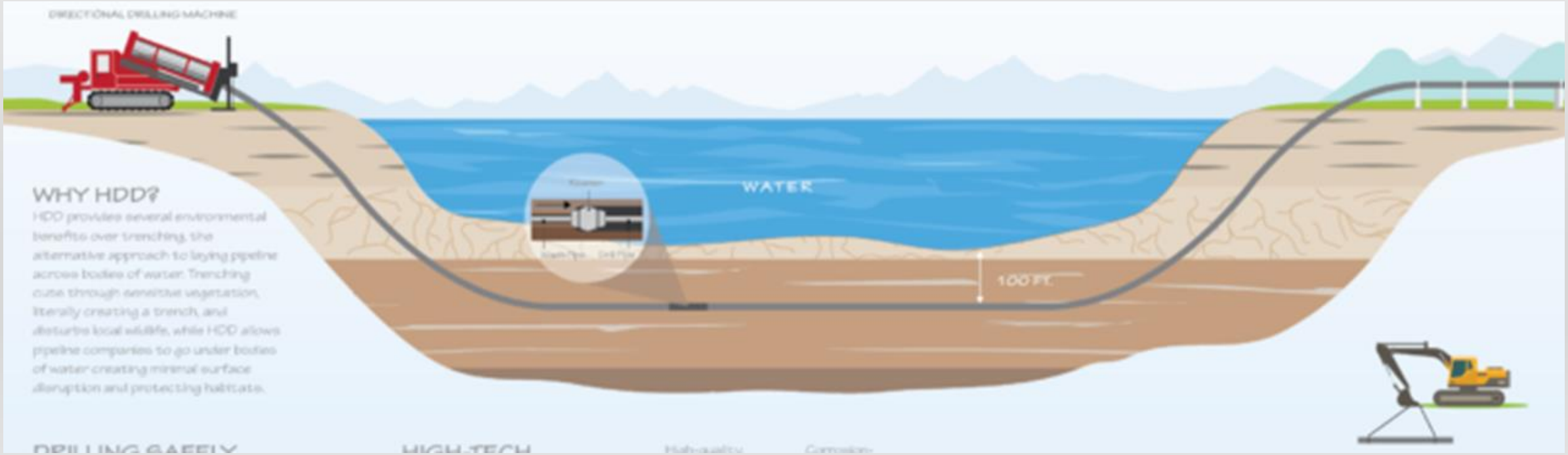
1. Avoid areas that are highly populated,
2. Avoid environmentally sensitive
3. Avoid sites that have cultural significance.
4. Operators will also try to follow existing pipeline
5. power line routes to minimize new environmental or community impacts.

Operators often try to follow existing pipeline or power line routes to minimize new environmental or community impacts

Pipeline companies are committed to working with landowners fairly, openly and with respect.

Pipeline developers may choose to utilize horizontal directional drilling to minimize environmental impacts and safely cross water bodies.

Next, as part of the planning process, a major pipeline project must include a detailed study of its environmental impacts. The potential impact of a pipeline on natural resources, wildlife, habitat and cultural resources are all considered. For example, pipeline planners avoid impacting rivers or lakes by tunneling deep beneath them.
Before a pipeline reaches a waterbody shoreline, horizontal directional drilling (HDD) can burrow the pipeline 100 feet or more beneath the bottom of a waterbody, never coming into contact or close to the water itself.



What happens if a pipeline crosses private land?

- Because pipelines must cross the nation to deliver products over long distances, pipelines have many neighbors in urban, suburban and rural communities. Pipelines cross under creeks and rivers, highways and roads, farmers' fields, parks, and may be close to homes, businesses or other community centers. Some of the land that pipelines cross is privately owned.

- Written agreements, or easement agreements, between landowners and pipeline companies allow pipeline companies to construct and maintain pipeline rights-of-way across privately-owned property. Most pipelines are buried below ground in a right-of-way, which allows the landowner to continue using the property for certain activities.

- The working space needed during initial construction may be temporarily wider than the permanent right-of-way, which may range from 25- to 150-feet wide depending on the easement, the pipeline system, the presence of other nearby utilities, and the land use along the right-of-way. Permanent rights-of-way may be wider or narrower depending on specific locations and agreement terms.

- Importantly, rights-of-way are kept clear to allow the pipeline to be protected, aerially surveyed, and properly maintained. Pipeline companies are responsible for maintaining their rights-of-way to protect the public and the environment, the line itself and customers from loss of service.

A right-of-way (ROW) is strip of land, usually about 25- to 150-feet wide, that contains a pipeline. The ROW:

- Allows workers to gain access for inspection, maintenance, testing or emergencies.
- Maintains an unobstructed view for regular aerial surveillance.
- Identifies an area that restricts certain activities to protect the landowner, the community through which the pipeline passes, and the area where the pipeline itself is located.

Landowner Relations

- Pipeline companies are committed to working with landowners fairly, openly and with respect. Operators negotiate with landowners in good faith and are responsive to their questions and concerns and consistent in upholding their commitments. Pipeline operators collaborated with regulators and landowners on a set of core training materials to develop strong relations with members of the public living close to a pipeline right-of-way.

العلاقة بين افراد شركة خطوط الانابيب وملاك الاراضي التي يمر بها خط لابد ان تقوم على الاحترام والمرونة والحفاظ على حقوق كل منهما

the “Liquids Pipeline Owner and Operator Commitment to Landowners,” published by the American Petroleum Institute (API) and the Association of Oil Pipe Lines (AOPL).

Eminent Domain حق الامتلاك

Eminent domain is the process by which government entities or others may use private property for public use following compensation to the private landowner. Pipeline operators view eminent domain as a last resort and work in good faith first to reach a mutually-acceptable agreement with landowners. Most negotiations between landowners and pipeline operators are successful in reaching an agreement. Several states have a state-specific Landowner Bill of Rights such as Texas, تكساس guaranteeing rights for landowners in any negotiations

LIQUIDS PIPELINE OWNER AND OPERATOR COMMITMENT TO LANDOWNERS الالتزامات بين مالك الارض وشركة مد الانابيب

Pipeline companies considering a new liquids pipeline project in your area are committed to working with you fairly, openly and with respect. As landowners potentially impacted by a pipeline project,

We make these 6 commitments to you:

1. Fairness الإنصاف

We commit to working with you fairly. At the end of the process of considering a pipeline project, regardless of whether the pipeline directly impacts your lands, you should feel that we treated you fairly.

2. Respect الاحترام

We commit to treating you and all stakeholders with respect. We will listen to your questions and concerns. We will share with you our perspective. We will work to understand your needs and appreciate your point of view

3. Openness الانفتاح

We commit to being open with you. We know you will have a lot of questions about the project. We will provide you as much information as early as we can to help you form your opinions and make your decisions in a timely fashion. We will provide you information about the project, its benefits to you and your community, potential short-term inconveniences and long-term impacts, the process for considering the project, and our company

4. Negotiate in Good Faith تفاوض بحسن نية

We commit to negotiating with you in good faith. We will be sincere in our commitments and offers to you. We will stress our desire to obtain survey or easement rights through negotiation first.
We will view eminent domain only as a last resort and will work in good faith first to reach a mutually acceptable agreement.
We will keep our commitments to you and make sure we are clear in what we are offering, the limits of what we can agree to and the timing of our offers.

5. Responsiveness الاستجابة

We commit to responding to your questions and concerns promptly. We understand you may have additional questions or thoughts after we meet with you or you hear from us. We will do our best to get you the information you are requesting. We may not be able to meet all of your requests, but we will respond to you in a timely fashion.

6. Consistency الاتساق

We commit to up holding these commitments to you as consistently as possible. Whether we are working with you directly or through someone we hire to help us, we will ensure they have the appropriate training and professionalism to perform their jobs. If you are ever dissatisfied by an interaction you've had with us, we want to hear about it and will work diligently to get our relationship with you back on track as soon as possible.

Pipeline route selection – the route to success

the route selection process inherent in any pipeline project, taking into account such key considerations as primary selection factors, engineering requirements, corridor selection as well as subterranean challenges and geo_hazards

Oil and gas pipeline routes are pivotal pieces of information upon which pipeline engineering depends. The route will define the pipeline size, terrainالتضاريس, soils, and engineering analysis requirements. Engineering assessment based upon agreed alignment selection criteria is an important part of a linear project. .يعد التقييم الهندسي المستند إلى معايير اختيار المحاذاة المتفق عليها جزءًا مهمًا من المشروع الخطي
To be able to reach the best construction line and optimize its components, the phases – namely corridor, route, alignment, and construction line selection — should be studied in the given order.

Selecting the optimum route does not end with geotechnical challenges, as it also requires interactive coordination between the owner, the engineer, the regulator, the landowners, the construction contractor and a multitude of other project stakeholders and interested parties.

Selection the routing of pipelines varies from place to place and from country to country, according to the regulating laws

In North America, pipeline route selection is driven by regulatory requirements at the federal, state and local levels and involves finding a route that minimizes the impact on the environment and archaeological artefacts and recognizes the concerns of the landowners while considering the geotechnical challenges which affect the construction of the pipeline.مسار الخط في امريكا الشمالية يمر بين الولايات الفيدرالية ذات الاعتبارات الولائية

In arctic regions like Siberia,مسار خط الانابيب في سهل سيبيريا the soil conditions are an important consideration where areas of permafrost are interspersed with normal soils. In the permafrost areas, the pipeline will be installed above ground on supports and the depth of the permafrost determines the design of the supports, while in normal soil areas the pipeline is buried in a trench in the conventional manner.

In mountainous terrain,المسار عبر الجبال والمرتفعات والتضاريس الغاية في الوعورة such as in Turkey, geotechnical considerations are a significant aspect of pipeline route selection, as well as environmental and landowner concerns. The pipeline design must address geohazard mitigation for seismic areas and sections of the route which could be subject to landslides.

Geo-political factors can also affect the route selection. Bringing Caspian Sea gas to Europe requires, among other pipelines, a new pipeline in Europe. A northern route requires a longer pipeline routed through environmentally sensitive areas, but this route supports future expansion of the pipeline system's capacity. A southern route is shorter and reduces environmental concerns, but as this route also involves a marine crossing, the future expansion of the pipeline system is curtailed كذلك الاعتبارات السياسية اذ ان خط الانابيب يمر عبر الدول المختلفة سياسيا وعسكريا

Primary selection factors

The detailed pipeline route selection is preceded by defining a broad area of search between the two fixed start and end points. That is, possible pipeline corridors. The route can then be filtered with consideration of public safety, pipeline integrity, environmental impact, consequences of escape of fluid, and based on social, economic, technical environmental grounds, constructability, land ownership, access, regulatory requirements and cost.

Economic, technical, environmental and safety considerations should be the primary factors governing the choice of pipeline routes. The shortest route might not be the most suitable, and physical obstacles, environmental constraints and other factors, such as locations of intermediate offtake points to end users along the pipeline route should be considered. Offtake points may dictate mainline routing so as to minimize the need or impact of the offtake lines or spurs. الاعتبارات الاولية لاختيار مسار الانابيب اعتبارات اقتصاديةوفنية وبيئية وامنية

Many route constraints will have technical solutions (e.g. routing through flood plains), and each will have an associated cost.

Corridor selection in project key stages

Pipeline routing is an iterative process, which starts with a wide ‘corridor of interest’ and then narrows down to a more defined route at each design stage as more data is acquired, to a final ‘right of way’ (ROW). Initially, a number of alternative corridors with widths up to 10 km wide are reviewed. Each project will have its own specific corridor-narrowing process depending on project size and location.

Many route constraints will have technical solutions (e.g. routing through flood plains), and each will have an associated cost.يوجد كثير من القيود اذ مر خط الانابيب عبر السيول والفياضانات مما يتطلب الكثير من التكلفة والجلول الفنية

Corridor selection in project key stages اهم مرحلة من مراحل المشروع اختيار المسار

Pipeline routing is an iterative process, which starts with a wide ‘corridor of interest’ and then narrows down to a more defined route at each design stage as more data is acquired, to a final ‘right of way’ (ROW). Initially, a number of alternative corridors with widths up to 10 km wide are reviewed. Each project will have its own specific corridor-narrowing process depending on project size and location.

Pipeline corridors should initially be selected to avoid key constraints.
The route can then be further refined through an iterative process, involving consultation with stakeholders and landowners and a review of the EIA criteria, to avoid additional identified constraints.
The ultimate aim is to achieve an economically and environmentally-feasible route for construction.

Terrain, subterranean conditions, geotechnical and hydrographical conditions التضاريس والظروف الجوفية والظروف الجيوتقنية والهيدروغرافية

The geography of the terrain traversed can generally be divided into surface topography and subterranean geology. Both natural and man-made geographical features can be considered under these two headings. يمكن تقسيم جغرافية التضاريس التي تم اجتيازها بشكل عام إلى طبوغرافيا سطحية وجيولوجيا جوفية. يمكن النظر إلى كل من المعالم الجغرافية الطبيعية والتي من صنع الإنسان تحت هذين العنوانين.

Surface :Crops, livestock, woodlands; Natural beauty, archaeological, ornamental rivers والغابات ، مناطق تجميع المياه ,: المسطحات

mountains;
Water catchment areas, forestry; Population, communications, services; Contouring, soil or rock type, water, soil corrosively; Designated areas, protected habitats, flora and fauna. Subterranean Earthquake zone; Geological features; Infill land and waste disposal sites, including those contaminated by disease, radioactivity or chemicals; The proximity of past, present and future mineral extractions, including uncharted workings, pipelines and underground services; Areas of geological instability, including faults, fissuring and earthquake zones; Existing or potential areas of land slippage, subsidence and differential settlement; Tunnels · Ground water hydrology, including flood plains.

GeGeo-hazards
Geo-hazards are widespread phenomena that are influenced by geological and environmental conditions and which involve both long-term and short-term processes. They range in size, magnitude and effect. Many geo-hazards are naturally occurring features and processes (e.g. landslides, debris flow, seismic activity, rock falls, etc.) but there are also many geo-hazards that are caused by anthropogenic processes (e.g. undermining, landfills, engineered fill, chemistry and contamination, etc.), and these too need to be taken into account during the pipeline routing exercise.

The process enables the routing of the pipeline through the most suitable terrain, problem areas are identified, serious geo-hazards are avoided, where possible, and risks are minimised and mitigated. In addition, terrain evaluation is undertaken so that the need for expensive remedial measures or site restoration works is limited or prevented and the operability of the pipeline is safeguarded through a proper appreciation of the terrain conditions. By minimizing the risk of damage to the pipeline the risk to human safety is reduced. تحديد مناطق المشاكل ، وتجنب المخاطر الجغرافية الخطيرة ، حيثما أمكن ، وتقليل المخاطر والتخفيف من حدتهاالتقدير المناسب لظروف التضاريس. من خلال تقليل مخاطر تلف خط الأنابيب إلى الحد الأدنى ، يتم تقليل المخاطر على سلامة الإنسان.

Terrain evaluationتقييم التضاريس

terrain evaluation along the pipeline corridor can be achieved using a variety of low-cost techniques that include satellite imagery and aerial photography interpretation, surface mapping and various other remote sensing techniques. This data can be incorporated, together with historical data on seismic events, geological features, meteorological processes and hydrological data, within a geographic information system (GIS – see below) and detailed terrain and hazard models developed. صور الأقمار الصناعية وتفسير التصوير الجوي ، ورسم الخرائط السطحية والعديد من تقنيات الاستشعار عن بعديمكن دمج هذه البيانات ، جنبًا إلى جنب مع البيانات التاريخية عن الأحداث الزلزالية ، والخصائص الجيولوجية ، وعمليات الأرصاد الجوية والبيانات الهيدرولوجية

terrain evaluation supports the anticipation, identification and assessment of the physical hazards and constraints within and outside of the pipeline corridor. It is essential that features outside the corridor be evaluated, as hazardous events outside of the corridor may be triggered by construction activity within the corridor and the resultant event may impact upon the pipeline.

The risks associated with geo-hazards or the likelihood of an event occurring and its consequences can be qualitatively and quantitatively assessed using a scoring system or by a quantitative risk assessment (QRA)

Safety of the pipeline is paramount in the routing selection. The extreme effect of a geological hazard on the pipeline is a rupture and it is this event that terrain evaluation and risk analysis seeks to avoid by improving the decision-making progress used in selecting the most appropriate route for the pipeline.

Conclusion

In onshore and pipeline projects alike, the potential for catastrophe is always lurking close at hand to catch the naïve or complacent investor and contractor off-guard. However, when these challenges are successfully addressed, leaving a pipeline system with solid integrity and performance as well as satisfied investors, contractors and communities, projects can be very rewarding, both in financial terms as well as in the esteem accorded to all those involved. احتمالية وقوع كارثة تكمن دائمًا في متناول اليد للقبض على المستثمر والمقاول الساذج أو الراضين عن الحراسة. ومع ذلك ، عندما تتم معالجة هذه التحديات بنجاح ، مما يترك نظام خطوط الأنابيب بنزاهة وأداء قويين بالإضافة إلى رضا المستثمرين والمقاولين والمجتمعات ، يمكن أن تكون المشاريع مجزية للغاية ، سواء من الناحية المالية أو من حيث التقدير الممنوح لجميع المعنيين.

This article was written كتب هذا المقال by Doug Evans, president 2012-2013, International Pipe Line & Offshore Contractors Association (IPLOCA).

2. Class location

What is a Class Location?

Every section of a pipeline is associated with what's called a "Class Location". A class location refers to an area on either side of a NEB (National Energy Board) regulated pipeline that is classified according to population density and factors such as environmental sensitivity.

The number and type of buildings near the pipeline are often used to estimate the number of people in the area.

There are four different class location categories:

Class location 1	10 or less residences
Class **location** 2	11-45 residences, a building or outside area with 20 or more people during normal use (i.e. playground or recreation area), and/or an industry such as a chemical plant.
Class **location** 3	46 or more residences
Class **location** 4	mostly apartments and condominiums with four or more stories.

NEB (National Energy Board) regulated pipeline companies are expected to have a clear understanding of the current class location of each section of their pipelines.
They are also expected to have the ability to monitor for population, development and/or environmental changes.

If the class location around the pipeline changes, a company must report how it plans to deal with the change to keep operating the pipeline safely. Guide E of the NEB's Filing Manual tells the company what information is needed, so that the NEB can evaluate the company's plan

Determining Class Location

A. This section classifies pipeline locations for purposes of this part, The following criteria apply to classifications under this section.

1. A "class location unit" is an onshore area that extends 220 yards (200 meters) on either side of the centerline of any continuous 1-mile (1.6 kilometers) of pipeline.

2. Each separate dwelling unit in a multiple dwelling unit building is counted as a separate building intended for human occupancy

B. Pipeline locations are classified as follows.

1. A Class 1 location is: (i) An offshore area; or (ii) Any class location unit that has 10 or fewer buildings intended

2. A Class 2 location is any class location unit that has more than 10 but fewer than 46 buildings intended for human occupancy.

3. A Class 3 location is:

• (i) Any class location unit that has 46 or more buildings intended for human occupancy; or

• (ii) An area where the pipeline lies within 100 yards (91 meters) of either a building or a small, well-defined outside area (such as a playground, recreation area, outdoor theater, or other place of public assembly) that is occupied by 20 or more persons on at least 5 days a week for 10 weeks in any 12-month period. (The days and weeks need not be consecutive.)

4. A Class 4 location is any class location unit where buildings with four or more stories above ground are prevalent.

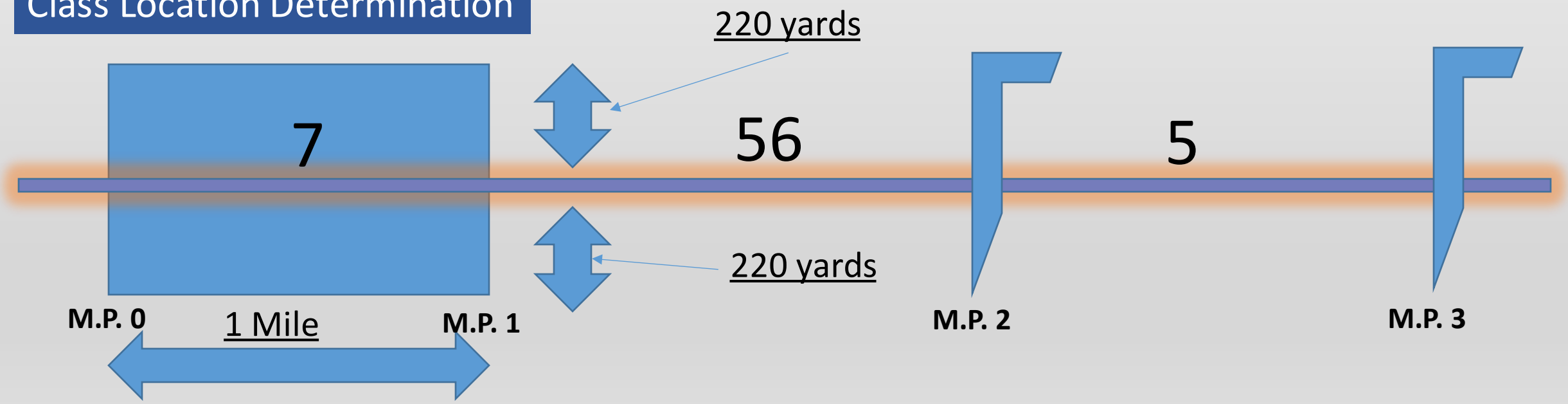
C. The length of Class locations 2, 3, and 4 may be adjusted as follows:

1) A Class 4 location ends 220 yards (200 meters) from the nearest building with four or more stories above ground.

Class Location Unit

Having a single four or more story building within 220 yards of a gas pipeline does not require upgrading to Class 4 requirements because paragraph (e) states in part: "where buildings with four or more stories above ground are prevalent." The use of "prevalent" indicates that they are common or that there are more than one such building in the area. Therefore, a single four or more story building would not cause an area to be designated a Class 4 location.

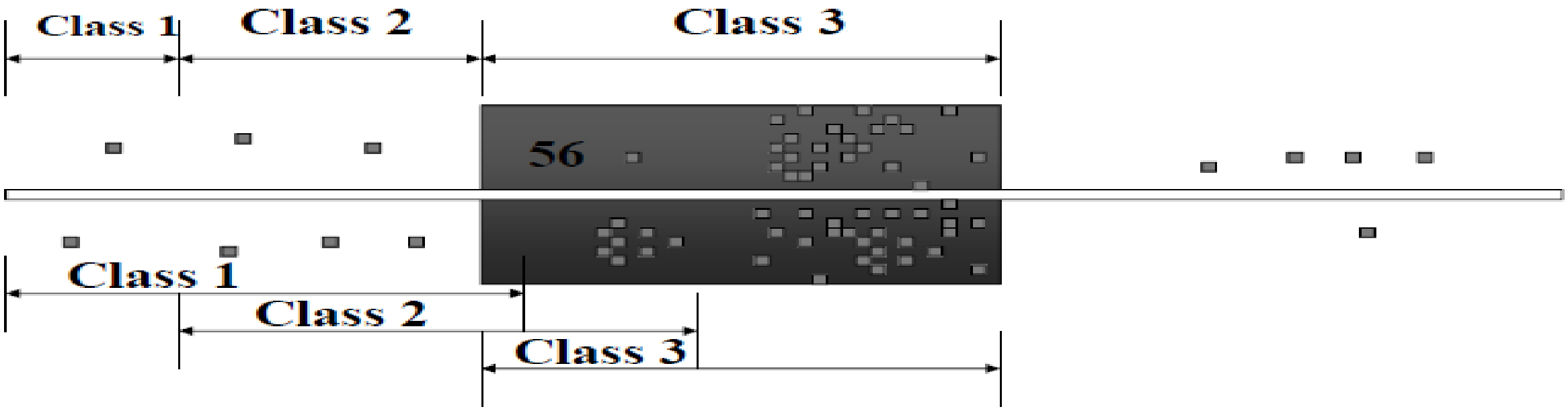
Class Location Determination



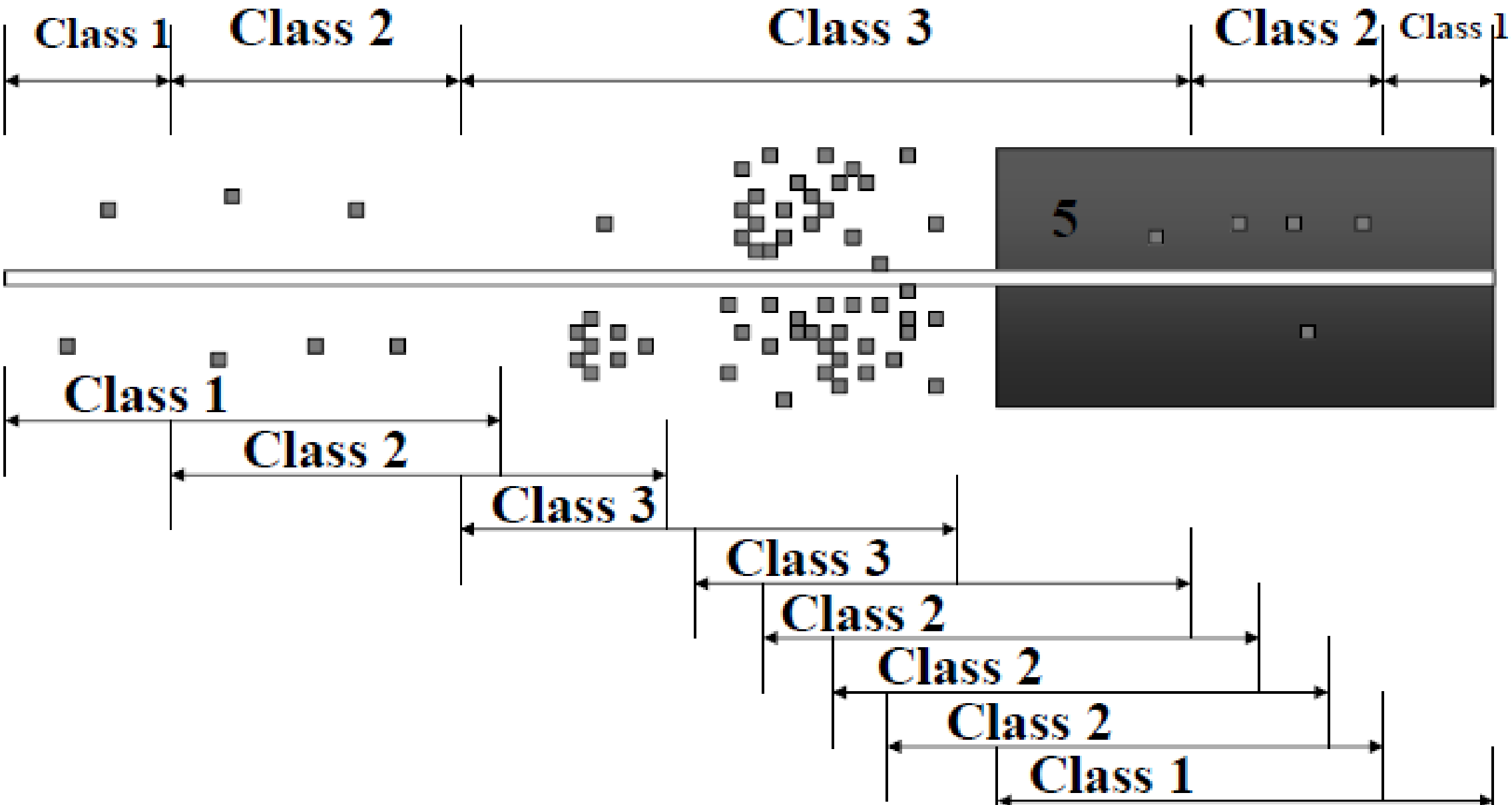
End to End Mile – the Wrong Way to do class location

M.P. = Mile Post


5
Class 1
Class 3
Class 1
M.P. 0
M.P. 1
M.P. 2
M.P. 3


Class 1
Class 2
Class 3
56
Class 1
Class 2
Class 3

Continuous Sliding Mile

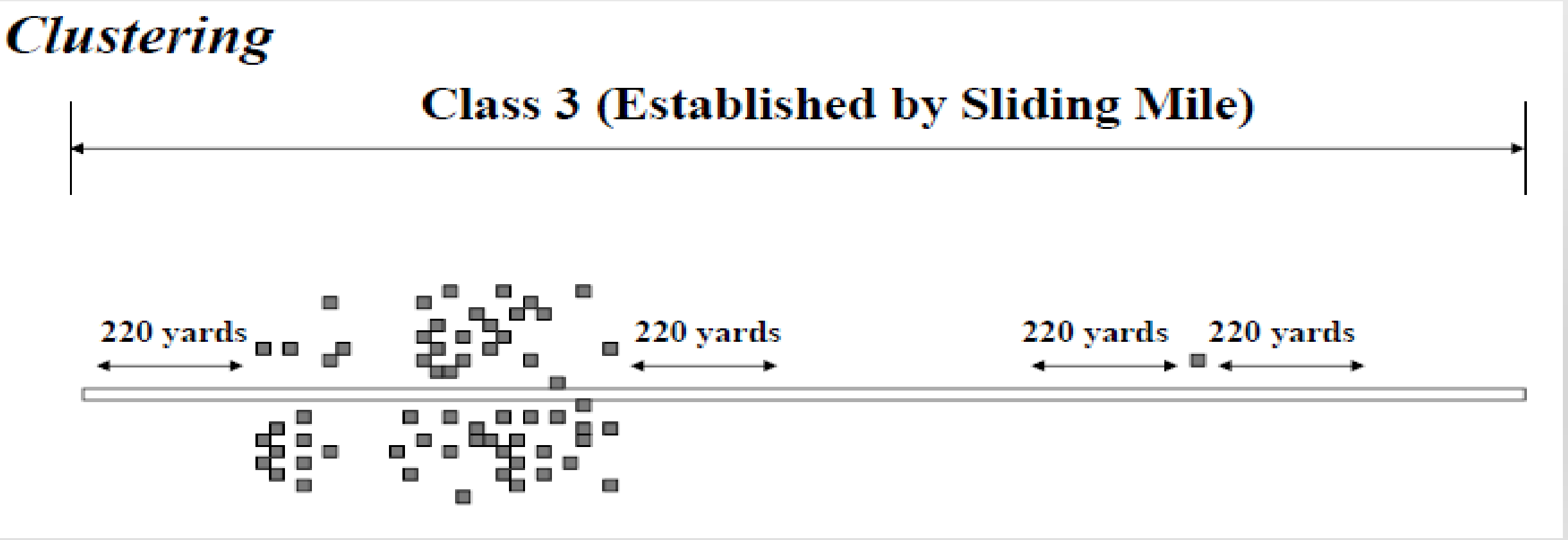


Adjustment of Class Location Length

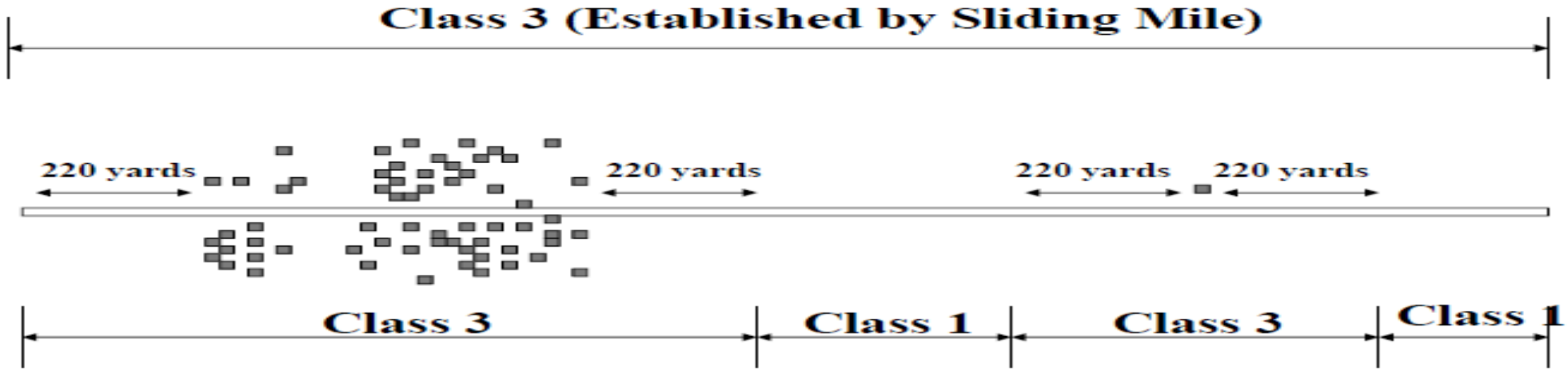
Clustering The length of Class locations 2, 3, and 4 may be adjusted as follows:

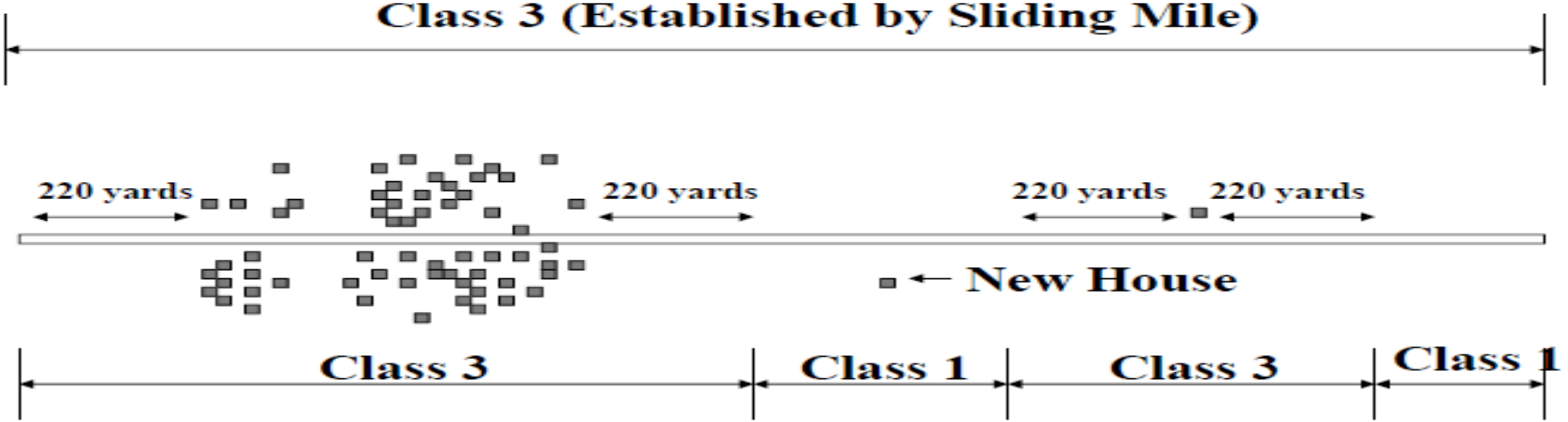
1) A Class 4 location ends 220 yards from the nearest building with four or more stories above ground.

2) When a cluster of buildings intended for human occupancy requires a Class 2 or 3 location, the class location ends 220 yards from the nearest building in the cluster.



Clustering


Class 3 (Established by Sliding Mile)
220 yards
220 yards
220 yards
220 yards
Class 3
Class 1
Class 3
Class 1


Class 3 (Established by Sliding Mile)
220 yards
220 yards
220 yards
220 yards
← New House
Class 3
Class 1
Class 3
Class 1

Clustering

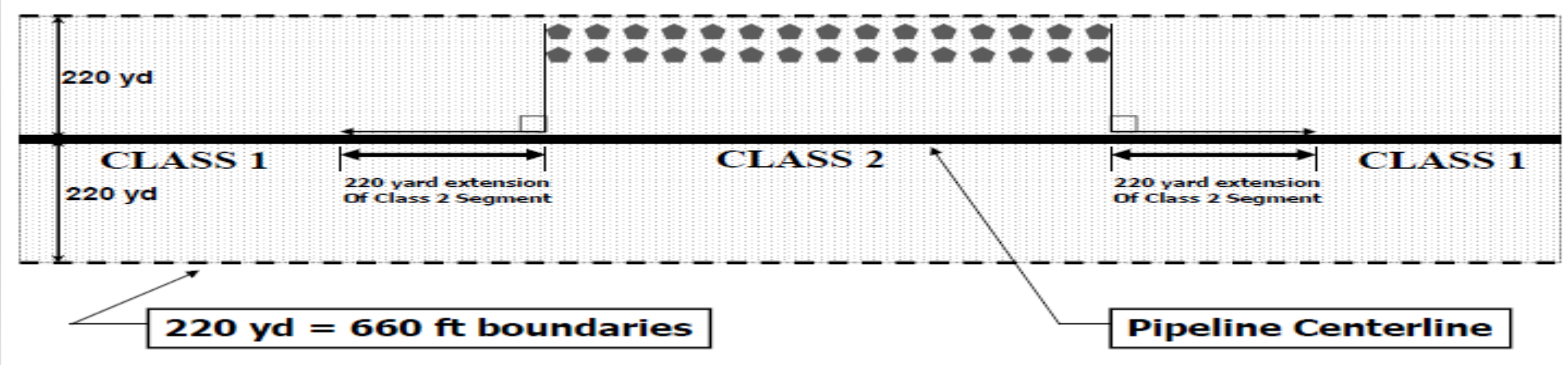
• Your application of paragraph (f) of (4. A Class 4 location), to restrict the boundaries of Class 2 and Class 3 locations created by a cluster of buildings in otherwise Class 1 situations such as you portray in your drawing is not correct.

Because the two clusters portrayed are within a continuous 1-mile length of pipeline, they affect one another and in the example you give would cause the class location to be Class 3 to a point of 220 yards beyond the extremities of the two "combined" clusters.

Boundary Adjustment of Class Locations Two Methods:

1. Perpendicular/parallel method
2. Arc method

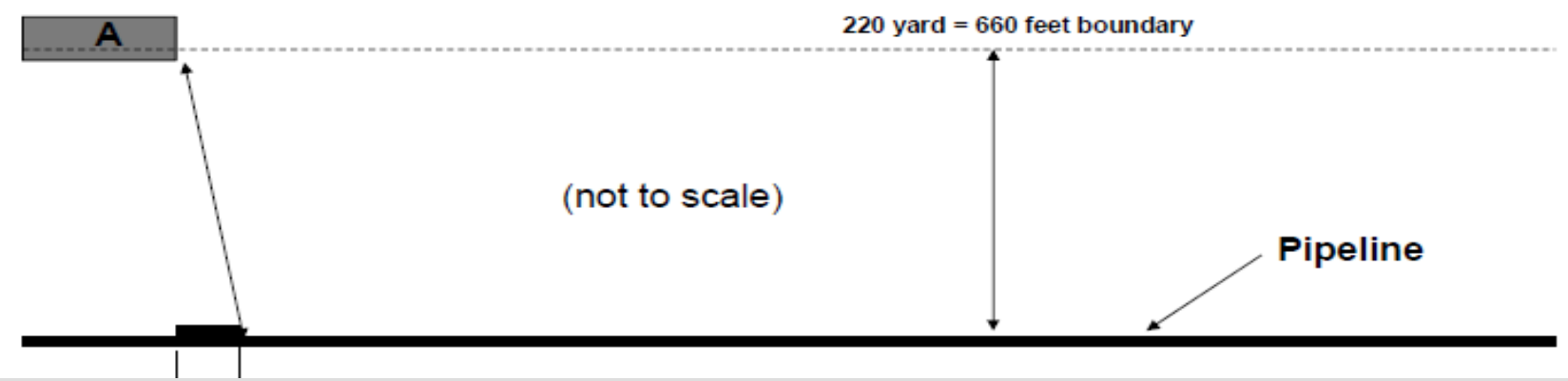
Adjustment of Class Locations (192.5) with the Perpendicular / Parallel Method:



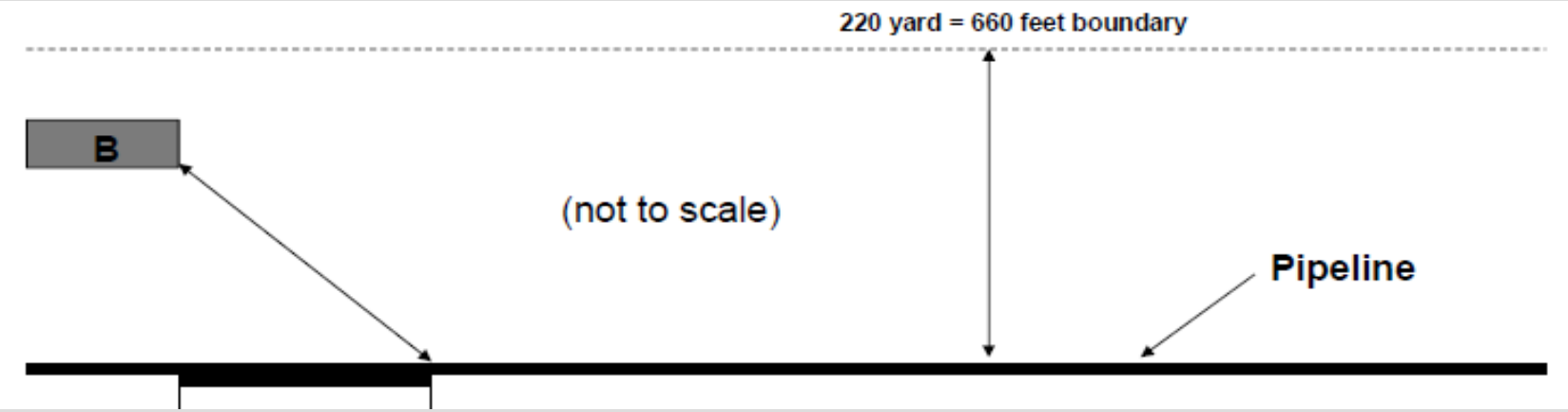
Arc Method for Adjustment of Class Location:

A. Interpretations in 192.5 #17 & #18 – December 1996
B. Consequently, we ……find both the "arc method" and the "perpendicular/parallel method" to be acceptable for determining the 220 yard boundary for the cluster of buildings in(4. A Class 4 location)

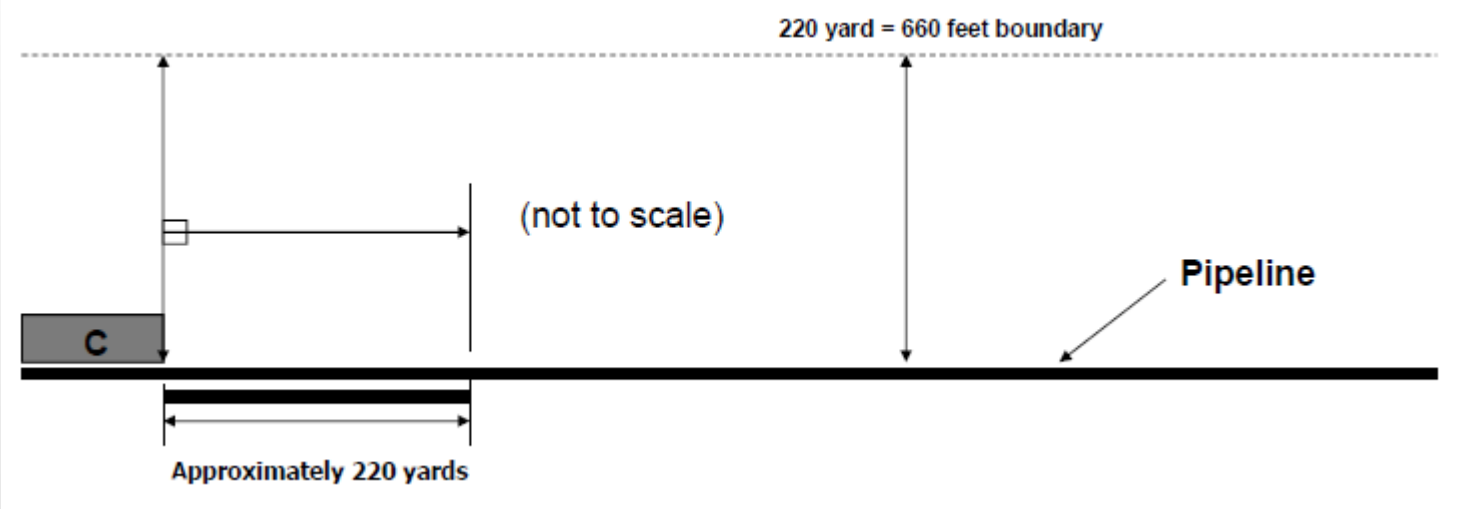
Example of Arc Method Application



Dwelling "A" is end of Class 3 Area Yellow Line represents length of class extension - much less than Perpendicular-Parallel Method

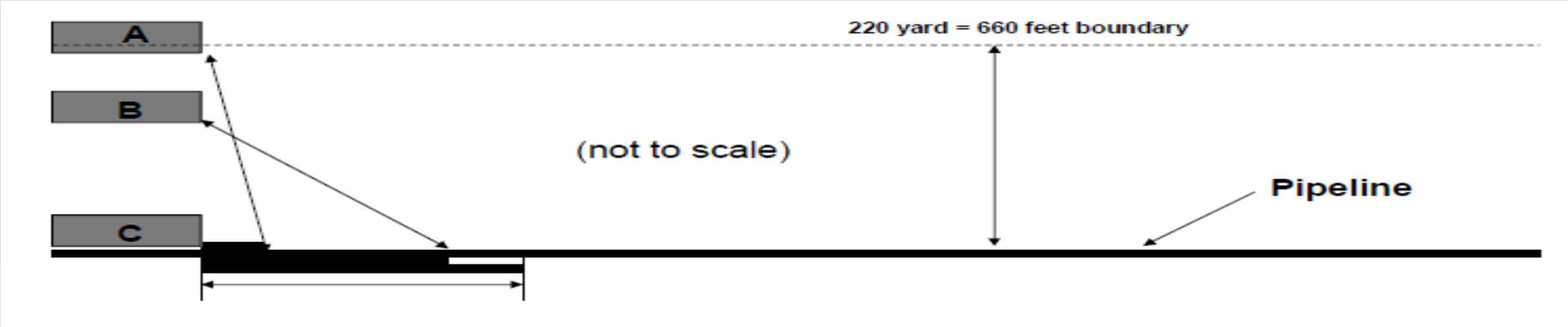


Dwelling "B" is end of Class 3 Area - Blue Line represents length of class extension - less than Perpendicular-Parallel Method



Dwelling “C” is end of Class 3 Area - Red Line represents length of class extension as the dwelling or building approaches the center line of the pipeline. The result from the Arc Method approaches the same value as the Perpendicular-Parallel Method

Case 1: Dwelling “C” is end of Class 3 Area (A & B are not present):
Red Line represents length of class extension Case 2: Dwelling “B” is end of Class 3 Area (A & C are not present):
Blue Line represents length of class extension Case 3: Dwelling “A” is end of Class 3 Area (B & C are not present):
Yellow Line represents length of class extension



Arc Method versus Perpendicular/Parallel Method Difference in Class Extension

Distance from Pipeline (ft)	Arc Method	Length of Extension (ft)	Perp./Parallel Method	Difference (ft)
0	660		600	0
50	658		660	2
100	652		660	8
150	643		660	17
200	629		660	31
250	611		660	49
300	588		660	72
330	572		660	88
350	560		660	100
400	525		660	135
450	483		660	177
500	431		660	229
550	365		660	295
600	275		660	385

Impacts of Increasing to Higher Class Locations

- Frequency

1. Leak Surveys
2. Transmission Line Patrolling

- Depth of Cover Requirements
- Design Factor

Design Factor	0.72	0.60	0.50	0.40
Class Location	1	2	3	4

Class Location Implication on Calculated Wall Thickness (one example)

P	D	E	T	F	S	t (in.)
1440	30	1.0	1.0	0.72	65,000	0.462
1440	30	1.0	1.0	0.60	65,000	0.554
1440	30	1.0	1.0	0.50	65,000	0.665
1440	30	1.0	1.0	0.40	65,000	0.831

P Design Pressure = 1440 psig,
S Yield Strength = 65,000 psig,
D Diameter = 30 in,
E = 1.0, T= 1.0
F Design Factor

Key Interpretations

Answers to Operator Questions

Areas within 100 yards

April 6, 2007

• For those areas within 100 yards of the pipeline, is the intent of 192.5(b)(3)(ii) to include, as Class 3 locations, building(s) such as a convenience store, i.e. Circle K, 7-11, etc., and video poker truck stops where persons may frequent on a daily basis?

• Yes, the intent of § 192.5(b)(3)(ii) is to include convenience stores, video poker truck stops and similar buildings in Class 3 locations where these facilities lie within 100 yards of the pipeline

20 Persons

"What is the interpretation under 192.5(b)(3)(ii) as to the 20 persons, such as all 20 present at one time or cumulative throughout the day?

Under § 192.5(b)(3)(ii), the 20 or more persons must all be present at the same time. However, this does not require the continuous presence of 20 or more people. For example, the minimum requirement is met if 20 people are present at a convenience store at any one time during the day.

Four or more stories

• "What is the definition and intent under 192.5(b)(4), where it addresses 'buildings with four or more stories above ground are prevalent'? If you have 10 buildings along a pipeline, a downtown area for example, and 5 or less of the buildings are four or more stories, would this be defined as prevalent and constitute being a Class 4 location?"

• In the example you use, ten buildings in a downtown area with five or more buildings four stories or more would meet the definition of prevalent (i.e., prevailing).